RESULTS AND DISCUSSION

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I. Growth:

I.1. Root characteristics:

Data in **Tables** (4,5 and 6) and figs (2,3 and 4) show the effect of foliar application with potassium, iron, boron and citric acid on root diameter, length and fresh weight of sugar beet at 80,100 and 120 days after sowing during 2006 and 2007 seasons.

As for root diameter, its high significant increase was existed with different applied treatments during 2006and 2007 seasons at 80, 100 and 120 days after sowing.

Also, foliar application with potassium at 1000 ppm and boron at 20ppm gave the highest values of root diameter at 120 days after sowing during 2006 and 2007 seasons, respectively.

Regarding, root length, data in Table (5) clearly indicate that all foliar application with different concentrations for potassium, iron, boron and citric acid caused a gradually significant increase in root length with the advancing of plant age during the two seasons of 2006 /2007.

Also, potassium at 1000 ppm and boron at 40ppm gave the maximum length at different samples till harvest time i,e, at 200 days after sowin during 2006 and 2007 seasons.

With regard to the fresh weight of root it was reached the level of high significant increase during both seasons with different applied treatments. Also, it could be noticed that boron at 40 ppm gave the highest values followed by potassium

(1000ppm), iron (40) ppm and citric acid (1000ppm) at 120 days after sowing during 2006 and 2007 seasons.

In this respect, it could be suggested that boron is associated with meristematic activity, cell division, cell growth and membrane function, protein synthesis and auxin formation (**Marschnar, 1995**), hence boron increased root growth (diameter and length), (**Marschnar, 1995**).

Similar results were also obtained by **Moustafa (1989), Ibrahim *et al.* (1998), Saif (1991), Becheit *et al.* (1992), Benoit and Caystermans (1997), El-Hawary (1999), Naeamat- Alla (2002) and Hilal (2005), Haggag and El-Khair (2007).**

Concerning the effect of potassium, the foliar spray with k at 1000 mg/L resulted in a significant increase in root length and diameter, total leaf area/plant as well as root and leaves dry matter content/plant during all growth stages in both seasons. Such results could be attributed to the essentiality of k, Fe and B as associated with photosynthetic pigments formation and sugar translocation across cell membrane activation of many enzymes and protein synthesis in meristematic tissues, cell division and cell growth which reflected on total leaf area and dry weight of leaves and roots. Similar results were obtained by **Warcholowa and Koter (1965), Abd El-hamid *et al.* (1992). Ismail and El-Ghait (2004), Grzebisz (2004) and Osman (2006).**

Table (4) Effect of foliar application with some nutrients and citric acid on root diameter of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100, 120 and 200 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Root diameter (cm) /plant																			
		diameter (cm) /plant					% relative to the control					diameter (cm) /plant					% relative to the control				
		2006										2007									
		60	80	100	120	200	60	80	100	120	200	60	80	100	120	200	60	80	100	120	200
Control	00.00	2.66	4.00	5.33	6.00	10.67	100.0	100.0	100.0	100.0	100.0	2.66	4.33	6.33	7.67	10.6	100.0	100.0	100.0	100.0	100.0
Potassium	500 ppm	2.70	5.33	6.66	8.00	13.67	101.5	133.2	129.9	128.8	133.3	2.86	6.67	7.00	7.67	12.3	107.5	154.0	110.5	100.0	116.0
	1000 ppm	4.33	6.33	7.67	9.33	13.00	162.7	158.2	143.9	121.8	155.5	3.60	7.33	7.67	9.00	12.3	135.3	169.2	121.1	117.3	116.0
Iron	200 ppm	4.00	5.67	6.67	7.67	13.00	150.3	141.7	125.1	121.8	127.8	3.00	6.67	8.00	8.10	20.8	112.7	154.0	126.3	105.6	196.2
	400 ppm	4.00	6.33	7.00	8.67	12.33	150.3	158.2	131.3	115.5	144.5	3.66	6.33	8.00	8.45	11.6	137.5	146.1	126.3	110.1	109.4
Boron	20 ppm	3.66	5.33	6.00	9.67	13.00	137.5	133.2	112.5	121.8	161.1	3.00	6.33	7.33	9.00	13.0	112.7	146.1	115.7	117.3	122.6
	40 ppm	4.00	6.33	6.67	7.67	14.67	150.3	158.2	127.8	137.4	127.8	3.50	6.67	7.33	8.33	15.3	131.5	154.0	115.7	108.6	144.3
Citric acid	500 ppm	4.00	4.33	7.33	7.33	13.67	150.3	108.2	137.5	128.1	122.1	3.00	5.00	6.67	8.00	12.6	112.7	115.4	105.3	104.3	118.8
	1000 ppm	4.00	5.50	7.00	8.00	12.33	150.3	137.5	133.3	115.5	131.3	3.50	6.67	7.33	7.33	11.3	131.5	154.0	115.7	95.6	106.6
L.S.D.	%5	1.01	1.23	0.83	2.21	2.27						0.55	1.26	1.52	1.14	4.28					
	%1	1.39	1.69	1.14	3.12	3.12						0.76	1.73	2.10	1.58	5.90					

Table (5) Effect of foliar application with some nutrients and citric acid on root length of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 ,120 and 200 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Root																			
		length (cm) /plant					% relative to the control					length (cm) /plant					% relative to the control				
		2006										2007									
		60	80	100	120	200	60	80	100	120	200	60	80	100	120	200	60	80	100	120	200
Control	00.00	8.0	12.6	14.3	19.3	19.6	100.0	100.0	100.0	100.0	100.0	5.67	13.6	16.0	17.0	20.0	100.0	100.0	100.0	100.0	100.0
Potassium	500 ppm	8.0	17.3	19.6	20.3	28.6	100.0	137.3	137.1	105.1	145.9	5.77	18.6	19.0	22.6	29.3	101.7	136.7	118.7	133.3	146.5
	1000ppm	11.6	15.0	20.3	22.6	30.3	145.0	119.1	1419	117.0	154.5	7.33	20.0	24.0	25.0	31.0	129.2	147.0	150.0	147.0	155.0
Iron	200 ppm	13.3	18.6	24.0	27.0	29.0	166.6	147.6	167.8	139.8	147.9	7.00	17.0	24.0	24.2	25.6	123.4	125.0	150.0	142.3	128.0
	400 ppm	15.0	18.3	19.0	28.0	27.3	187.5	145.2	132.8	145.0	139.2	7.33	17.3	22.0	24.0	25.3	129.2	127.2	137.5	141.1	126.5
Boron	20 ppm	13.3	17.0	20.6	21.0	25.0	166.6	134.9	144.0	108.8	127.5	6.67	18.3	20.3	25.0	24.3	117.6	134.5	126.8	147.0	121.5
	40 ppm	14.6	19.0	19.6	27.6	30.0	182.5	150.9	137.0	143.0	153.0	7.33	15.0	17.3	24.0	28.6	129.2	110.2	108.1	141.1	143.0
Citric acid	500 ppm	13.3	16.3	19.0	23.0	26.3	166.6	129.3	132.8	119.1	134.1	7.00	14.6	17.0	20.6	26.3	123.4	107.3	106.2	121.5	131.5
	1000ppm	13.0	18.0	20.0	22.6	20.6	162.5	142.8	139.8	117.0	105.1	6.67	15.3	21.3	22.0	20.6	117.6	112.5	133.1	129.4	103.0
L.S.D.	%5	1.76	2.17	1.52	2.90	5.89						1.18	2.6	1.41	1.66	7.55					
	%1	2.42	2.98	2.10	4.00	8.11						1.63	3.57	1.94	2.29	10.4					

Table (6) Effect of foliar application with some nutrients and citric acid on root fresh weight (g)/plant of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons

Characteristics / Treatments		Root fresh weight (g) /plant															
		fresh weight (g) /plant				% relative to the control				fresh weight (g) /plant				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	141.3	206.7	300.0	331.7	100.00	100.00	100.00	100.00	129.7	313.7	330.0	421.7	100.00	100.00	100.00	100.00
Potassium	500 ppm	197.5	205.8	323.3	463.3	139.77	99.57	107.76	139.67	136.0	396.7	425.0	490.0	104.85	126.45	128.78	116.19
	1000 ppm	358.7	540.3	640.0	651.7	253.85	261.39	213.33	196.47	270.5	472.3	552.0	717.3	213.29	150.55	167.27	170.09
Iron	200 ppm	281.7	348.3	413.3	600.3	199.36	168.50	137.76	180.97	226.7	322.7	440.0	448.3	174.78	102.86	133.33	106.30
	400 ppm	305.0	440.3	556.7	649.7	215.85	213.01	185.56	195.86	223.3	383.3	621.3	632.7	172.16	122.18	188.27	150.03
Boron	20 ppm	275.0	351.3	435.0	530.0	194.62	169.95	145.00	159.78	246.7	330.0	507.0	536.7	190.20	105.19	153.63	127.27
	40 ppm	281.0	618.3	641.7	716.7	198.86	299.12	213.90	216.06	259.3	447.7	621.3	750.7	199.92	142.71	188.27	178.01
Citric acid	500 ppm	300.0	411.7	403.3	546.3	212.31	199.17	134.43	121.58	220.0	468.7	488.3	586.0	169.62	149.41	147.96	138.96
	1000 ppm	227.3	458.3	533.0	600.0	160.86	221.72	177.66	180.88	285.3	417.7	550.7	722.3	219.96	133.15	166.87	171.28
L.S.D.	%5	26.40	32.23	47.88	28.97					29.28	41.90	41.67	58.0				
	%1	36.38	44.41	65.97	39.91					40.35	57.73	57.42	77.7				

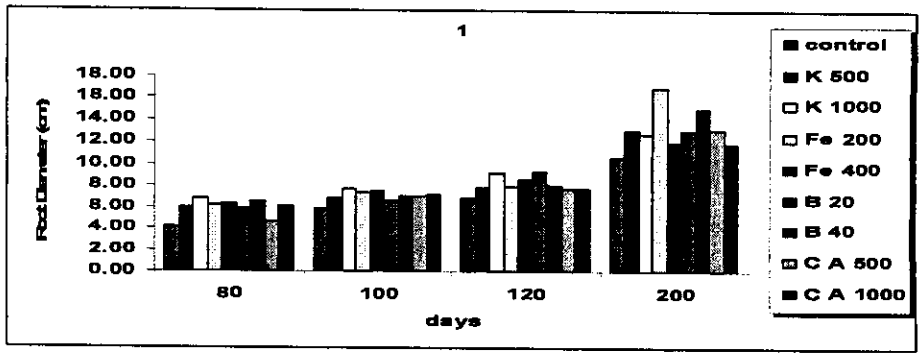


Fig. 2 Effect of foliar application with some nutrients and citric acid on root diameter of sugar beet *(Beta vulgaris L)* plants, 80, 100 ,120 and 200 days after sowing during 2006 and 2007 seasons

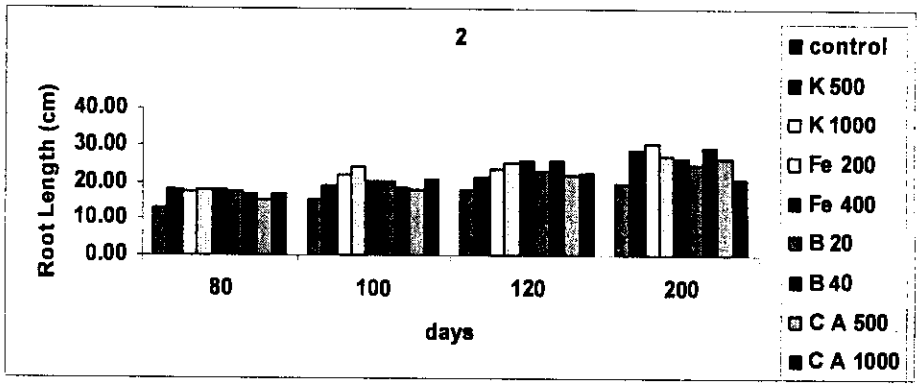


Fig. 3 Effect of foliar application with some nutrients and citric acid on root length of sugar beet (*Beta vulgaris L*)plants at 80, 100 ,120 and 200 days after sowing during 2006 and 2007 seasons

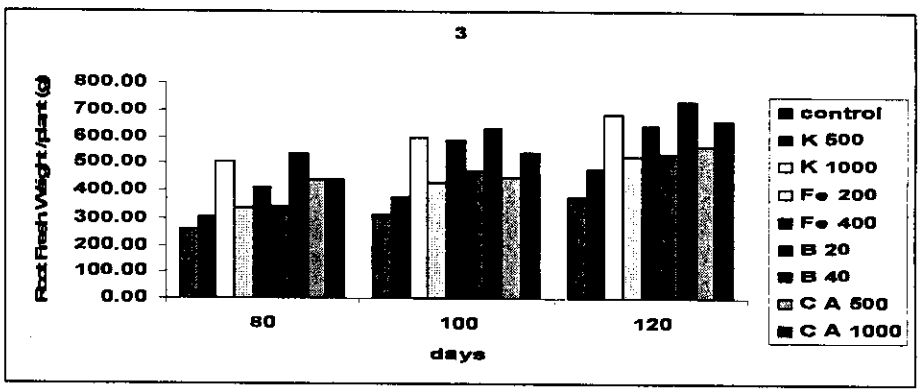


Fig. 4 Effect of foliar application with some nutrients and citric acid on root fresh weight of sugar beet (*Beta vulgaris L*) plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons

I.2. Root quality:

Data in Tables (7, 8 and 9) and Figs (5, 6 and 7) clearly indicate that each of sucrose %, juice purity% and total soluble solids% (T. S. S) in root of sugar beet were increased to reach the high level of significance with different applied treatments during 2006 and 2007 seasons.

Concerning sucrose%, the only foliar spray with citric acid at 500ppm increased this trait significantly at 5% during 2006 and 2007 seasons. Moreover, boron at 40ppm gave the highest values those reached 18.17% and 18.58% during 2006 and 2007 seasons, respectively, meanwhile values were 13.63 and 13.53% sucrose in case of control plants.

The promotion effect of boron on sugar yield may be due to more quantities of photosynthates (Sucrose) are being translocated and stored in the root. At the same time boron plays, a vital role during the development of sugar beet root. These results are in agreement with those of **Genaidy (1988), Saif (1991), Bondok (1996), El-Hawary (1999), Saif (2000) and Hussein (2002).**

Regarding the total soluble solids (T. S. S), as shown in Table (7) was behaved as the same as the above mentioned characteristics. Since, all applied treatments showed its high significant increase but its maximum was also, obtained with the foliar application with potassium at 1000 ppm and boron at 40 ppm treatments.

With regard to the purity% in root of sugar beet data in Table (8) clearly indicate that, it was nearly behaved as the same as the sucrose% and total soluble solids in root of sugar beet.

Since, the iron and boron treatments gave the highest values compared with the control plants.

The highest values of juice purity in root of sugar beet obtained with foliar application by iron (200ppm) and boron (40ppm) respectively, at 120 days after sowing during 2006 and 2007 seasons, since values were 76.04%, 72.39% and 72.25%, 71.46%, respectively. Similar findings were obtained by **Saif (1991), Zalat (1991) and El-Sheref (2007).**

In this respect, boron increased dramatically cytokinin levels in treated roots, which lead to accelerate cambial activity and cell division which reflects up on root quality and increased storage cells. On the other hand, cytokinins acts at different sites when they inhibit the alternative pathway in isolated mitochondria **(Dizengremel *et al.* 1982).** So increasing of root fresh weight and diameter may due to the high content of cytokinins in roots **(Bondok, 1996)**.

Table (7) Effect of foliar application with some nutrients and citric acid on root sucrose percentage of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Root															
		Sucrose %				% relative to the control				Sucrose %				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	0.00	5.89	8.47	11.20	13.63	100.00	100.00	100.00	100.00	6.16	9.27	12.87	13.53	100.00	100.00	100.00	100.00
Potassium	500 ppm	9.13	13.36	15.73	16.75	155.00	157.73	140.44	122.89	8.49	14.45	14.90	17.31	137.82	155.87	115.77	127.93
	1000 ppm	10.96	15.95	16.70	17.51	186.07	188.31	149.10	128.46	10.09	15.85	17.30	17.58	163.79	170.98	134.42	129.93
Iron	200 ppm	9.82	12.96	15.93	16.98	166.72	153.01	142.23	124.57	9.36	14.29	14.93	17.50	151.94	154.15	116.00	129.34
	400 ppm	9.70	15.66	16.07	17.33	164.68	184.88	143.48	127.14	9.94	15.57	16.43	17.37	161.36	167.96	127.66	128.38
Boron	20 ppm	8.75	16.20	16.50	16.50	148.55	191.26	147.32	121.05	9.88	15.38	17.27	17.70	160.38	165.91	134.18	130.82
	40 ppm	9.32	14.17	17.33	18.17	158.23	167.29	154.73	133.30	10.06	16.48	17.20	18.58	163.31	177.77	133.64	137.32
Citric acid	500 ppm	7.76	10.72	12.47	14.48	131.74	126.56	101.33	106.23	8.08	10.32	14.03	15.62	131.16	111.32	109.01	115.44
	1000 ppm	8.32	9.03	14.63	15.48	141.25	106.61	130.62	113.57	8.46	12.68	14.83	16.58	137.33	136.78	115.22	122.54
L.S.D.	%5	0.77	2.49	1.14	0.65					0.72	0.92	0.74	2.54				
	%1	1.06	3.44	1.58	0.92					0.99	1.27	1.02	3.50				

Table (8) Effect of foliar application with some nutrients and citric acid on root Total soluble solid percentage (T.S.S%) of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Root															
		T.S.S %				% relative to the control				T.S.S %				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	14.33	17.00	18.33	21.67	100.00	100.00	100.00	100.00	14.33	17.67	21.67	21.67	100.00	100.00	100.00	100.00
Potassium	500 ppm	17.67	22.47	25.00	26.67	123.30	132.17	136.38	123.07	17.05	23.00	23.33	24.67	118.98	130.16	107.66	113.84
	1000 ppm	18.67	22.47	24.00	23.33	130.28	132.17	130.93	107.66	19.20	23.33	26.00	24.33	133.98	131.86	119.98	112.27
Iron	200 ppm	16.67	21.17	22.00	22.33	116.32	124.52	120.02	103.04	18.17	23.00	23.00	26.33	126.79	130.16	106.13	121.50
	400 ppm	15.67	21.33	23.00	25.33	109.35	125.47	125.47	116.88	18.67	24.67	24.67	25.00	130.28	139.61	113.84	115.36
Boron	20 ppm	15.67	22.50	23.67	24.33	109.35	132.35	129.13	112.27	17.67	23.33	24.67	26.00	123.30	131.86	113.84	119.98
	40 ppm	16.00	23.00	24.00	25.10	109.36	135.29	130.93	115.82	17.27	24.33	25.67	26.00	120.51	137.69	118.45	119.98
Citric acid	500 ppm	15.33	20.47	21.00	21.33	106.97	120.41	114.56	98.43	15.97	18.33	22.00	23.33	111.44	103.73	101.52	107.66
	1000 ppm	15.67	18.00	20.67	23.00	109.35	105.88	112.76	106.13	15.93	20.67	23.33	23.67	111.16	116.69	107.66	109.22
L.S.D.	%5	1.75	1.16	1.20	1.01					0.67	0.99	1.42	1.30				
	%1	2.41	1.60	1.66	1.40					0.92	1.37	1.96	1.80				

Table (9) Effect of foliar application with some nutrients and citric acid on root juice purity percentage of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments ts		Root															
		purity %				% relative to the control				purity %				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	41.10	46.20	61.10	62.89	100.00	100.00	100.00	100.00	42.98	52.46	58.46	62.44	100.00	100.00	100.00	100.00
Potassium	500 ppm	51.66	59.45	62.92	62.80	125.69	128.67	102.57	99.85	49.83	62.82	63.86	70.16	115.93	119.74	109.23	112.36
	1000 ppm	58.70	70.90	69.58	75.05	148.82	153.46	113.87	119.33	52.55	67.93	66.53	72.25	122.40	129.48	113.80	115.71
Iron	200 ppm	58.90	61.21	72.40	76.04	143.30	132.48	118.49	120.90	51.51	62.13	64.91	66.46	119.84	118.43	111.03	106.43
	400 ppm	61.90	73.41	69.86	68.41	150.60	158.89	114.33	108.41	53.24	63.11	66.59	69.48	123.87	1120.30	113.90	111.27
Boron	20 ppm	56.23	72.00	69.70	67.81	136.81	155.84	114.07	107.82	55.91	65.92	70.00	68.07	130.08	125.65	119.73	109.01
	40 ppm	58.25	61.60	72.20	72.39	141.72	133.33	118.16	115.10	58.25	67.73	67.00	71.46	135.52	129.10	114.60	114.44
Citric acid	500 ppm	50.61	52.36	59.38	67.88	123.13	113.33	97.18	107.93	50.59	56.30	63.77	66.95	117.70	107.31	109.08	107.22
	1000 ppm	53.09	50.16	63.60	74.89	129.17	108.57	104.09	119.08	53.10	61.34	63.56	70.04	123.54	116.92	108.72	112.17
L.S.D.	%5	3.61	4.08	7.09	3.70					4.58	4.83	5.15	3.91				
	%1	4.97	5.62	9.77	5.10					6.30	6.65	7.10	5.38				

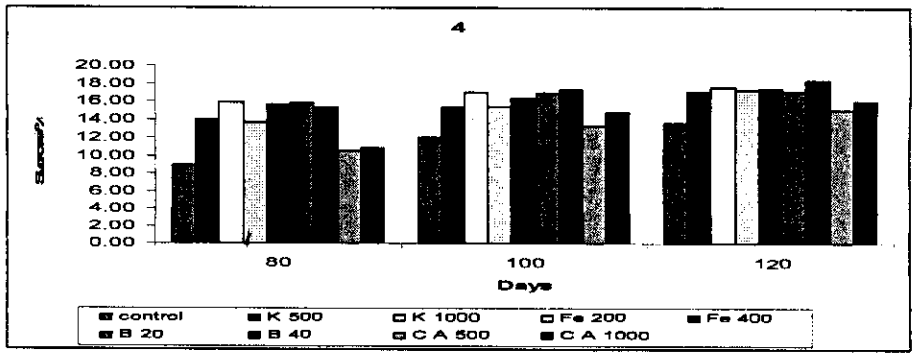


Fig. 5 Effect of foliar application with some nutrients and citric acid on root sucrose percentage of sugar beet (*Beta vulgaris L*)plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons

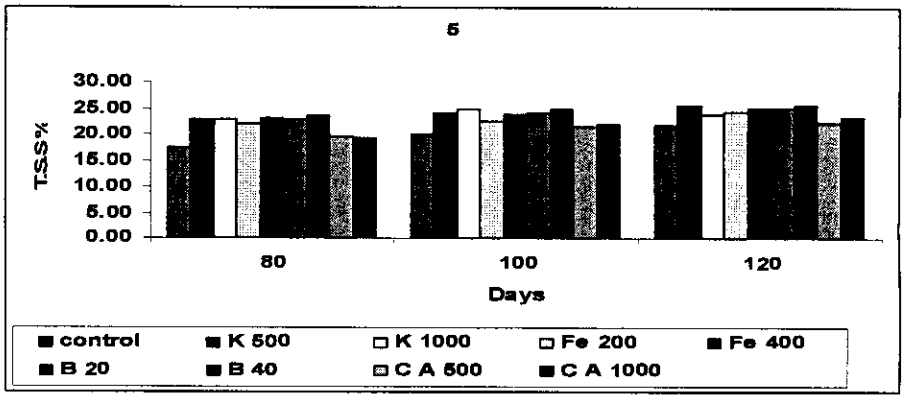


Fig. 6 Effect of foliar application with some nutrients and citric acid on root Total soluble solid percentage of sugar beet (*Beta vulgaris L*)plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons

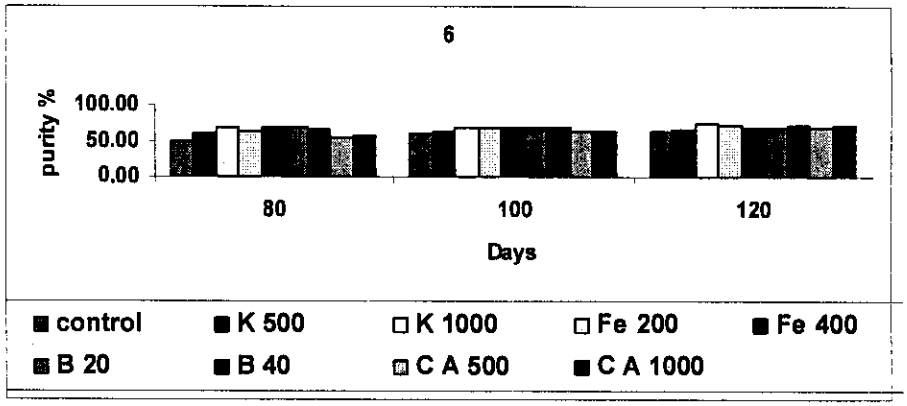


Fig. 7 Effect of foliar application with some nutrients and citric acid on root juice purity percentage of sugar beet (*Beta vulgaris L*)plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

I.3. Leaf Characteristics:

As shown in Table (10) it could be clearly noticed that number of leaves per plant was increased to reach the high level of significance with foliar application by potassium (1000ppm) and boron (40ppm) at 120 days after sowing during 2006 and 2007 seasons. The only exception was that insignificant increase with citric acid (500ppm) and boron (20 ppm) at 120 days after sowing during 2006 and 2007 seasons. Also, in most cases number of leaves was gradually increased till the third sampling at 120 days after sowing during 2006 and 2007 seasons.

Concerning the effect of different foliar application with potassium, iron, boron and citric acid on the leaves fresh weight, Data shown in **Table** (11) indicate that, leaves fresh weight was highly significantly increased with different applied treatments except that significant increase only at 5% level with potassium (500ppm) during 2006 season and insignificantly increased with it on citric acid treatments during the two seasons.

In this respect, **Bondok (1996)** found that, different concentrations of boron reduced shoot fresh weight, these results may be due to the reduction of auxin levels and the high level of ABA in sugar beet shoots after boron application which led to a limitation of vegetative growth. The reduction of shoot weight may also due to the role of boron up on the translocation of carbohydrates from the vegetative (source) to storage organs (root) **(Pilbeam & Krkby, 1983).**

Potassium and boron deficiency is associated with a disturbance in synthesis of plant hormones and nucleic acids metabolism. They also mentioned that, many symptoms of

boron deficiency are very similar to symptoms of abnormally high concentrations of auxins. Moreover, evidence of decrease in IAA-oxidase activity as results of boron deficiency was shown by **Shkevnik et al (1964).** Moreover, deficiency of boron lead to depression in cytokinin biosynthesis **(Wagner and Michael, 1971).**

As shown in Tables (12,13 & 14) it could be clearly noticed that total fresh weight in sugar beet plants at 80, 100 and 120 days after sowing were increased with different used foliar application during 2006 and 2007 seasons.

In this respect, boron at 40ppm gave the highest value at 100 and 120 days after sowing during two seasons meanwhile potassium at 1000 ppm gave the highest value at 80 days after sowing.

Also, foliar application with all treatments was significantly increased at different stages of growth during two seasons.

The increment of top yield of sugar beet plants by adding k may be due to the role of k element in improving enzyme activation **(Marschner, 1995)**. Therefore, the effect of k nutrient on top yield may be due to increasing photosynthetic area which resulted in increasing photosynthetiates gains, water relations and vegetative growth by increasing cell division **(Marschner 1995).**

As for leaves dry weight g/plant it could be noticed that, nearly behaved as the same as total fresh weight. Since, the potassium at 1000 ppm gave the highest value when compared with control plants. Also, potassium at 1000ppm treatment was

more pronounced in this respect followed by boron at 40ppm and iron at 200ppm.

Regarding, the total leaf area cm^2 per plant, **Data in Table** (14) and Fig (12) indicate that potassium at 1000ppm was increased to reach the high level of significance during two seasons. Meanwhile, boron at 40ppm gave the highest value at 60 and 80 days after sowing.

The enhancement of leaf area is of great interest because that could be led to not only more efficiency of photosynthesis but also synthesizing more assimilates and high rates of their translocation specially toward sink sites, i.e., the formed roots. Similar results were recorded by **Bashi *et al.* (1992), Kim *et al.* (1999). Neamat-Ali *et al.* (2002). Osman (2006).**

As shown in Table (15) and fig (13) indicate that, foliar application with potassium at 1000ppm was significantly increased the leaf area index% of sugar beet plants at 100 and 120 days after sowing during two seasons. Also, boron at 40ppm gave the highest value of leaf area at 60 and 80 days after sowing.

The increment of top yield of sugar beet pants by adding k may be due to the role of k element in improving enzyme activation (**Marschner 1995**). Therefore, the effect of k nutrient on top yield may be due to increasing photosynthetic area which resulted in increasing photosynthetic gains, water relations and vegetative growth by increasing cell division **(Marschner, 1995).**

Also, the positive effects of citric acid as antioxidant on growth and development of sugar beet might be due to: it's

Table (10) Effect of foliar application with some nutrients and citric acid on leaves (number/plant) of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 120 and 200 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Leaves																			
		number /plant					% relative to the control					number /plant					% relative to the control				
		2006										2007									
		60	80	100	120	200	60	80	100	120	200	60	80	100	120	200	60	80	100	120	200
Control	00.00	12.0	19.6	22.6	23.3	25.3	100.0	100.0	100.0	100.0	100.0	12.0	21.0	21.3	22.6	24.6	100.0	100.0	100.0	100.0	100.0
Potassium	500 ppm	12.7	24.0	24.0	29.0	35.3	105.8	122.4	106.1	124.4	139.5	16.0	24.0	25.3	28.6	27.6	133.3	114.2	118.7	126.4	112.1
	1000 ppm	14.0	25.0	26.3	31.0	37.3	116.6	127.5	116.3	133.0	147.4	16.6	25.3	26.3	29.0	34.3	138.8	120.4	123.4	128.5	139.1
Iron	200 ppm	13.6	20.6	26.6	27.3	37.0	113.3	105.1	117.6	117.1	146.2	17.0	21.3	25.0	26.6	26.6	141.6	101.4	117.2	117.6	108.1
	400 ppm	15.0	24.0	25.0	31.0	36.3	125.0	122.4	110.6	133.0	143.4	17.0	23.3	25.0	25.2	33.0	141.6	110.9	117.2	111.2	134.1
Boron	20 ppm	14.6	19.6	25.0	25.2	34.3	121.6	100.0	110.6	108.1	135.5	17.3	21.6	24.3	25.0	34.3	144.1	102.8	114.0	110.2	139.4
	40 ppm	14.0	23.6	26.6	28.6	38.0	116.6	120.4	117.6	122.7	150.2	17.0	22.6	24.0	26.6	33.3	141.6	107.6	112.5	117.6	135.3
Citric acid	500 ppm	13.6	23.3	25.0	26.6	31.3	113.3	118.8	110.6	114.1	123.7	15.0	23.0	24.0	26.6	27.0	125.0	109.5	112.5	117.6	109.7
	1000 ppm	12.0	22.6	23.6	25.3	31.0	100.0	115.3	104.4	108.5	122.5	17.3	23.6	25.0	25.6	29.3	144.1	112.3	117.2	113.2	119.1
L.S.D.	%5	1.90	1.96	1.42	2.56	8.63						3.32	2.00	3.11	2.56	5.98					
	%1	2.60	2.12	2.06	3.52	11.8						3.50	2.95	4.30	3.52	8.24					

Table (11) Effect of foliar application with some nutrients and citric acid on leaves fresh weight (g) /plant of sugar beet *(Beta vulgaris L.)* plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Leaves															
		fresh weight (g) /plant				% relative to the control				fresh weight (g) /plant				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	263.3	525.0	558.3	753.3	100.00	100.00	100.00	100.00	292.7	486.0	576.7	700.7	100.00	100.00	100.00	100.00
Potassium	500 ppm	232.5	677.5	756.7	830.0	88.30	129.04	135.53	110.18	306.0	594.33	616.0	727.3	104.54	122.29	106.81	103.79
	1000ppm	600.0	705.0	708.3	906.7	227.87	134.28	126.86	120.3	605.7	625.0	713.3	875.0	206.93	128.60	123.68	124.87
Iron	200 ppm	424.0	623.3	696.7	816.7	161.03	118.72	124.78	108.41	507.3	571.01	777.3	825.0	173.31	117.49	134.78	117.73
	400 ppm	501.7	713.3	720.7	750.3	190.54	132.86	129.08	99.60	547.3	606.3	716.0	760.0	186.98	124.75	124.15	108.46
Boron	20 ppm	501.7	531.7	744.7	795.0	190.54	101.20	133.38	105.53	555.7	586.7	715.0	756.7	189.85	120.72	123.98	107.99
	40 ppm	591.7	650.0	666.7	950.0	224.07	123.80	119.41	126.11	479.0	572.0	662.7	918.3	163.64	117.69	114.91	131.06
Citric acid	500 ppm	524.7	549.0	606.7	683.3	199.27	104.57	118.66	90.70	466.7	624.7	670.7	716.7	159.44	128.53	116.29	102.28
	1000ppm	590.0	606.7	753.3	876.3	224.07	115.56	143.48	116.32	551.0	665.0	755.0	725.0	188.24	136.83	130.91	103.46
L.S.D.	%5	60.61	85.70	35.41	72.80					63.89	75.01	99.21	79.80				
	%1	83.51	118.1	48.79	100.3					88.03	103.3	136.3	110.0				

Table (12) Effect of foliar application with some nutrients and citric acid on leaves Total fresh weight of Roots and Leaves of sugar beet*(Beta vulgaris L.)*plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments ts		Total fresh weight (Roots and Leaves) g/plants															
		Total fresh weight (g) /plant				% relative to the control				Total fresh weight (g) /plant				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	404.6	731.7	858.3	1085.0	100.00	100.00	100.00	100.00	422.4	799.7	1030.7	1122.4	100.00	100.00	100.00	100.00
Potassium	500 ppm	430.0	883.3	1080.0	1293.3	106.27	120.71	125.83	119.19	442.0	991.0	1152.3	1217.3	104.64	123.92	111.79	108.45
	1000ppm	958.7	1245.3	1348.3	1558.4	236.95	170.19	157.08	143.63	876.2	1097.3	1277.0	1592.3	207.43	137.21	123.89	141.86
Iron	200 ppm	705.7	971.6	1110.0	1417.0	174.41	132.78	129.32	130.59	797.7	893.7	1265.0	1273.3	173.76	111.75	122.73	113.44
	400 ppm	806.7	1153.6	1277.4	1400.0	199.38	157.66	148.82	129.03	889.6	989.6	1381.3	1392.7	182.43	123.74	134.01	124.08
Boron	20 ppm	776.7	883.0	1179.7	1480.0	191.96	120.67	137.44	136.40	833.4	916.7	1263.7	1293.4	189.96	114.63	122.60	115.23
	40 ppm	872.7	1268.3	1308.4	1666.7	215.69	173.33	152.44	153.61	738.3	1019.7	1339.6	1669.0	174.78	127.51	129.96	148.69
Citric acid	500 ppm	824.7	960.7	1010.0	1229.6	203.83	131.29	117.67	113.32	686.7	1093.4	1205.0	1302.7	162.57	136.72	116.91	116.06
	1000ppm	817.3	1065.0	1286.3	1476.3	202.00	145.55	149.86	136.06	950.3	1082.7	1425.7	1447.3	197.98	135.38	138.32	128.94
L.S.D.	% 5	87.01	117.93	83.29	116.91					62.40	58.74	53.17	58.42				
	%1	119.89	162.51	114.76	161.03					85.97	80.93	73.26	80.49				

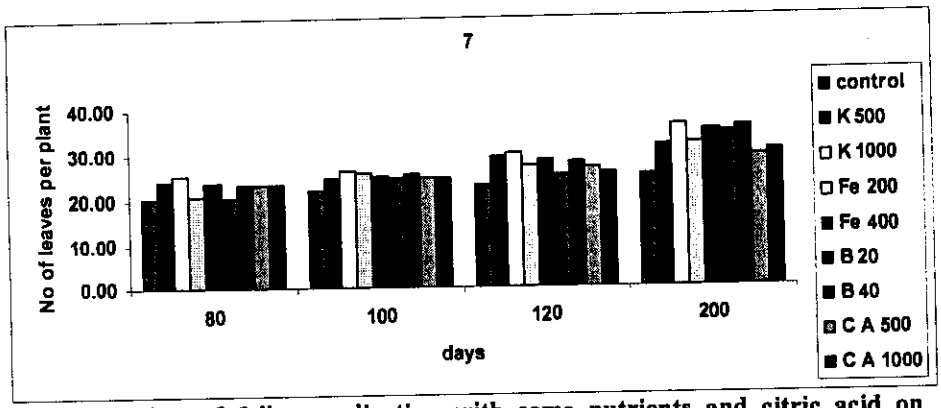


Fig. (8) Effect of foliar application with some nutrients and citric acid on leavesnumber/plant of sugar beet (*Beta vulgaris L*) plants at 80, 100 120 and 200 days after sowing during 2006 and 2007 seasons

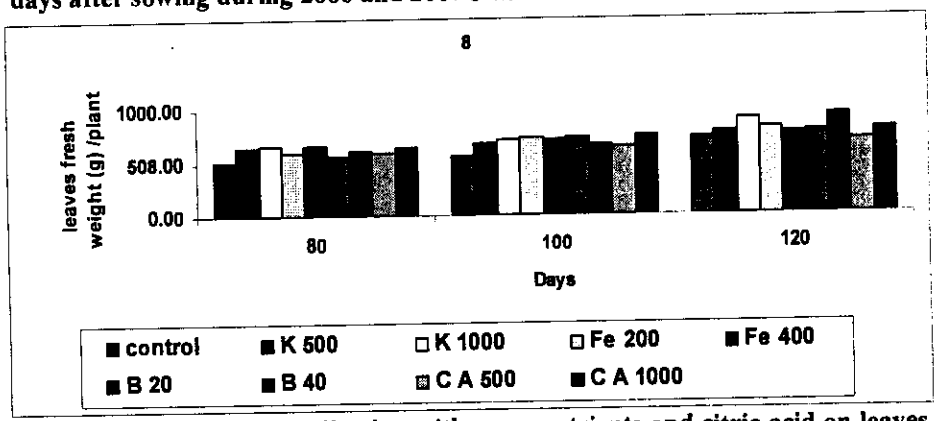


Fig.(9) Effect of foliar application with some nutrients and citric acid on leaves fresh weight (g) /plant of sugar beet (*Beta vulgaris L*) plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

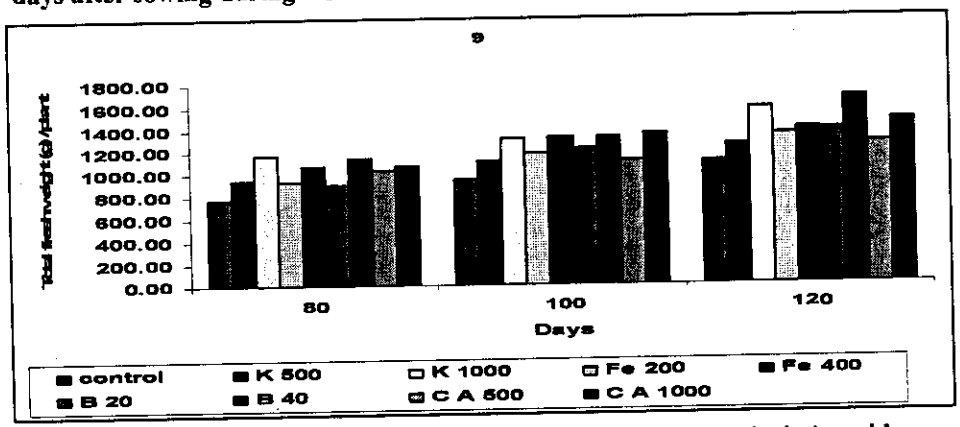


Fig. (10) Effect of foliar application with some nutrients and citric acid on leaves Total fresh weightof Roots and Leaves of sugar beet (*Beta vulgaris L*) plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons

Table (13) Effect of foliar application with some nutrients and citric acid on leaves dry weight (g) / plant of sugar beet *(Beta vulgaris L.)* plants at 60, 80, 100 and 120 days after sowing during 2006and 2007 seasons.

Characteristics / Treatments		leaves															
		dry weight (g) /plant				% relative to the control				dry weight (g) /plant				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	19.11	37.53	44.60	60.94	100.00	100.00	100.00	100.00	21.74	35.33	47.80	56.61	100.00	100.00	100.00	100.00
Potassium	500 ppm	20.29	55.89	70.63	75.91	106.17	148.92	158.36	124.56	25.85	49.50	59.87	61.45	118.90	140.10	125.25	108.54
	1000ppm	54.00	60.55	85.35	91.07	282.57	161.33	191.36	149.44	52.57	52.56	74.18	74.74	241.81	148.76	155.18	132.02
Iron	200 ppm	38.62	53.22	69.90	72.52	202.09	141.80	156.72	119.00	46.41	48.53	61.95	70.95	213.47	137.36	129.60	125.33
	400 ppm	41.79	57.00	57.49	59.87	218.68	151.87	128.90	98.24	44.82	50.08	56.85	61.40	206.16	141.74	118.93	108.46
Boron	20 ppm	51.30	52.00	55.78	65.26	268.44	138.55	125.06	107.08	52.26	53.34	54.44	57.61	240.38	150.97	113.89	101.76
	40 ppm	51.12	55.93	67.91	68.61	267.50	149.02	152.26	112.58	63.30	64.02	69.42	69.56	291.16	181.20	145.23	122.87
Citric acid	500 ppm	33.21	48.96	51.36	57.26	173.78	130.45	115.15	93.96	31.50	54.46	59.03	59.48	144.89	154.14	123.49	105.59
	1000ppm	60.64	61.39	62.32	67.14	317.32	163.57	139.73	110.17	54.43	56.74	56.79	57.60	250.36	160.60	118.80	101.74
L.S.D.	%5	7.25	6.37	5.096	4.64					5.70	8.034	6811	5.15				
	%1	9.99	8.78	7.021	6.39					7.85	11.07	9.384	7.09				

Table (14) Effect of foliar application with some nutrients and citric acid on Total leaves area (c m²) of sugar beet *(Beta vulgaris L.)* plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Total leaf area (c m²)															
		Total leaf area (c m²)/plant				% relative to the control				Total leaf area (c m²)/plant				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	1500	2946	3501	4783	100.00	100.00	100.00	100.00	1706	2773	3752	4443	100.00	100.00	100.00	100.00
Potassium	500 ppm	1592	4387	5544	5958	106.18	148.91	158.36	124.56	2029	3885	4699	4823	118.93	140.12	125.25	108.57
	1000 ppm	4238	4753	6699	7148	282.59	161.33	191.37	149.44	4125	4126	5823	5867	241.84	148.81	155.19	132.05
Iron	200 ppm	3031	4177	5487	5692	202.06	141.80	156.72	119.00	3643	3809	4863	5569	213.54	137.81	129.61	125.35
	400 ppm	3280	4474	4512	4699	218.7	151.88	128.90	98.24	3518	3931	4458	4819	206.21	141.75	118.81	108.48
Boron	20 ppm	4027	4081	4378	5122	268.46	138.55	125.06	107.09	4187	4522	4102	4273	245.42	163.07	109.32	96.17
	40 ppm	4012	4390	5330	5385	267.52	149.03	152.26	112.58	4969	5449	5025	5460	291.26	196.50	133.92	122.88
Citric acid	500 ppm	2606	3843	4031	4494	173.79	130.44	115.15	93.96	2472	4275	4633	4669	144.94	154.16	123.50	105.08
	1000 ppm	4760	4819	4892	5270	317.34	163.57	139.73	110.07	4272	4454	4458	4521	250.45	160.62	118.81	101.75
L.S.D.	% 5	729.4	583.2	501.2	1024					621.7	807.4	681.7	530.8				
	%1	1005	802.5	690.5	1438					856.5	1112	939.3	731.4				

Table (15) Effect of foliar application with some nutrients and citric acid on Leaf area index of sugar beet *(Beta vulgaris L.)* plants at 60, 80, 100 and 120 days after sowing during 2006 and 2007 seasons.

Characteristics / Treatments		Leaf area index %															
		% /plant				% relative to the control				% /plant				% relative to the control			
		2006								2007							
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	15.00	29.46	35.01	47.83	100.00	100.00	100.00	100.00	17.06	27.73	37.52	44.43	100.00	100.00	100.00	100.00
Potassium	500 ppm	15.92	43.87	55.44	59.58	106.18	148.91	158.36	124.56	20.29	38.85	46.99	48.23	118.93	140.12	125.25	108.57
	1000 ppm	42.38	47.53	66.99	71.48	282.59	161.33	191.37	149.44	41.25	41.26	58.23	58.67	241.84	148.81	155.19	132.05
Iron	200 ppm	30.31	41.77	54.87	56.92	202.06	141.80	156.72	119.00	36.43	38.09	48.63	55.69	213.54	137.81	129.61	125.35
	400 ppm	32.80	44.74	45.12	46.99	218.7	151.88	128.90	98.24	35.18	39.31	44.58	48.19	206.21	141.75	118.81	108.48
Boron	20 ppm	40.27	40.81	43.78	51.22	268.46	138.55	125.06	107.09	41.87	45.22	41.02	42.73	245.42	163.07	109.32	96.17
	40 ppm	40.12	43.90	53.30	53.85	267.52	149.03	152.26	112.58	49.69	54.49	50.25	54.60	291.26	196.50	133.92	122.88
Citric acid	500 ppm	26.06	38.43	40.31	44.94	173.79	130.44	115.15	93.96	24.72	42.75	46.33	46.69	144.94	154.16	123.50	105.08
	1000 ppm	47.60	48.19	48.92	52.70	317.34	163.57	139.73	110.07	42.72	44.54	44.58	45.21	250.45	160.62	118.81	101.75
L.S.D.	%5	9.10	7.51	6.29	6.67					7.19	9.88	8.54	4.97				
	%1	12.45	10.34	8.67	9.19					9.90	13.61	11.78	6.84				

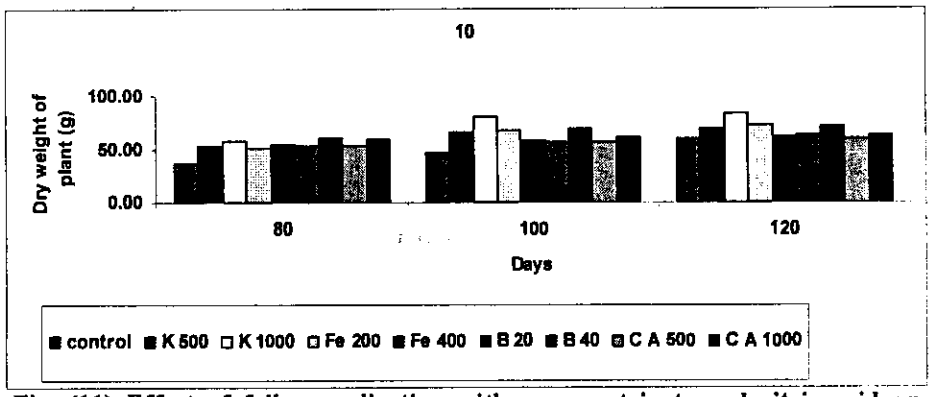


Fig. (11) Effect of foliar application with some nutrients and citric acid on leaves dry weight (g) / plant of sugar beet (*Beta vulgaris L*)plants at 80, 100 and 120 days after sowing during 2006and 2007 seasons

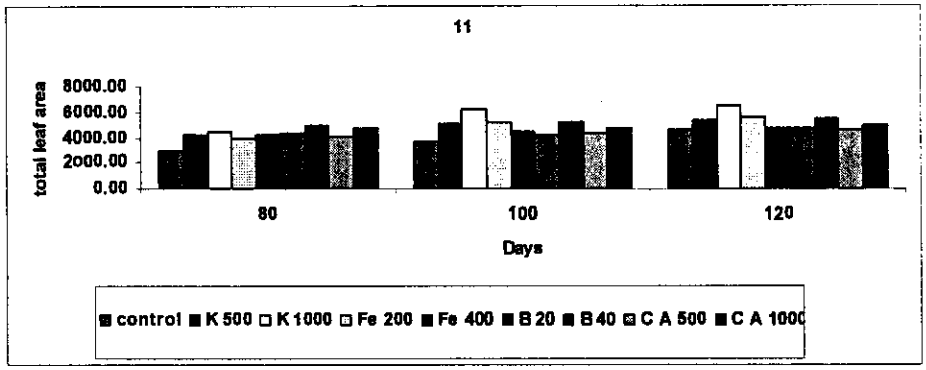


Fig.(12) Effect of foliar application with some nutrients and citric acid on Total leaf area (c m^2) of sugar beet (*Beta vulgaris L*) plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons

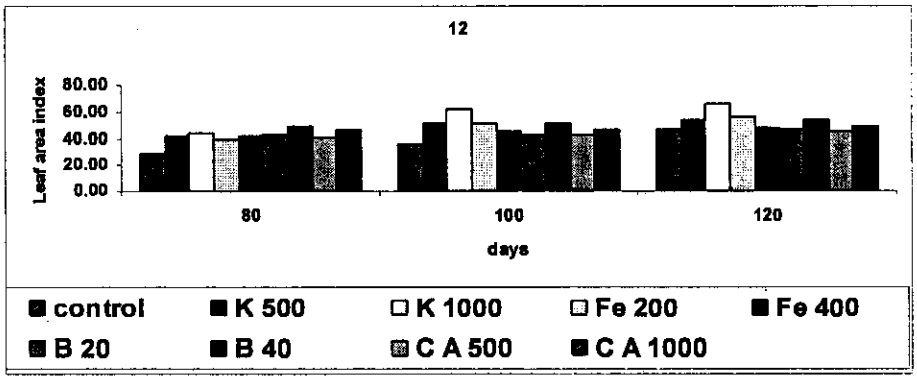


Fig. (13) Effect of foliar application with some nutrients and citric acid on Leaf area index of sugar beet (*Beta vulgaris L*) plants at 80, 100 and 120 days after sowing during 2006 and 2007 seasons

action as cofactors for some specific enzymes, i.e. dismutase, catalase and peroxidase those catalyzed breakdown the toxic radicals, its simulative effect on carotenoids synthesis as defensive mechanism against stress adverse effects of pathogen infection, it's enhancement of cell division and cell enlargement and DNA replication. **Aono *et al.* (1993); Fathy *et al.* (2003); and Wanas (2006)**

II. Photosynthetic pigments:

Data in Table (16) and figs (B) (a, b, c) indicate that different photosynthetic pigments as chlorophyll a, b and carotenoids were positively responded to the different applied treatments during 2007 season. Also, potassium at 1000 ppm and boron at 40 ppm gave the highest values in this respect comparing with the control plants. Increasing of chlorophylls and carotenoids concentration were enhanced photosynthesis efficiency and increased dry matter production. Also, the stimulation of photosynthetic pigments formation could be attributed to the vigorous growth obtained in Tables (13, 14 & 15).similar results were reported by **Bondok (1996), Abd-El-Hamid (1997)**. Increment of photosynthesis pigments in response to ascorbic acid might be due to its action as antioxidants for protecting chloroplasts from oxidative damage by free radicals. **Ghourab (2000), Borowczak *et al.* (2002), Wanas (2006) and Haggag and El-Khair (2007).**

In this respect, it could be suggested that, the enhancement effect of K, Fe, B and CA on increasing plant pigments concentration could be attributed to the favorable effect of these nutrients to increase bio synthesis of chlorophylls

Table (16) Effect of foliar application with some nutrients and citric acid on photosynthetic pigments (mg/g f.w) in leaves of sugar beet (*Beta vulgaris* L.) 60, 80, 100 and 120 days after sowing during 2007 season .

Characteristics / Treatments		pigment											
		Chlorophyll a				Chlorophyll b				Carotene			
		Days after sowing											
		60	80	100	120	60	80	100	120	60	80	100	120
Control	0.0 ppm	2.14	2.90	3.00	3.01	0.85	1.63	1.20	1.13	0.18	0.19	0.29	1.36
Potassium	500 Ppm	2.25	3.65	5.78	4.99	1.14	1.25	1.66	2.93	1.34	2.48	1.28	1.33
	1000 Ppm	2.38	3.05	3.13	5.73	0.89	1.25	1.38	1.94	1.63	2.01	1.66	1.14
Iron	200 Ppm	2.06	2.98	4.20	4.47	0.96	1.55	1.85	2.13	1.58	1.32	1.28	1.84
	400 Ppm	3.95	3.52	4.81	5.02	1.20	1.62	1.89	2.15	1.93	1.88	1.26	1.20
Boron	20 Ppm	2.48	3.51	4.61	5.40	1.10	1.18	1.49	2.71	1.46	2.35	1.28	1.25
	40 Ppm	2.87	3.66	4.89	5.41	1.51	1.22	1.59	2.75	1.83	1.18	1.20	1.36
Citric acid	500 Ppm	2.45	3.25	4.97	5.14	1.36	1.45	1.73	2.67	1.56	2.11	1.21	1.28
	1000 Ppm	2.90	3.45	5.39	6.47	1.75	1.80	1.81	2.87	1.10	2.16	1.17	1.24

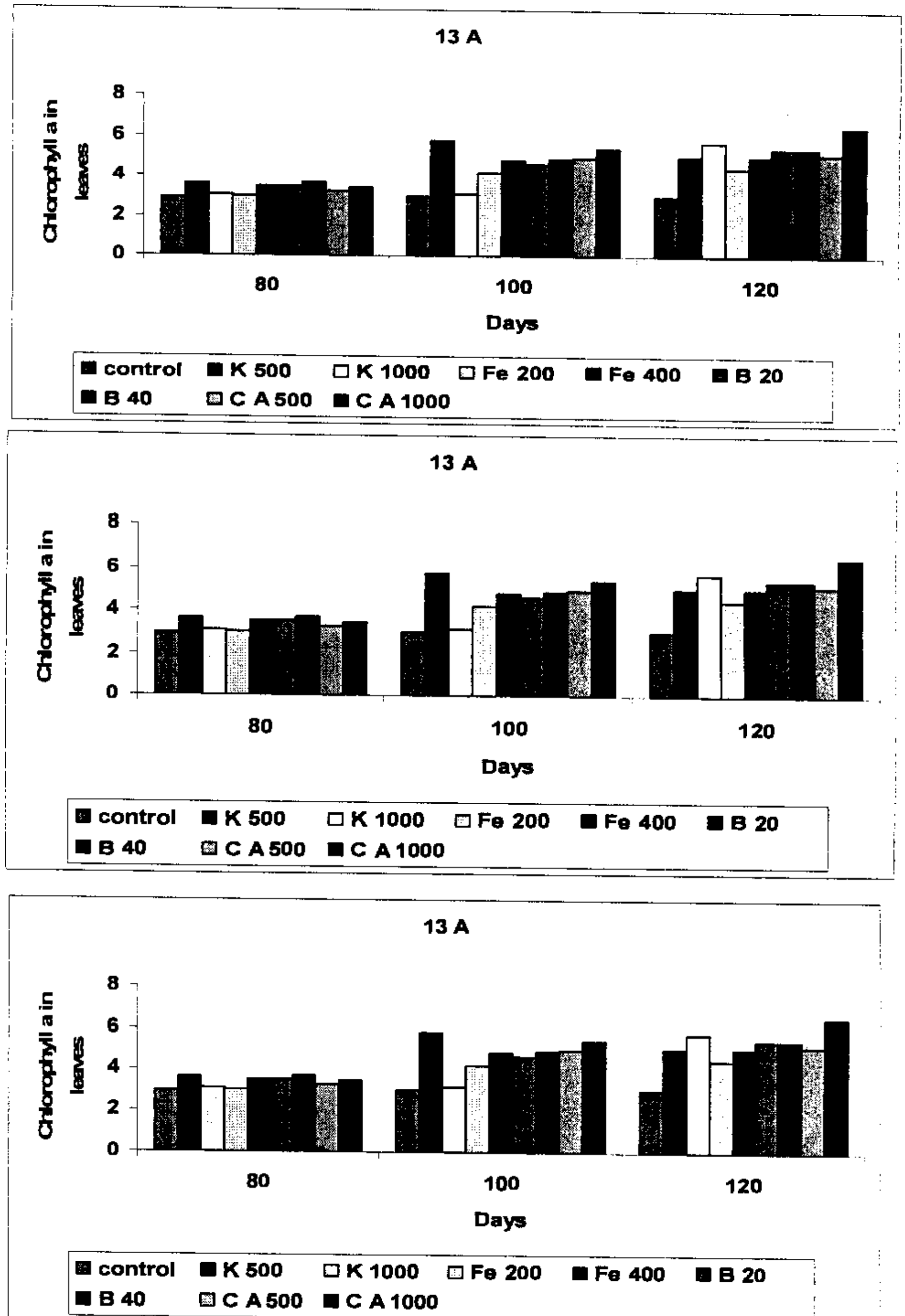


Fig. 14(a-b-c)) Effect of foliar application with some nutrients and citric acid on photosynthetic pigments (mg/g f.w) in leaves of sugar beet(*Beta vulgaris L*) leaves at 80, 100 and 120 days after sowing during 2007 season

through improving the absorption of N, Mg, and Fe ions which are involved in chloroplast formation, which might be expected as a reason for chlorophyll increases in sugar beet leaves **Possingham (1980),. Abd El-Hamid *et al.* (1992), Marshner (1995) and Besheit *et al.* (1992) Bondok (1996), Larbi *et al.* (2004).** Also, found that, K application effects on the structure of plastids as well as quality and number of chloroplasts per cell were increased.

In this connection, it could be mentioned that increasing sugar beet chlorophyll content in different periods due to the use of K, Fe, B and CA which led to an increase of the assimilation rate and efficiency of solar energy conversion which reflected on the ability of sugar beet plants to increase the productivity, sugar storage ability and consequently final sugar percentage and root yield.

III. Chemical composition:

1. Minerals concentration in Root:

Data in Table (17) clearly indicate that all applied treatments increased minerals (i.e., N, P and K) concentrations in root of sugar beet plants at different stages of growth during 2007 season when compared with the control plants.

Also foliar spray with potassium at 1000 ppm gave the highest concentrations of minerals (N, P and K) during 2007 season when compared with other treatments or control plants.

2. Minerals concentration in leaves:

Data in Tables (18 & 19) and figs (a, b, and c) indicate that all foliar sprayed treatments increased N, P, K, Ca, Mg, Fe

and B concentration in leaves of sugar beet plants at 80, 100 and 120 days after sowing during 2007 season. Also, foliar spray with potassium at 1000ppm gave the highest increase in N and K meanwhile, citric acid at 1000 ppm gave the highest increase in P and Fe during 2007 season. Also, Mg and B were increased to reach its maximum with boron at 40ppm treatment compared with control plants and other treatments.

In this respect. **Tsialtas and Maslaris (2006)** showed that, the leaf K or between soil K concentrations were found. Also, element concentrations in roots affected leaf nutrients but the effects were year specific. In 2002, root K was negatively related to leaf Na concentration while in 2003, a negative relationship between root Na and leaf K or Ca was evident. This result are in agreement with those obtained by **El-Sahfy (1996), Abd-El-Hamid (1996), Negm and hassan (1998), El-Nour et al. (2000) and Koriem et al (2002).**

Fathy *et al.* (2003), reported that the enhancement of natural protective antioxidants of total phenols and corticoids as well as they induced an potent biosynthesis case due to the higher photosynthetic pigments content (protection of chlorophyll's, and chloroplasts against stress degradable senescence effects), thereby higher carbohydrates accumulation and content as well as higher minerals. The strong positive correlations of such constituents vs growth and fruit yield confirmed and coincided such functions and roles of antioxidants.

Table (17) Effect of foliar application with some nutrients and citric acid on nitrogen, phosphorus and potassium concentrations(mg/g D.w)in roots of sugar beet *(Beta vulgaris L.)*plant at 60, 80, 100and120 days after sowing during 2007 season.

Characteristics / Treatments		Root											
		N(mg/g)D.w Days after sowing				P (mg/g) D.w Days after sowing				K (mg/g) D.w Days after sowing			
		60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	10.2	10.0	9.90	10.0	1.20	1.00	1.10	1.10	14.7	15.0	15.3	15.5
Potassium	500ppm	16.0	18.0	20.5	20.6	1.40	1.50	1.60	1.70	16.5	17.5	20.5	26.8
	1000ppm	18.4	20.4	22.5	22.6	1.50	1.60	1.70	1.70	18.5	20.0	22.5	29.0
Iron	200 ppm	14.5	16.4	18.5	19.0	1.30	1.30	1.40	1.50	15.2	17.7	20.0	23.5
	400 ppm	16.5	18.6	20.4	20.5	1.30	1.40	1.60	1.70	17.8	19.0	22.5	26.0
Boron	20 ppm	12.5	14.4	16.0	16.5	1.10	1.20	1.30	1.30	15.0	24.2	19.8	20.0
	40 ppm	14.5	16.5	18.0	18.5	1.20	1.30	1.40	1.50	17.2	26.8	21.5	23.5
Citric acid	500 ppm	11.5	13.5	15.5	16.0	1.70	1.80	1.80	1.80	21.5	21.5	26.8	24.0
	1000 ppm	14.0	16.0	17.5	18.0	1.90	1.90	2.00	2.10	24.3	23.5	29.0	29.0

Table (18) Effect of foliar application with some nutrients and citric acid on nitrogen, phosphorus and potassium concentrations(mg/g D.w)in leavses of sugar beet *(Beta vulgaris L.)*plant at 60, 80,100and120 days after sowing during 2007 season .

Characteristics / Treatments		Leaves											
		N (mg/g)				P (mg/g)				K (mg/g)			
		Days after sowing											
		60	80	100	120	60	80	100	120	60	80	100	120
Control	0.0 ppm	21.8	21.9	21.6	21.7	1.70	1.80	1.70	1.70	30.0	30.0	30.0	30.0
Potassium	500 Ppm	27.3	30.7	34.0	34.5	2.60	0 2.7	2.70	3.10	42.0	46.0	46.0	50.0
	1000 Ppm	32.8	35.7	39.1	38.0	2.70	2.80	2.90	3.00	42.0	47.0	47.0	51.0
Iron	200 Ppm	25.0	27.0	31.5	34.6	2.40	2.50	2.60	2.80	33.5	42.0	44.0	45.0
	400 Ppm	29.0	32.0	36.4	38.2	2.50	2.60	2.70	2.80	35.0	43.0	45.0	45.5
Boron	20 Ppm	22.0	25.0	29.0	31.8	2.10	2.20	2.20	2.30	36.0	40.0	42.5	43.5
	40 Ppm	27.0	31.0	33.0	35.1	2.20	2.20	2.40	2.50	37.0	41.0	43.5	44.0
Citric acid	500 Ppm	24.5	26.0	31.2	33.5	3.00	3.20	3.20	3.30	40. 0	45.0	48.0	48.5
	1000 Ppm	29.2	33.0	36.2	35.6	3.20	3.10	3.30	3.40	41.0	44.0	49.0	50. 0

Table (19) Effect of foliar application with some nutrients and citric acid on calcium ,magnesium, iron and boron concentration in leaves of sugar beet *(Beta vulgaris L.)*plant at 60,80,100 and 120 days after sowing during 2007 season.

Characteristics / Treatments		Leaves															
		Calcium (mg/g) D.w				Magnesium (mg/g) D.w				Iron (mg/g) D . w				Boron (mg/g) D.w			
		Days after sowing															
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control	00.00	7.40	7.80	7.80	7.85	1.44	1.76	1.76	1.78	2.44	2.29	2.40	2.33	0.90	0.096	0.097	0.100
Potassium	500 ppm	8.20	8.40	8.40	8.80	3.00	3.06	3.06	3.05	3.12	3.64	3.62	4.31	0.078	0.153	0.158	0.136
	1000 ppm	10.02	11.26	12.20	12.60	3.20	3.32	3.08	3.06	5.41	5.45	5.17	5.34	0.134	0.126	0.139	0.139
Iron	200 ppm	11.00	12.00	12.40	12.50	2.36	3.40	3.40	3.52	3.45	4.24	4.15	4.87	0.090	0.097	0.119	0.120
	400 ppm	14.20	15.05	16.20	16.31	3.28	4.32	4.32	4.20	4.12	4.33	4.47	5.46	0.119	0.100	0.106	0.133
Boron	20 ppm	9.05	9.50	9.74	10.10	4.10	4.32	5.00	5.32	4.04	4.45	4.36	4.69	0.126	0.115	0.154	0.176
	40 ppm	9.50	9.80	10.10	10.40	4.16	5.40	5.80	6.16	4.99	5.17	5.23	5.45	0.100	0.165	0.169	0.193
Citric acid	500 ppm	8.80	8.90	8.95	9.20	3.00	3.44	3.20	3.80	4.88	5.16	5.33	5.60	0.099	0.120	0.123	0.119
	1000 ppm	8.90	9.02	9.15	9.35	3.32	3.35	3.76	3.92	4.44	5.41	5.88	5.90	0.109	0.101	0.155	0.163

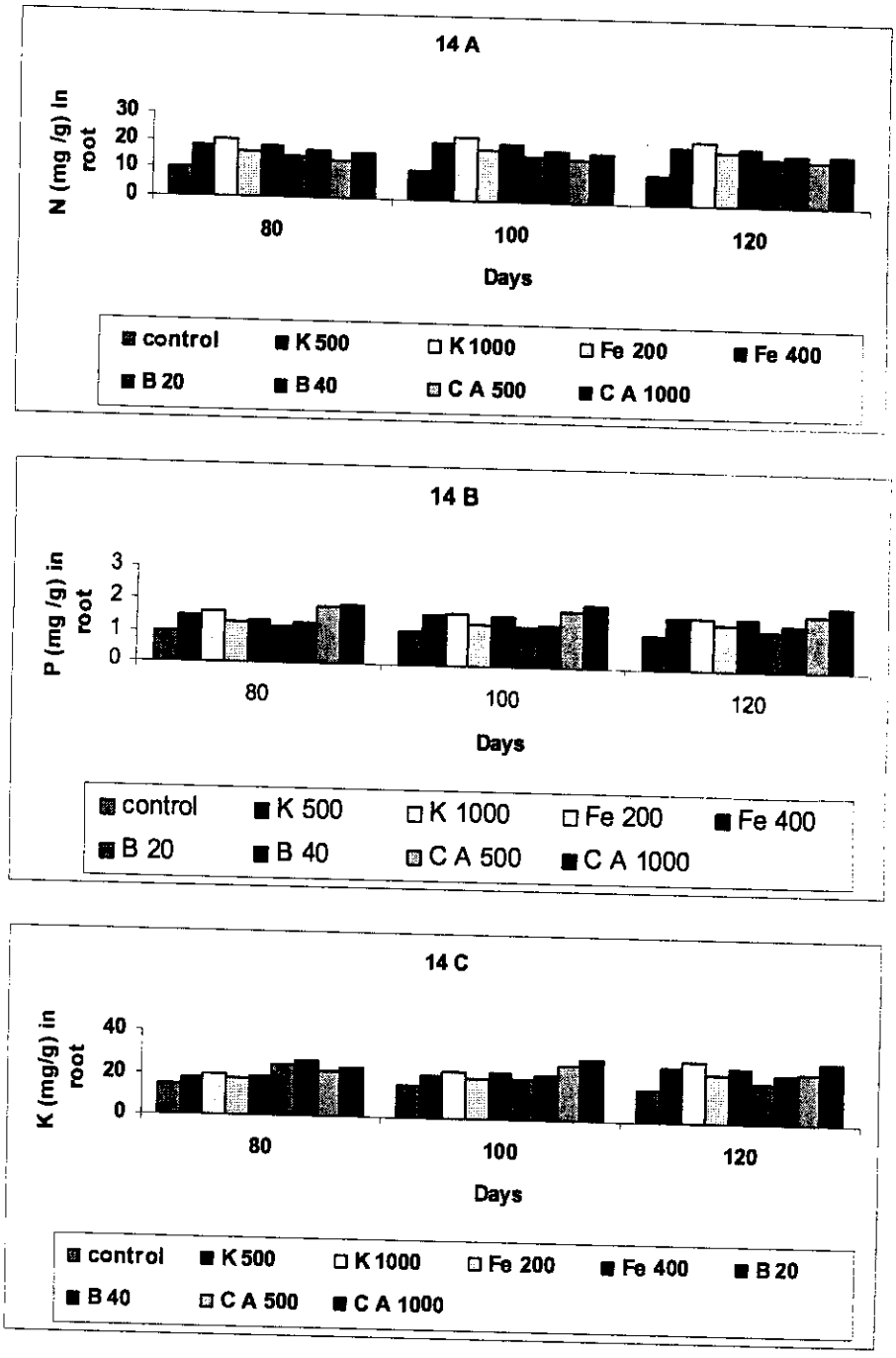


Fig. (15) (a-b-c) Effect of foliar application with some nutrients and citric acid on nitrogen, phosphorus and potassium (mg/g D.w) in root of sugar beet (*Beta vulgaris L*)plant at 80,100and120 days after sowing during 2007

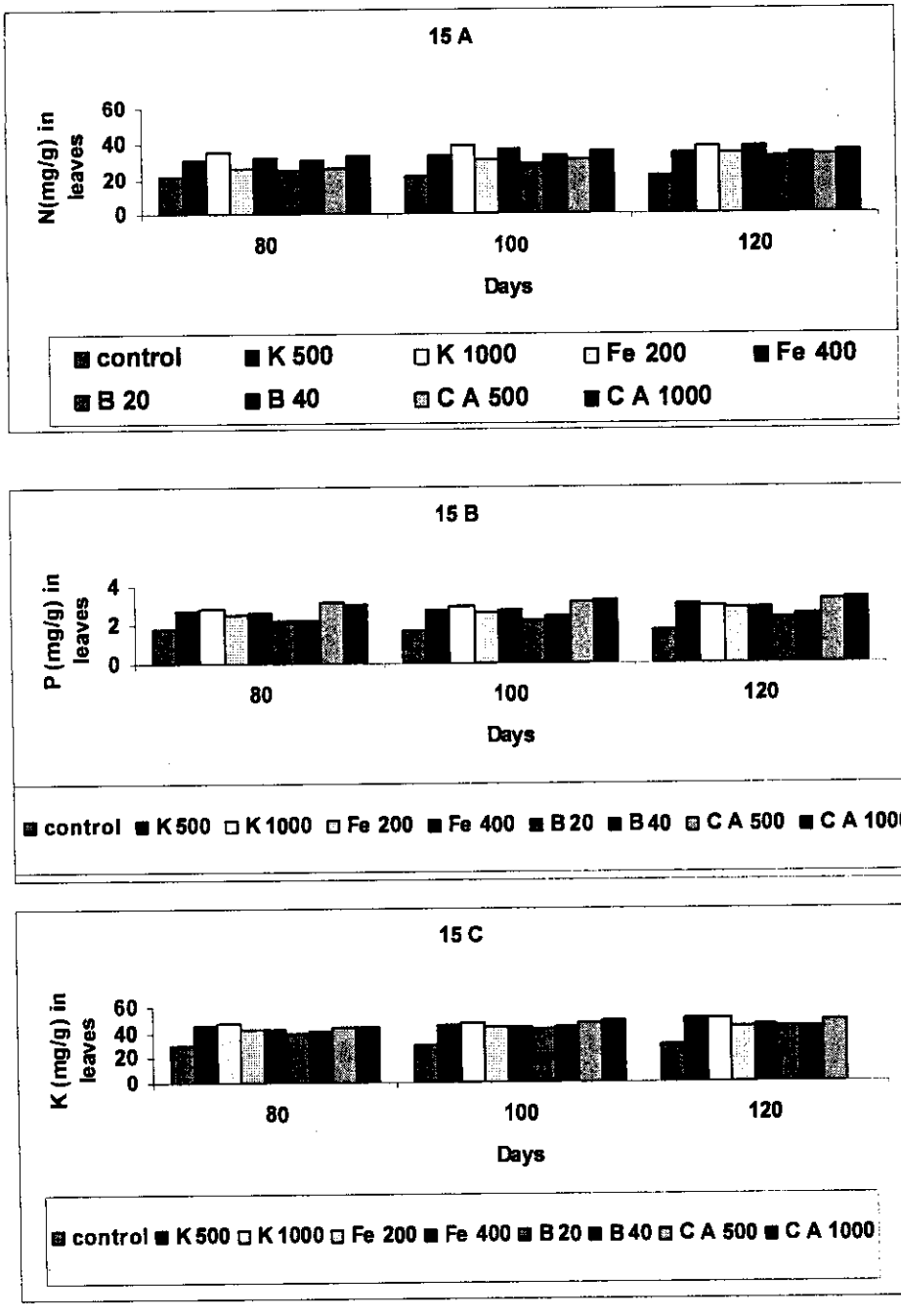


Fig. (16) (a-b-c) Effect of foliar application with some nutrients and citric acid on nitrogen, phosphorus and potassium content of sugar beet (*Beta vulgaris L*) plant at 80,100and120 days after sowing during 2007 season

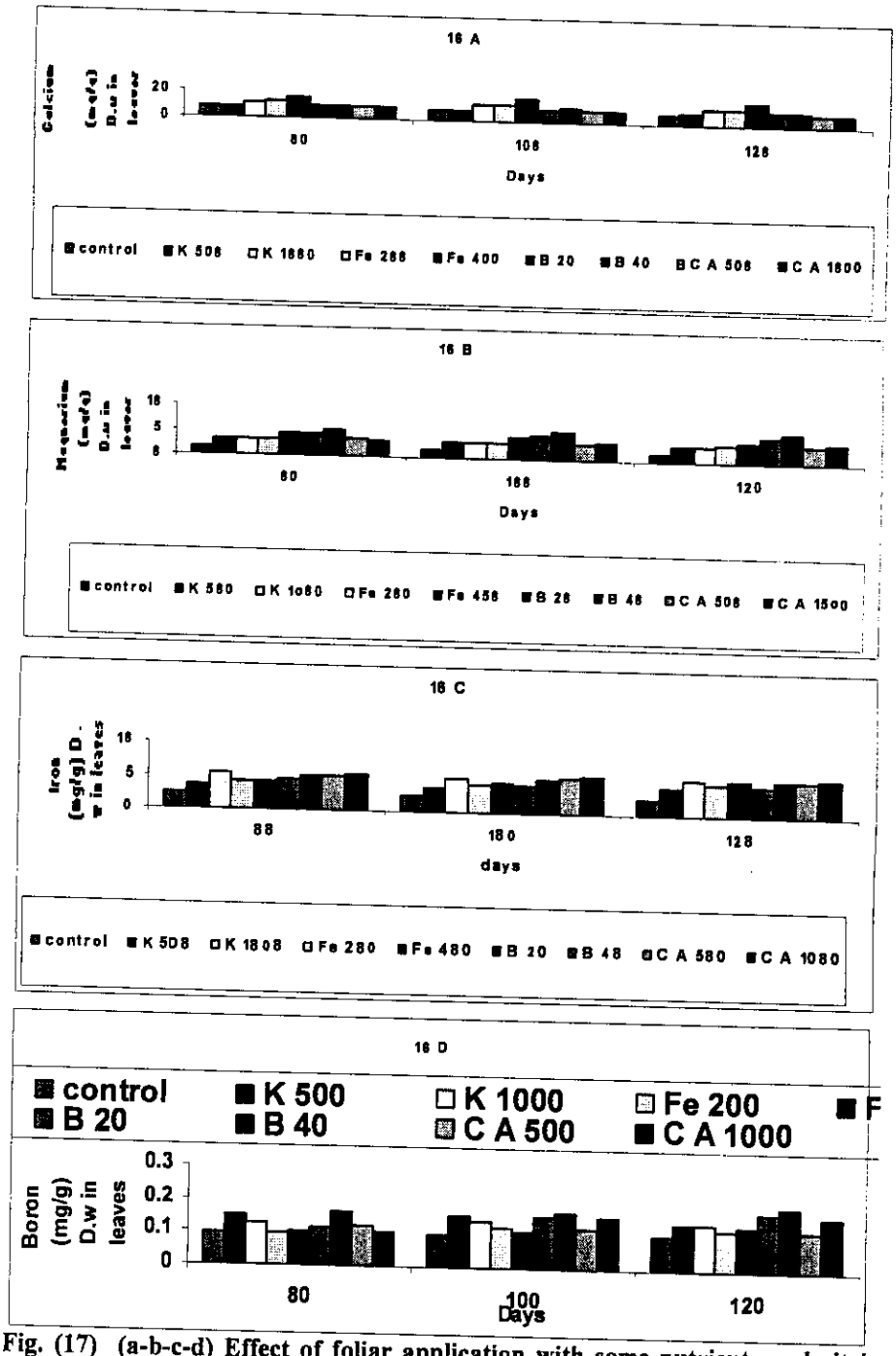


Fig. (17) (a-b-c-d) Effect of foliar application with some nutrients and citric acid on calcium ,magnesium, iron and boron concentration in leaves of sugar beet (*Beta vulgaris L*) plant at 80,100 and 120 days after sowing during 2007 season

In this respect, boron has a major influence on plasmamembran of plant cells and ion transport and that B amendment increased N, K, Ca and Mg levels in soybean leaves. Also **Davis *et al.* (2003)** mentioned that boron application was associated with increased tomato growth, uptake and tissue concentration of N, Ca, K and B.

3. Sugars, carbohydrates and crude protein concentration in leaves:

As shown in Table (20 & 21) and figs(18, a, b, c) and (19, a, b, C) it could be clearly noticed that total sugars (reducing and non reducing) and total carbohydrates in leaves were increased with different applied treatments at 80, 100 and 120 days after sowing during 2007 season when compared with the control treatment.

As for total sugars and their fractions, boron at 40 ppm gave the highest values followed by potassium at 1000 ppm treatment during 2007 season. Meanwhile, Iron at 200 ppm gave the lowest values in this respect.

Concerning the total carbohydrates concentration it was behaved as the same as the total sugars.

Also, it could be the noticed that application of boron at 40 ppm gave the highest carbohydrates concentration in leaves of sugar beet at 80, 100 and 120 days after sowing during 2007 season.

In this respect, high concentration of total carbohydrates is a direct result for high rates of photosynthesis with great efficiency. That was preceded with large photosynthetic area (Tables 10&11) and high concentration of photosynthetic

pigments (Table, 16) as well under the treatment of various foliar sprayed but it reached its maximum with boron one.

This result are in agreement with those reported by **Abd-El-Hamid *et al.* (1992) and (1997)**, they concluded that foliar applications of potassium alone or with micronutrients increased the amount of carbohydrates and crude protein in roots and leaves of fodder beet plants, also **Marschner (1995)** pointed out that K, Fe and B effects Carbohydrates and protein metabolism through its role as an activator of several enzymes involved in metabolic reactions.

With regard to the protein concentration, it could be noticed that boron at 40ppm treatment gave the highest increase in leaves of sugar beet plants at 80, 100 and 120 days after sowing followed by potassium at 1000 ppm during 2007 season. In addition these data being more evident when related to the control ones.

Also, potassium is required for N uptake and protein synthesis in plants. The total N uptake is usually lowered and protein synthesis was reduced in K deficient plants, as indicated by a buildup of amino acids. The involvement of K is needed for ATP for both processes.

The results are in agreement with those obtained by **Abd-El-Hamid (1992) and (1997)** on fodder beet plant. And **Wanas (2006)** on squash plants. Also, in this connection, **Dolya (1971)** stated that spaying beet plant with boron and zinc increased Nitrogen and protein level in sugar beet leaves.

Tisdal and nelson (1975) attributed such increases in sugar beet plants as a result of foliar application with k may

Table (20) Effect of foliar application with some nutrients and citric acid on total sugars, reducing sugar and non reducing sugar content in leaves of sugar beet *(Beta vulgaris L.)* at 60, 80, 100and120 days after sowing during 2007 seasons.

Characteristics / Treatments		Leaves											
		Total sugars (mg/g) D.w				Reducing sugars (mg/g) D.w				Non reducing sugars (mg/g) D.w			
		Days after sowing											
		60	80	100	120	60	80	100	120	60	80	100	120
Control	0.0 ppm	0.39	0.37	0.39	0.38	0.12	0.12	0.13	0.12	0.27	0.35	0.26	0.26
Potassium	500 Ppm	0.78	0.79	0.81	0.79	0.27	0.29	0.31	0.29	0.51	0.50	0.50	0.40
	1000 Ppm	0.83	0.91	0.95	0.93	0.30	0.31	0.32	0.31	0.53	0.60	0.63	0.62
Iron	200 Ppm	0.57	0.60	0.62	0.60	0.22	0.23	0.24	0.23	0.35	0.37	0.38	0.37
	400 Ppm	0.62	0.65	0.67	0.66	0.22	0.24	0.25	0.24	0.40	0.41	0.42	0.42
Boron	20 Ppm	0.99	0.99	1.02	1.00	0.41	0.42	0.43	0.43	0.58	0.57	0.59	0.57
	40 Ppm	1.03	1.07	1.13	1.08	0.43	0.46	0.49	0.46	0.60	0.61	0.62	0.62
Citric acid	500 Ppm	0.67	0.69	0.72	0.70	0.25	0.27	0.28	0.27	0.42	0.42	0.44	0.43
	1000 Ppm	0.78	0.76	0.79	0.75	0.27	0.29	0.30	0.29	0.41	0.48	0.49	0.46

Table (21) Effect of foliar application with some nutrients and citric acid on total carbohydrate and crude protein content in leaves of sugar beet *(Beta vulgaris L.)*plants at 60, 80, 100 and 120 days after sowing during 2007 seasons.

Characteristics / Treatments		Total carbohydrate in leaves								Crude protein in leaves							
		(mg/g) D .w				% relative to the control				(mg/g) D .w				% relative to the control			
		Season 2007															
		Days after sowing															
		60	80	100	120	60	80	100	120	60	80	100	120	60	80	100	120
Control		8.95	9.60	9.42	9.50	100.00	100.00	100.00	100.00	13.50	13.62	13.68	13.50	100.00	100.00	100.00	100.00
Potassium	500ppm	14.60	13.30	13.70	13.85	163.12	138.54	145.43	145.78	21.25	17.06	19.18	21.25	125.25	140.20	157.40	158.99
	1000ppm	15.16	15.48	15.68	15.80	169.38	161.25	166.45	166.31	24.43	20.50	22.31	24.43	150.51	163.08	180.96	175.58
Iron	200ppm	12.17	12.33	12.55	12.60	135.97	128.43	133.22	132.63	19.68	15.62	16.87	19.68	114.68	123.31	145.77	159.43
	400ppm	14.12	14.50	14.70	14.75	157.76	151.04	156.05	155.26	22.75	18.12	20.00	22.75	133.03	146.19	168.51	176.03
Boron	20ppm	11.23	11.45	11.69	11.70	125.47	119.27	124.09	123.15	18.12	13.75	15.62	18.12	100.95	114.18	134.22	146.53
	40ppm	11.32	11.50	11.64	11.80	126.48	119.79	123.56	124.52	20.62	16.87	19.37	20.62	123.86	141.59	152.74	161.72
Citric acid	500 pm	16.00	16.00	16.10	16.20	178.77	166.66	170.91	170.52	19.50	15.31	16.25	19.50	112.40	118.78	144.44	154.35
	1000ppm	18.25	18.20	18.25	18.90	203.91	189.58	193.73	198.94	22.62	18.25	20.62	22.62	133.99	150.73	167.55	164.08

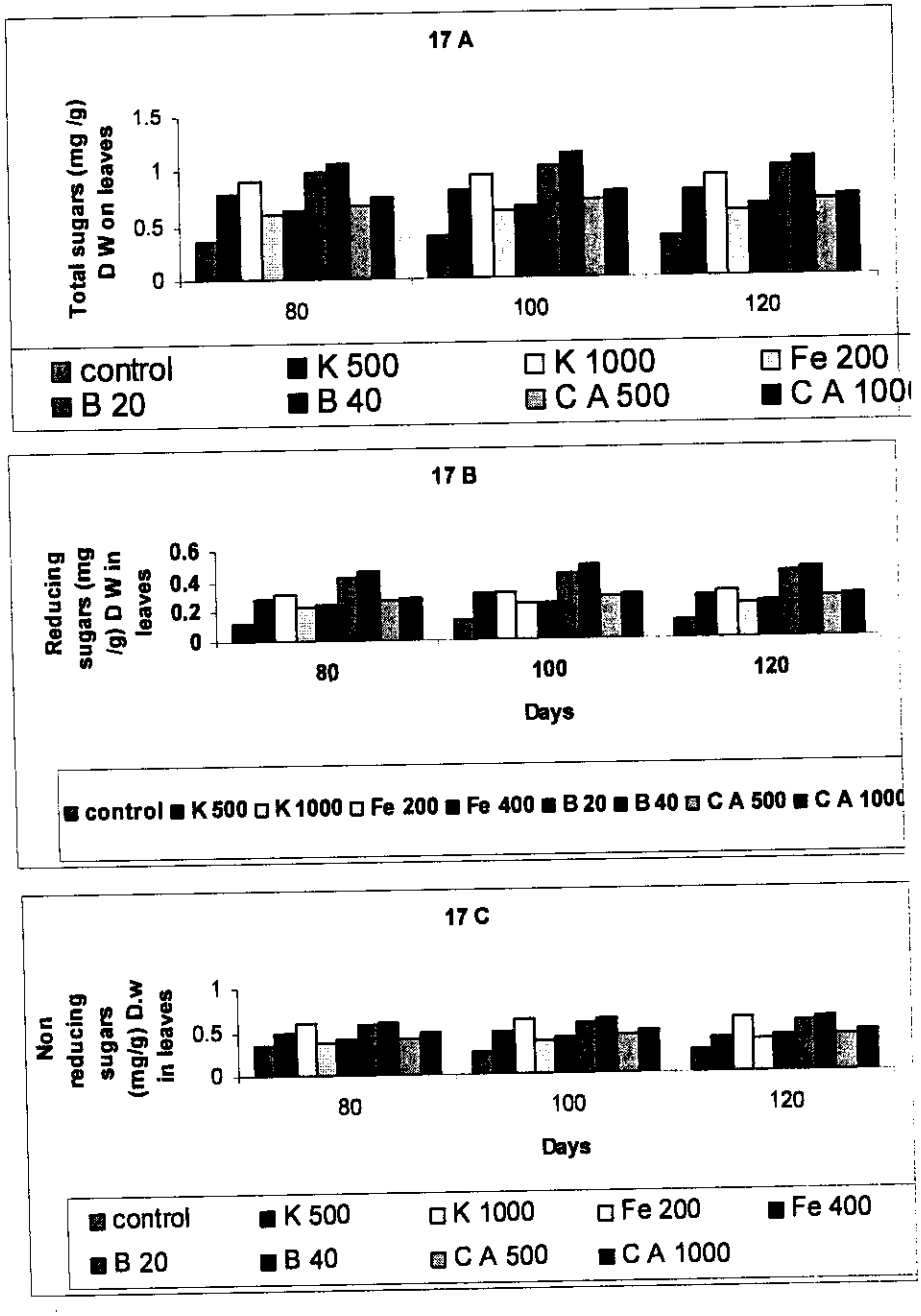
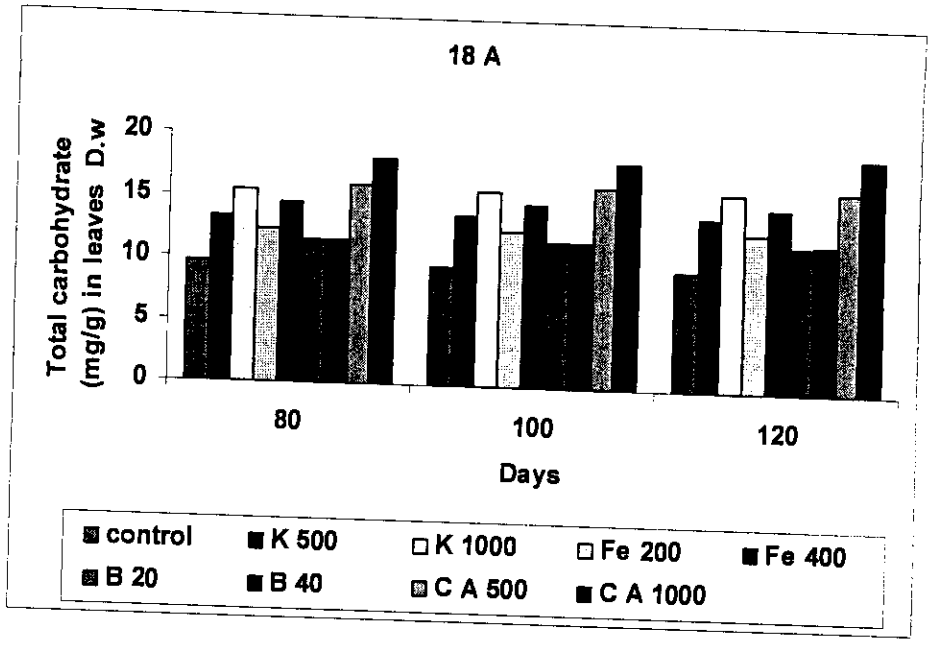


Fig.(18) (a-b-c) Effect of foliar application with some nutrients and citric acid on total sugars, reducing sugar and non reducing sugar content in leaves of sugar beet (*Beta vulgaris L*) at 80,100and120 days after sowing during 2007 seasons



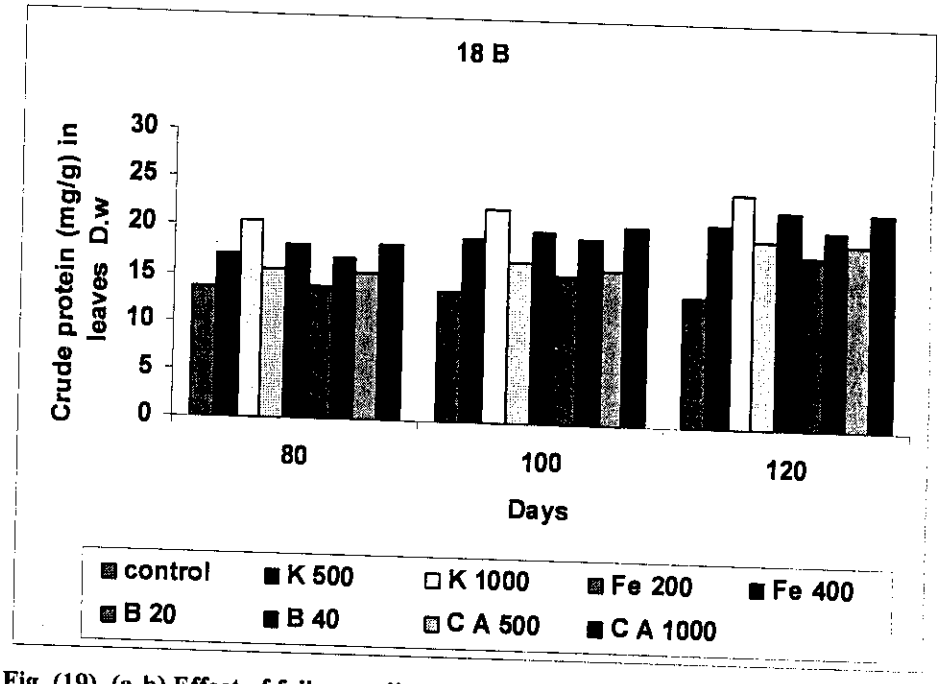


Fig. (19) (a-b) Effect of foliar application with some nutrients and citric acid on total carbohydrate and crude protein in leaves of sugar beet (*Beta vulgaris L*)plants at 80, 100 and 120 days after sowing during 2007 seasons.

be due to one or more of the following physiological functions for k: a) carbohydrates metabolism or formation breakdown and translocation of starch b) control and regulation of activities of various essential elements and c) activation of various enzymes

IV. Disease severity % of cercospora leave spot:

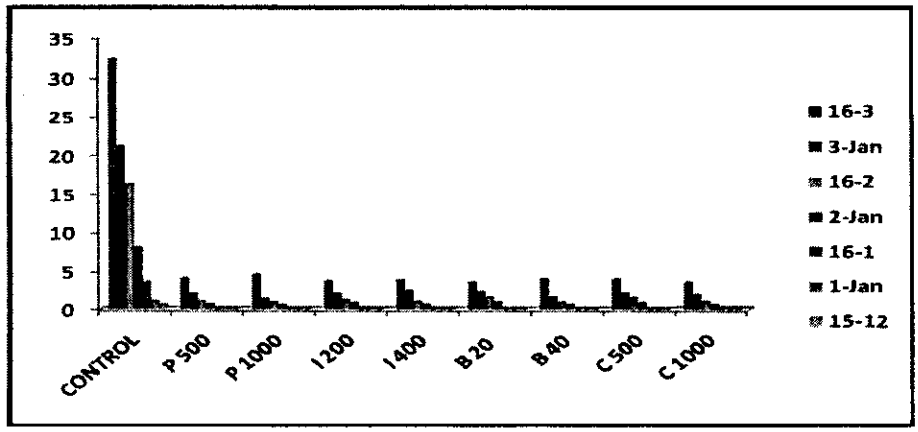
Data in Table (22) and fig (20) show that disease severity % of cercospora leaf spot of sugar beet plants was differed according to estimation period and different treatments. Also, disease severity of cercospora leaf spot was gradually increased till the last period of estimation (180 days), however, severity of infection increased to reach from 7.5 and 8.01 to 30.25 and 32.24% in control plants during 2006 and 2007, respectively. Moreover, all different applied treatments were decreased the disease severity of cercospora leaf spot. This severity % decreased from 0.5 to 0.7%, 1.6 to 1.5%, 2.4 to 20% and 4 to 32% respectively at fourth period of estimation.

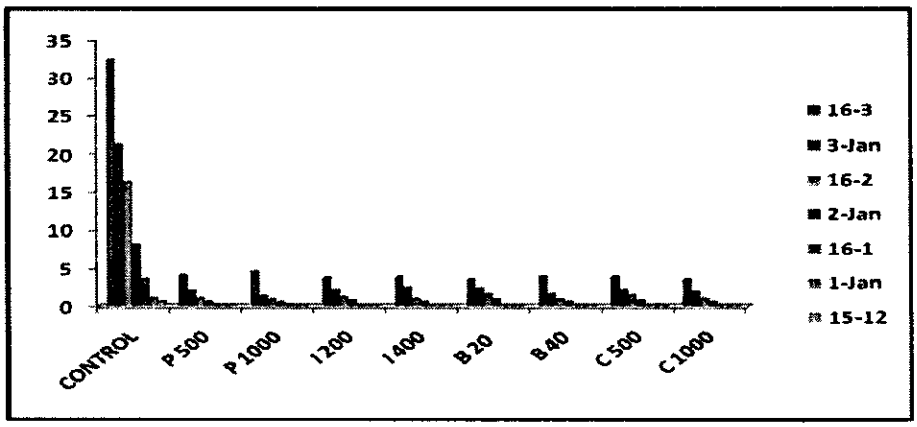
The lowest values of disease severity were recorded with potassium at 1000ppm at 1st, 2nd and 3rd periods in both seasons when compared with to other treatments followed by boron at 40ppm and citric acid at 500ppm.

These results are in agreement with the previous findings by **Siebold (1980), Piszczek (2001)**. Sodium and K extruded on the surface of sugar beet leaves led to decrease the induction with powdery mildew in young leaf. Also, the low K on leaf surface of old leaves and high in young leaf may be the inducer factor to systemic protection in young leaf and lead to more

Table (22) Estimation of disease severity% (cercospora leaf spot) of sugar beet (Beta vulgaris L.)plant as affected by foliar application of potassium ,boron, iron and citric acid every 15 days in leaves during two seasons (2006-2007) .

Characteristics / Treatments		Estimation of disease severity every 15 days in leaves													
		disease severity% (2006) season							disease severity% (2007) season						
		75	90	105	120	135	150	165	75	90	105	120	135	150	165
Control	0.0 ppm	0.5	1.00	3.02	7.50	15.60	20.14	30.25	0.6	1.02	3.50	8.01	16.20	21.03	32.24
Potassium	500 Ppm	0.00	0.00	0.00	0.50	1.00	1.50	3.00	0.00	0.00	0.00	0.60	1.00	2.01	4.02
	1000 Ppm	0.00	0.00	0.00	0.00	0.90	1.35	2.50	0.00	0.00	0.00	0.50	0.90	1.35	4.50
Iron	200 Ppm	0.00	0.00	0.00	0.70	1.20	2.05	3.50	0.00	0.00	0.00	0.80	1.20	2.05	3.70
	400 Ppm	0.00	0.00	0.00	0.60	1.00	2.40	3.12	0.00	0.00	0.00	0.60	1.00	2.40	3.82
Boron	20 Ppm	0.00	0.00	0.00	0.50	1.60	2.30	3.20	0.00	0.00	0.00	0.90	1.60	2.30	3.50
	40 Ppm	0.00	0.00	0.00	0.50	0.90	1.60	3.01	0.00	0.00	0.00	0.60	0.90	1.60	3.91
Citric acid	500 Ppm	0.00	0.00	0.00	0.60	1.50	2.10	2.90	0.00	0.00	0.00	0.80	1.50	2.10	3.90
	1000 Ppm	0.00	0.00	0.00	0.50	1.00	1.90	2.50	0.00	0.00	0.00	0.60	1.00	1.90	3.50





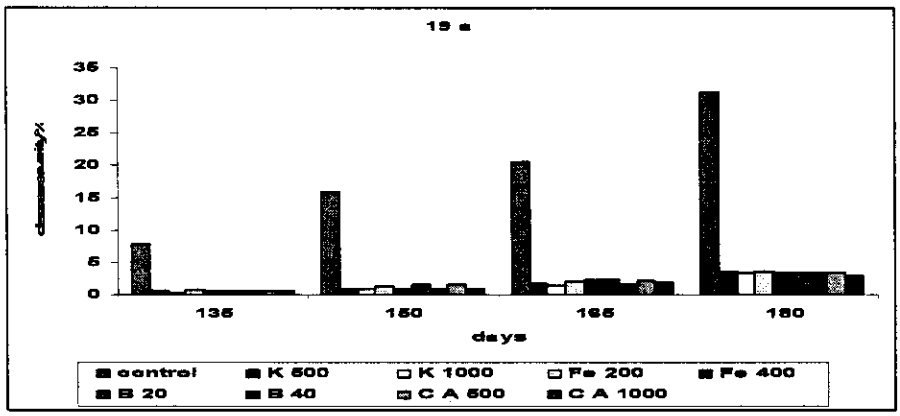


Fig. (20, a-b). Effect of some nutrients and citric acid on disease severity% (cercospora leaf spot) of sugar beet (Beta vulgaris)/plant as affected by foliar application of potassium ,boron, iron and citric acid every 15 days in leaves during two seasons (2006-2007) .

resistant to powdery mildew. Also the percentage of conidia germination decreased with increasing the concentration of NaCl or KCl in vitro study. This might be due to the toxicity of Na^+ and K^+ against Erysiphebetae **(Esia *et al.* 2000).**

Also, **Tomader (2005)** suggested that catechol or ascorbic acid may act as effective in induceing disease resistance in plants.

V: Yield characteristics:

Data in Table (23 & 24) and figs (21, a, b, c) and (22, a, b, c) indicate the effect of K, Fe, B and citric acid on yield of root and leaves of sugar beet plants at harvest during 2006 and 2007 seasons.

As for root fresh weight per plant, its significant increase existed with different applied treatments during the two seasons when compared with the control. Also it could be noticed that foliar application with boron at 40 ppm ranked the first in this respect followed by potassium at 1000ppm, citric acid at 1000 ppm and iron at 400 ppm during the two seasons.

With regard to the fresh weight of leaves at harvest, it was high significantly increased with potassium at 1000 ppm treatment meanwhile boron at 40 ppm during 2006 season only. Also, it was significantly increased at 5% level with different other treatments.

As shown in Table (24) the sucrose %, total soluble solids % and juice purity% on root quality of sugar beet plants at harvest during 2006 & 2007 season.

Table (23) Effect of foliar application with some nutrients and citric acid on yield (fresh weight of Roots, Leaves and total fresh weight (K.g)/plant) of sugar beet *(Beta vulgaris L.)* Plants during 2006 and 2007 seasons

Characteristics / Treatments		Roots				Leaves				Total fresh weight (k/g) /plant			
		Fresh weight (k.g) /plant		% relative to the control		Fresh weight (k.g) /plant		% relative to the control		(k.g)/plant		% relative to the control	
		seasons											
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Control	0.0 ppm	1.55	1.58	100.00	100.00	0.883	0.733	100.00	100.00	2.433	2.313	100.00	100.00
Potassium	500ppm	2.31	2.27	149.03	143.67	1.033	0.966	116.98	131.78	3.343	3.236	137.40	139.90
	1000ppm	2.56	2.72	165.16	172.15	1.367	1.500	154.81	204.63	3.927	4.220	161.40	182.44
Iron	200ppm	2.50	1.98	161.29	125.31	0.750	0.958	84.93	130.69	3.250	2.938	133.57	128.96
	400ppm	2.61	2.71	168.38	171.51	1.175	1.222	133.06	166.71	3.785	3.932	155.56	169.99
Boron	20ppm	2.44	2.62	157.41	165.82	1.192	1.180	134.99	160.98	3.632	3.800	149.28	164.28
	40ppm	2.56	2.79	165.16	176.58	1.193	1.227	135.10	121.69	3.753	4.017	154.25	173.67
Citric acid	500ppm	1.64	1.64	105.80	103.79	0.891	0.892	106.56	117.05	2.531	2.532	104.02	109.46
	1000 ppm	2.40	2.41	154.83	152.53	0.941	0.858	123.78	167.39	3.341	3.268	137.32	141.28
L.S.D.	%5	0.71	0.46			0.273	0.232			0.467	0.474		
	%1	0.98	0.63			0.377	0.320			0.644	0.653		

Table (24) Effect of foliar application with some nutrients and citric acid on root quality (sucrose, total soluble solid and juice purity percentage) in of sugar beet *(Beta vulgaris L.)* plants at harvest during 2006 and 2007 seasons.

Characteristics / Treatments		Root quality											
		Sucrose (%)		% relative to the control		Total soluble solid (%)		% relative to the control		Juice purity (%)		% relative to the control	
		seasons											
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Control	00.00	16.70	16.89	100.00	100.00	24.00	24.26	100.00	100.00	69.58	69.63	100.00	100.00
Potassium	500 ppm	19.21	19.50	115.02	115.45	25.00	25.33	104.16	103.25	76.84	76.98	102.85	104.68
	1000 ppm	20.44	20.67	122.39	122.38	25.97	26.43	104.16	108.94	78.70	78.20	113.10	112.30
Iron	200 ppm	18.85	18.87	112.87	111.72	25.00	25.28	104.16	104.20	75.40	74.64	108.31	107.23
	400 ppm	19.69	19.60	117.90	116.04	25.48	26.45	106.16	109.02	77.27	74.10	111.03	106.41
Boron	20 ppm	18.11	18.21	108.44	107.81	25.00	25.05	108.20	108.53	72.44	72.69	104.05	104.39
	40 ppm	20.36	20.62	121.91	122.08	25.94	26.38	108.08	108.73	78.48	78.16	112.76	112.25
Citric acid	500 ppm	17.70	17.96	105.98	106.33	25.47	25.47	106.12	104.98	69.49	70.51	99.81	101.26
	1000 ppm	18.57	18.32	111.19	108.46	25.27	25.25	105.29	104.08	73.48	72.55	105.54	104.19
L.S.D.	%5	0.616	0.877			0.563	0.715			2.04	2.64		
	%1	0.849	1.209			0.776	0.986			2.81	3.64		

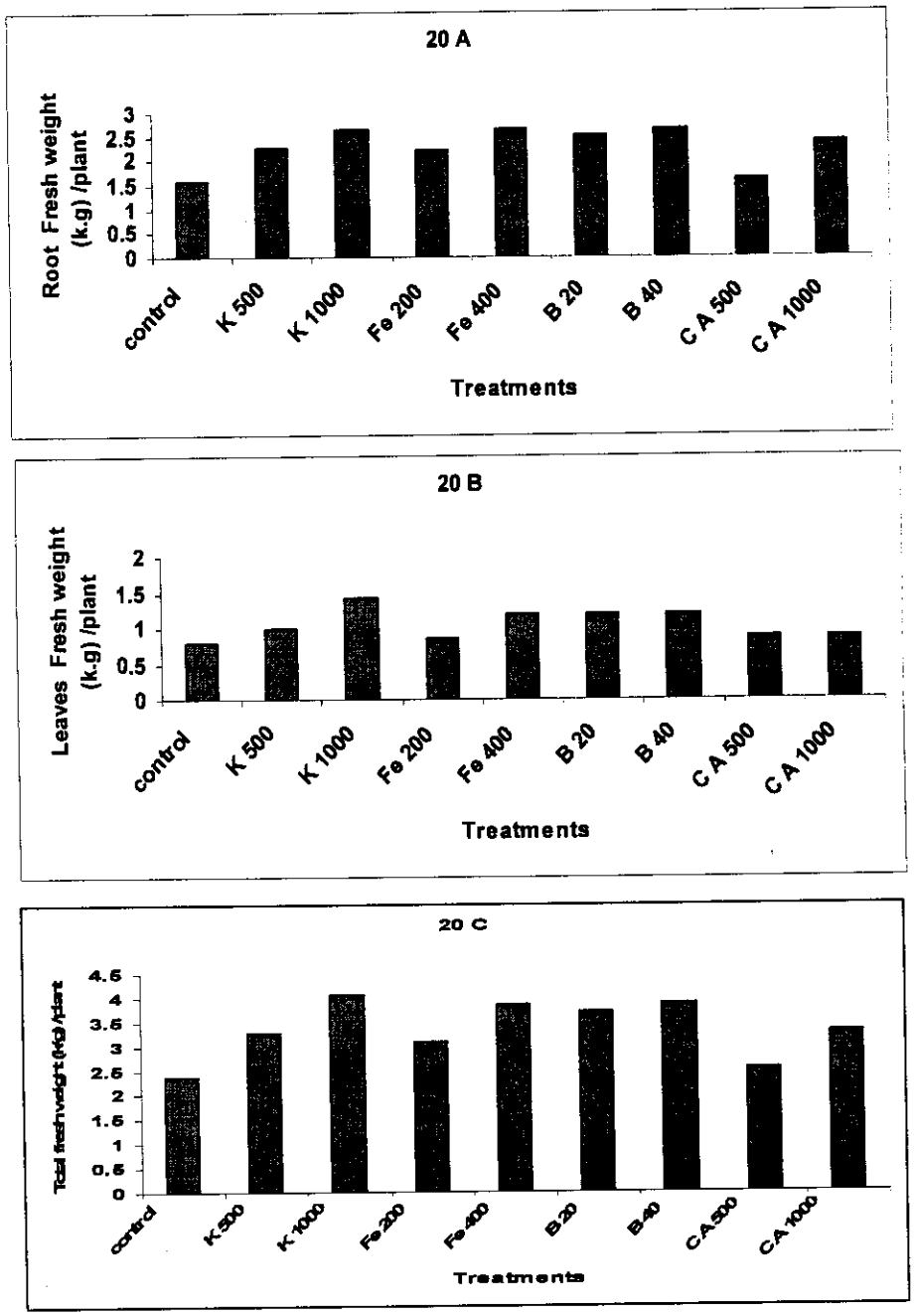
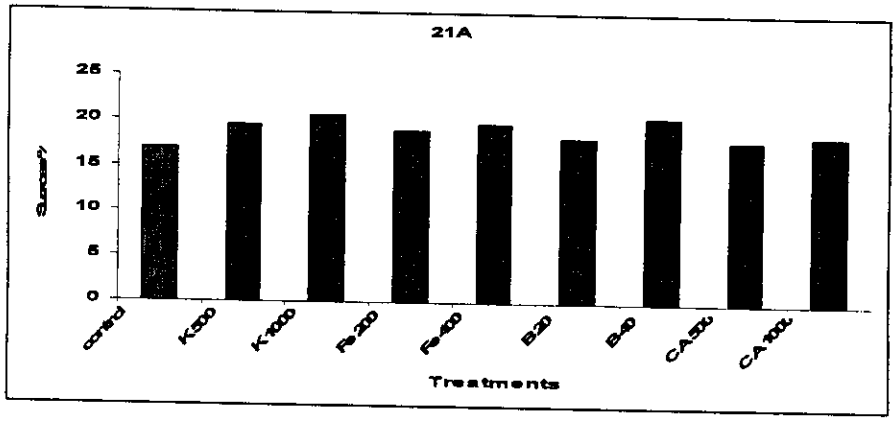
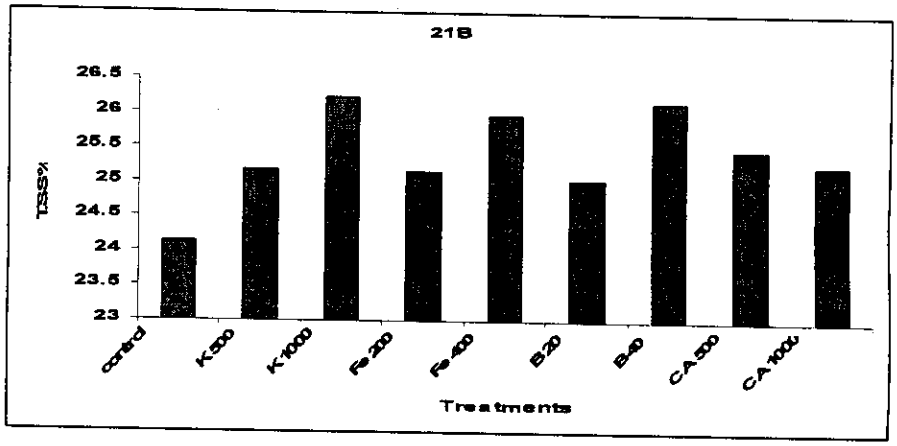


Fig. (21, a-b-c). Effect of foliar application with some nutrients and citric acid on fresh weight (Roots and Leaves) and total fresh weight of sugar beet (*Beta vulgaris L*) plants during of two seasons 2006





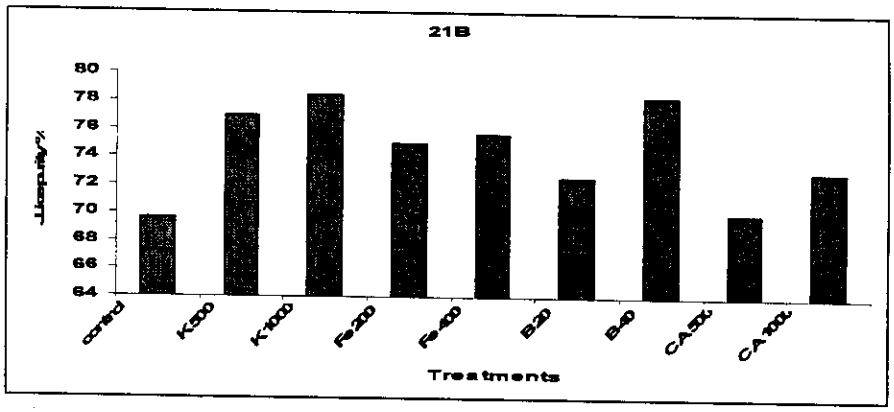


Fig.(22, a-b-c). Effect of foliar application with some nutrients and citric acid on (sucrose, total soluble solids and juice purity) percentage in root quality of sugar beet (*Beta vulgaris L*) plants at harvest during 2006 and 2007 seasons

With regard to sucrose% it was high significantly increased during the two seasons with different applied foliar treatments. The exception was that significant increase only at 5% level with citric acid at 500ppm during 2007 season.

Regarding, total soluble solids% it could be noticed that, nearly behaved as the same as the sucrose%. Since, the potassium and boron treatments gave the highest values when compared with the control.

In addition, high significant increases were existed in juice purity% with different foliar application treatment. The exception was that significant increase with boron at 20ppm and citric acid at 500ppm during 2006 season.

The results emphasized that the amount of root yield, root dry matter and nutrients uptake were significantly higher in the combined treatment (Fe) than the other treatments and reached a maximum with Fe-chelated form. Little increase in carbohydrates was found by Fe addition. the interaction effect of (Fe). Was significant in increasing T.S.S. (T/fed). **Negm and Hassan (1998).**

Vi- Relationship between disease severity % and root yield and quality

In this respect, it could be suggested that, the positive effect of Data in **Tables** (25 and 26) and figs (23 and 24) show the effect of various foliar application of K, Fe, B and Citric acid on relationship between disease severity % and total fresh weight (root and leaves) and root quality of sugar beet plants at 120 and 200 days after sowing average of two seasons.

As for disease severity, was decreased with different applied treatments. Also, potassium at 1000 ppm gave the lowest value of disease severity% followed by boron at 40 ppm, potassium at 500 ppm and citric acid at 1000ppm at 120 days after sowing. Meanwhile, at harvest time citric acid at 1000ppm gave the lowest value of disease severity % followed by boron at 40ppm and potassium 1000ppm respectively.

Moreover, various applied treatments were increased total fresh weight (root and leaves) of sugar beet plants at 120 days after sowing average two seasons.

Also, foliar application with boron at 40 ppm at 120 days gave the highest mean values of T.S.S.% that reached 24.00% which ranked the first, followed by potassium at 1000ppm but foliar application with potassium at 1000ppm which ranked the first at harvest in the respect.

Generally, sugar beet under foliar treatments gave not only the highest vigorous growth in the early stage but also increased root yields and the improvement of root quality. Also, disease severity was decreased with different foliar application treatments.

From these results, a positive correlation between decreasing disease severity % and increasing root yield and root quality was obtained by K at 1000ppm application when compared with untreated plants.

This result are in agreement with those reported by, **Bondok (1996), El-Hawary (1999), Neamat-Alla *et al.* (2002), Ibrahim *et al.* (2002), Kudzho *et al.* (2002), Ismael and El-Ghait (2004), Osman (2006), and Elamin *et al.* (2007).**

Table (25) Effect of foliar application with some nutrients and citric acid on Relationship between disease severtiy of cercospora leaf spot and fresh weight of Roots ,Leaves and Root quality of sugar beet *(Beta vulgaris L.)*Plants at 120 days after sowing average of two seasons.

Characteristics / Treatments		Disease severity %	Root	Leave	Total fresh weight(Root-Leave) g/ plant	Root quality		
			Fresh weight (g)/plant	Fresh weight (g)/plant		Sucrose%	T.S.S %	Purity%
Control	0.0 Ppm	7.75	376.7	727.00	1103.7	14.18	21.67	65.43
Potassium	500 Ppm	0.55	476.65	778.65	1255.3	17.03	22.67	75.12
	1000 Ppm	0.25	684.50	890.85	1575.35	17.41	23.33	74.62
Iron	200 Ppm	0.75	524.3	820.85	1345.15	17.28	22.33	77.38
	400 Ppm	0.60	642.2	755.00	1397.2	17.44	23.16	75.30
Boron	20 Ppm	0.70	533.35	853.35	1386.7	17.10	22.66	75.46
	40 Ppm	0.55	733.70	934.15	1667.85	16.87	24.00	70.29
Citric acid	500 Ppm	0.70	566.15	700.00	1266.15	15.05	21.33	70.55
	1000 Ppm	0.55	661.15	800.65	1461.80	15.25	20.67	73.77

Table (26) Effect of foliar application with some nutrients , citric acid and Relationship between disease severity of cercospora leaf spot and fresh weight of Roots,Leaves and Root quality of sugar beet *(Beta vulgaris L.)*Plants at harvest time average of two seasons.

Characteristics / Treatments		Disease severity %	Root	Leave	Total fresh weight(Root-Leave)kg/ plant	Root quality		
			Fresh weight (kg)/plant	Fresh weight (kg)/plant		Sucrose %	T.S.S %	Purity%
Control	0.0 Ppm	31.24	1.565	0.808	2.373	16.79	24.13	69.58
Potassium	500 Ppm	3.51	2.290	0.999	3.289	19.35	25.16	76.90
	1000 Ppm	3.50	2.640	1.433	4.073	20.55	26.20	78.43
Iron	200 Ppm	3.60	2.240	0.854	3.094	18.86	25.14	75.01
	400 Ppm	3.47	2.660	1.198	3.858	19.64	25.96	75.65
Boron	20 Ppm	3.35	2.530	1.186	3.716	18.16	25.02	72.58
	40 Ppm	3.46	2.675	1.160	3.835	20.49	26.16	78.32
Citric acid	500 Ppm	3.40	1.640	0.891	2.531	17.83	25.47	70.00
	1000 Ppm	3.00	2.405	0.899	3.304	18.44	25.26	73.00

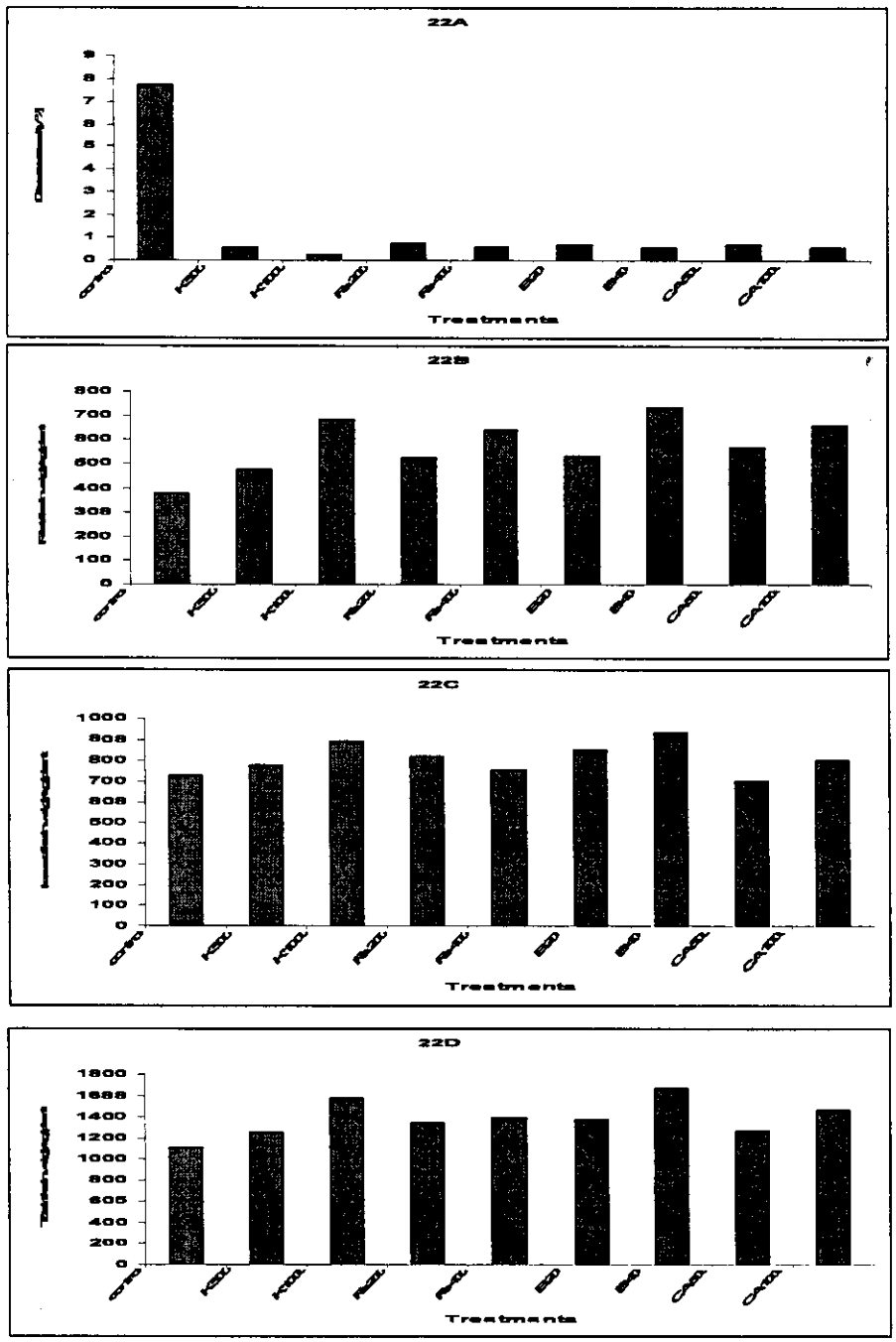


Fig.(23,a-b-c-d) Effect of foliar application with some nutrients and citric acid and Relationship between disease severity leaf spot and fresh weight on Roots, Leaves of sugar beet (Beta vulgaris L.) plants at 120 days after sowing average of two seasons.

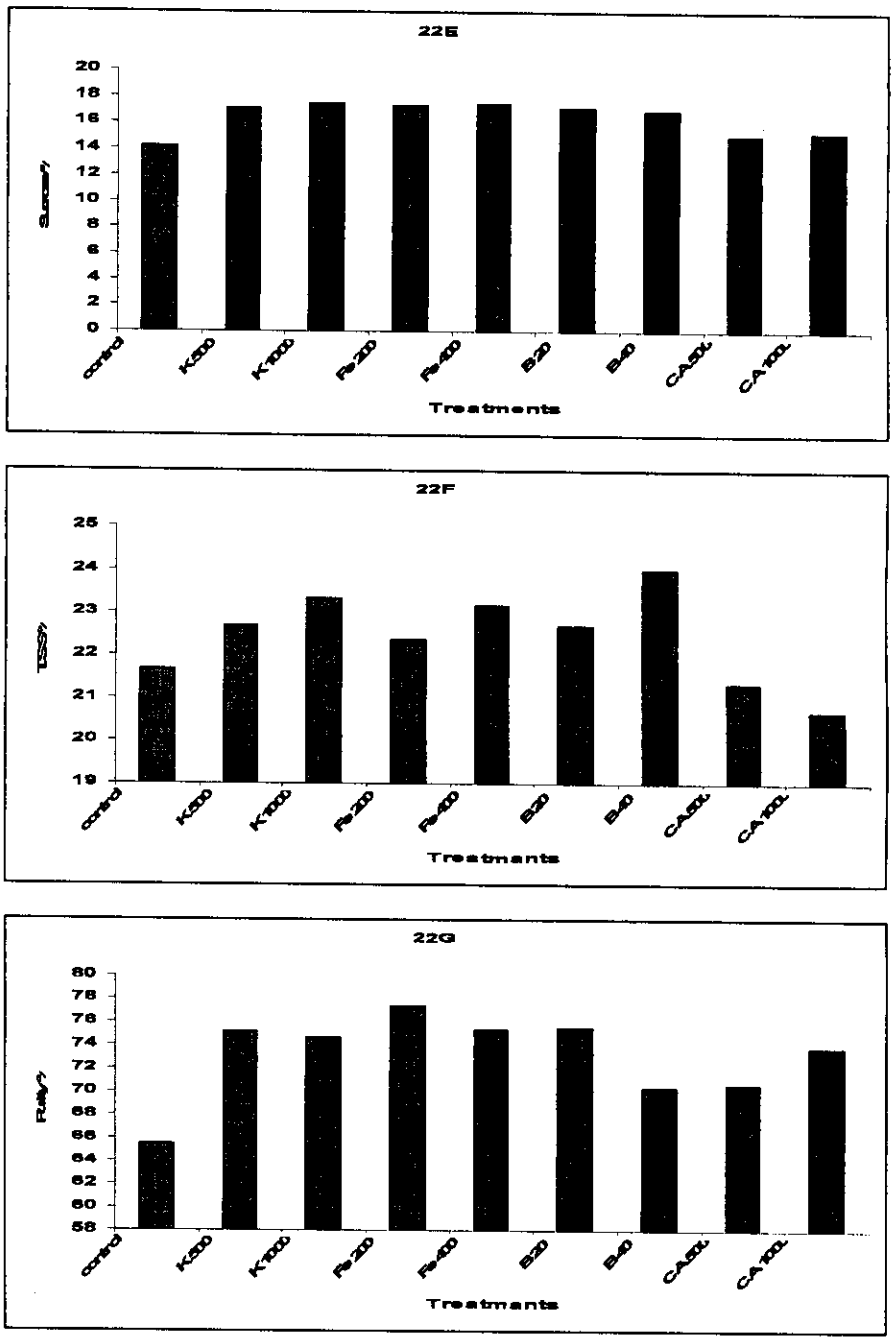


Fig. (23, a-b-c) Effect of foliar application with some nutrients and citric acid and Relationship between disease severity leaf spot and Root quality of sugar beet (*Beta vulgaris L*) plants at 120 days after sowing average of two seasons.

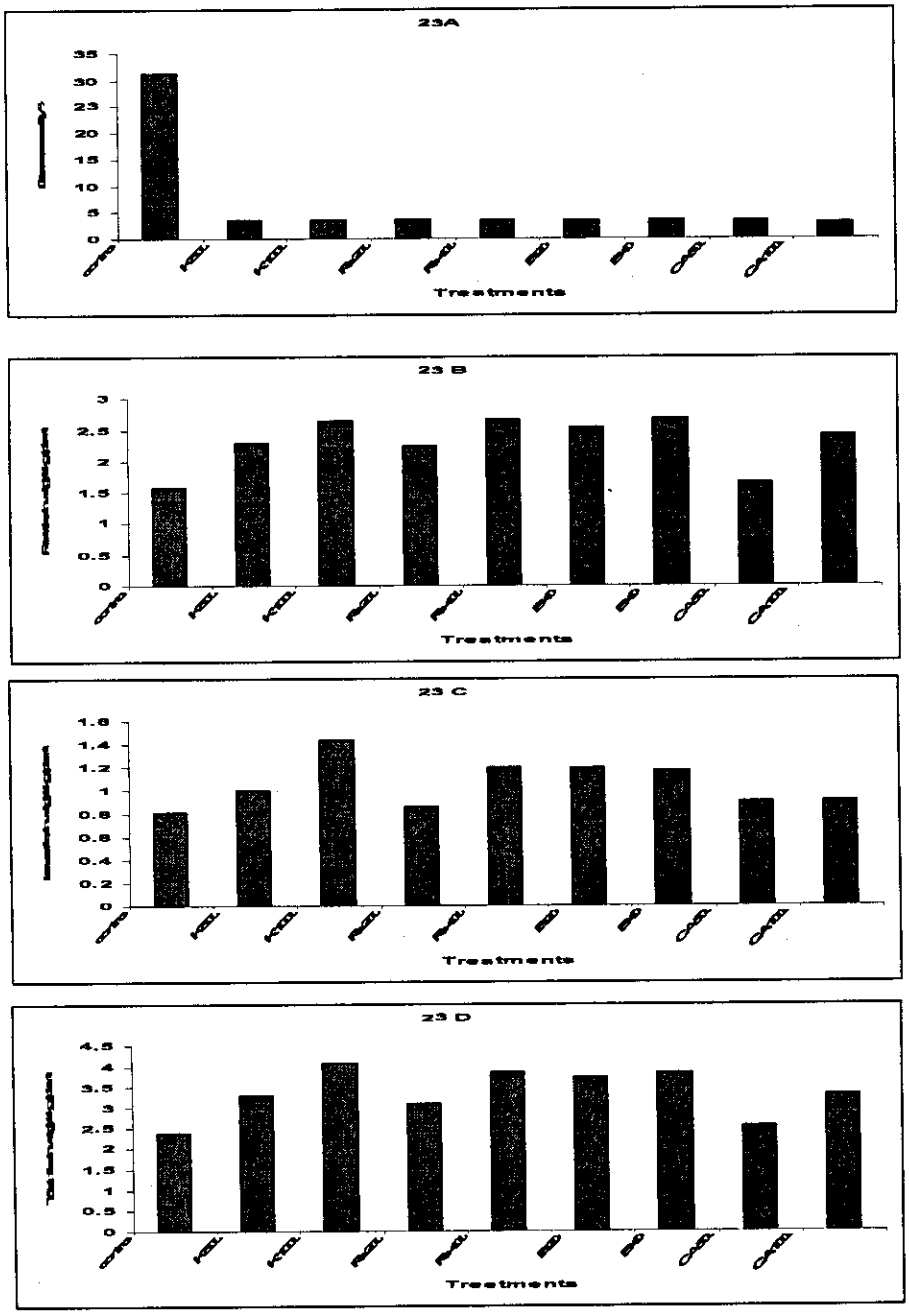


Fig. (24, a-b-c-d) Effect of foliar application with some nutrients , citric acid and Relationship between disease severity leaf spot and fresh weight on Roots, Leaves of sugar beet (Beta vulgaris L.)plants at average of two seasons.

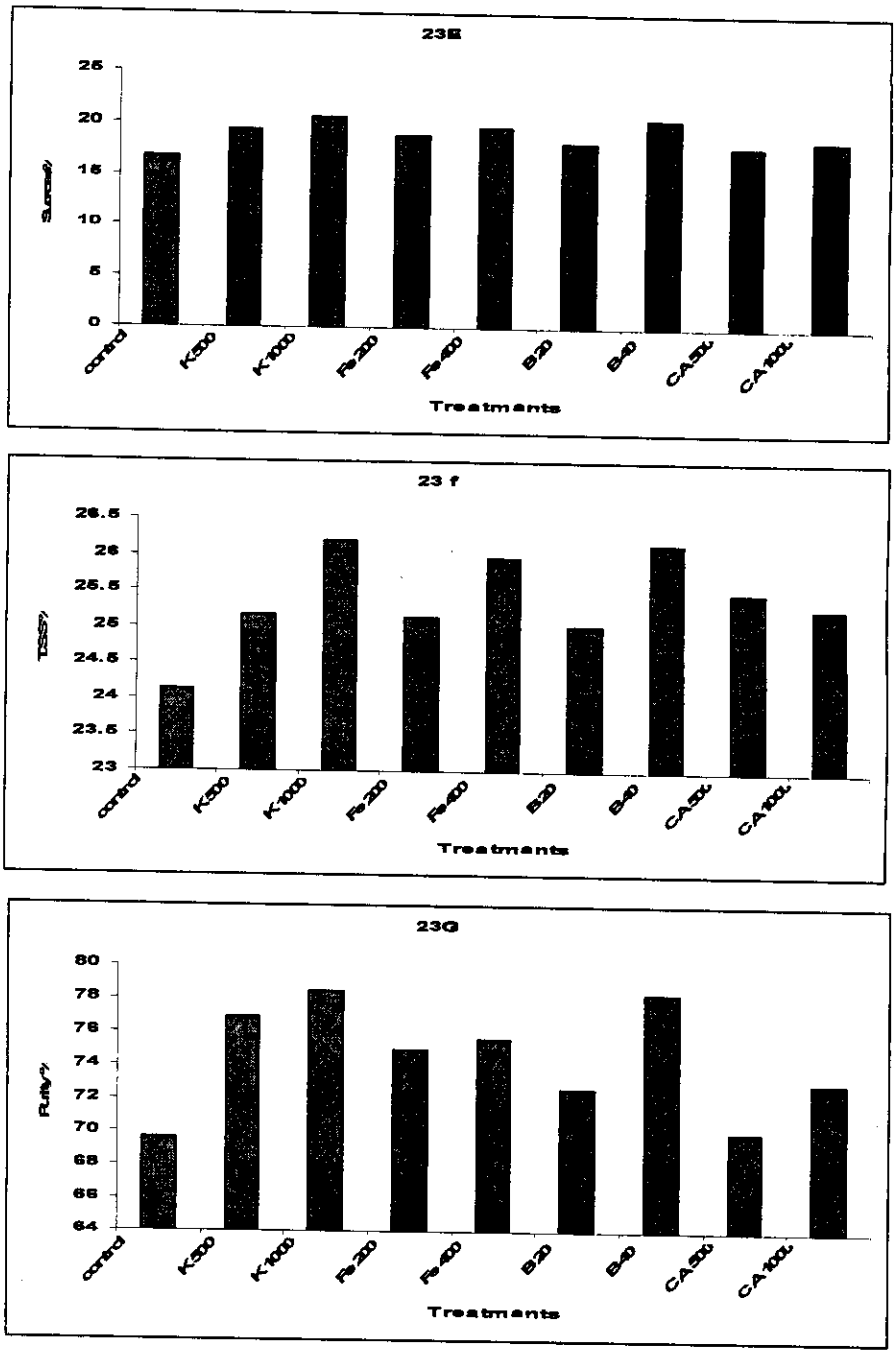


Fig. (24, a-b-c) Effect of foliar application with some nutrients , citric acid and Relationship between disease severity leaf spot and Root quality of sugar beet (Beta vulgaris L.) plants at average of two seasons.

In this respect, the sugar yield at harvest time could be predicted by determining the nutrient status of the leaves during the vegetative growth. is recommended that the most economical fertilizer treatment for sugar beet grown 24 kg K_2O/feddan, which produced the highest sugar yield (approximately 6 t/feddan) and the highest juice purity (78%) **Abd-El-Hadi (2002)** potassium deficiency in plants (maize, sugar beet, wheat) are discussed in detail **Grzebisz *et al.* (2005).**

El–Maghraby *et al.* (1998), found that k at a rate of 0, 24 and 48 k2o/fed fertilizer increased significantly sucrose and purity % of sugar beet plants and **El-Taweel (1999)** mentioned that k application at sugar beet plants form 0 to 24 and 48 kg k2o/fed significantly increased total soluble solids, sucrose and purity %.

In this respect, different concentrations of K, Fe, B and CA increased root fresh weight/plant and sucrose %, these results may be due to the role of boron for translocation carbohydrates from the vegetative to storage organs root in plants.

Furthermore, the presence K, B and CA ions in plants play a role in phloem loading and transport of assimilates as well as enhanced the movement of photosynthates and facilitate sugar transport from the leaves to the roots of sugar beet plants. (In which led to increases the root yield and sucrose present age of the previous results obtained in Tables (23 and 24).

In this respect, it could be suggested that, the positive effect ok K, Fe, B, and citric acid application on the reduction at

disease severity % of cercospora leaf spot may be due to their role to alleviate the adverse effects of Biotic stress conditions (Pathogen infection) via enhancing the interval metabolically protective status by their promotional effect on synthesis of natural protective antioxidants (normal defense mechanisms), their action as cofactors for some specific antioxidant enzymes (i-e dismutdse, catrlase, peroxidesc) their stimulative effect on total phenols and carotenoids synthesis and their act as inducers of disease resistant in plants, such conclusion has reviewed by **Mackersie *et al.*, (1996) and Tomader, (2005).**

In this respect, **Haggag and El-Khair (2007)** reported that, the highest effective natural compounds were antioxidants (i.e. oxalic acid, ascorbic acid and citric acid) that decrease the incidence of potato late and early blights disease and gave increase in oxidative enzyme activities as well as increased tuber yield. The study demonstrated that these natural compounds not only inhibit the blight pathogens but also have an effect in improving the growth and tuber yield of potato plants.

In general, it could be concluded that foliar application of K, Fe, B and citric acid at different concentrations plays an important role in reduction and protection of sugar beet plants against infection with cercospora leaf spot disease.

These sprays should be applied before severe leaf spot disease occurs as these plants appear unable to adequately recover from the morphological or physiological changes resulting from their infection with cercospora leaf spot disease.

It also increases plant growth and root yield and improves root quality (sucrose and purity %) which could reflected upon high yield of root and sucrose % per plant.