Experiment I

RESULTS AND DISCUSSION

Experiment I :

4.1. Effect of GA_3 or IAA at 10 ppm on Germination, Fresh and Dry Weights ,Some Organic Components and Some Nutrient Contents of the Germinated cv. El-Hamawy Apricot Seeds.

The apricot cv. El-Hamawy has an economic value in Egypt due to its fruit quality . Besides, its seed is free from the toxic organic compound that known amygdalin (seeds may be used as a Nut). This local cultivar is mainly propagated by seeds and rarely by grafting.

Generally seeds of this cultivars exhibited very low germinability even though placed under favorable conditions such as water and temperature . Therefore it was thought advisable to investigate the possibility of improving germination of El-Hamway seeds by using the two growth regulators Gibberellic acid (GA_3) and Indole-acetic acid (IAA) separately at the rate of 10 ppm and were used as soaking materials . Seeds of El-Hamawy apricot were carefully mechanically de-coated (without endocarp), then were soaked in the assigned growth regulators for 24 hours or in distilled water as control . Sowing took place under controlled technique as previously described in material and methods .

The following determination and chemical analysis were carried out :

* Germination percentage and its rate index .
* Seedling fresh and dry weights.
* The organic components i.e. carbohydrate & protein fractions and free & total amino acids .
* Some micro- and macro-nutrients .

4.1.1 Effect on Germination Criteria:

As shown in table (1) it could be stated that GA_3 at 10 ppm enhanced the germination percentage of apricot seeds cv. El-Hamawy. The highest stimulation existed during the first 13 days.

The same conclusion was also noticed by using IAA, but with less enhancing effect than GA_3. This indicates that GA_3 at 10 ppm may influence the internal processes leading to acceleration of germination and seedling emergency. Many other workers reported the same conclusions as they cocluded that GA_3 stimulated seed germination of many plants *(Alden & Hermann, 1971 ; Palevitch and Thomas, 1976; Corbineau and Come, 1981; Zagorski and Lewák, 1984; Abdou and El-Banna, 1989 and Wanas, 1992)*. **The stimulatory effect of GA_3 on germination percentage may be discussed partially on the bases that GA_3 induces de novo enzyme synthesis** *(Devlin and Witham, 1983)*. **In addition, GA_3 seemed to affect sterols and phospholipids** *(Amrhein, 1983)* **and that are responsible for providing or performing and mobilization of all required compounds as energy source for embryos during all germination processes. Moreover, stimulation of the germination process required not only sufficient energy supply but also presence of the major phytohormones (i.e. auxin, gibberellin and cytokinin) for maintaining the highest activity of cell division assosiated with this process** *(Devlin and Witham, 1983)*. **The importance of GA_3 for improving the germination was also detected by many workers** *(Paul, et al., 1973; Arias, et al., 1976; Pinfield and Davies, 1978; Von Schirach-Szmigiel, 1979; Bianco, et al., 1984* **and** *Pinfield & Sanchez-Torres, 1984)*. **That is why the GA_3 or IAA treatments in the present study stimulated germination process** *(Koller and Hadas, 1982 and Pharis & Reid, 1985)*.

Table (1): Effect of GA_3 or IAA at 10 ppm on germination criteria of apricot seed cv. El-Hamawy.

Treatments	days after soaking				total% of germ-ination	germina-tion ra-te index
	13	17	24	30		
Control	56.7	10.0	3.3	6.7	76.7	15.48
GA3	70.0	10.0	10.0	3.3	93.3	15.21
IAA	60.0	13.3	3.3	3.3	80.0	13.75

4.1.2. Effect on the fresh and dry weights:

There is no doubt that fresh weight must be increased gradually from starting sample (before sowing) to reach the maximum rate during plumule emergency stage (Table,2). However, this rate was different according to the treatments. Meanwhile, in spite of the decrease in dry weights the absorption of water rates increased during both radical developing and plumule emergency stages, but such absorption rate was judged by the application of GA_3 or IAA under their used concentrations. Also it was found that GA_3 at the rate of 10 ppm greatly increased the rate of water absorption during both stages over the control and *vice versa* was true with using IAA. This finding may be discussed on the bases that GA_3 and IAA affected the permeability of the developing seedling to water. In other words, as the absorption of water depending upon the water and osmotic potentials of the tissues, thus GA_3 seemed to have a positive effect on such potential while IAA seemed to have a negative effect in this respect comparing to control one. This effect seemed to have

positive correlation with germination percentage and acceleration of seedling emergency *(Aharoni, et al.,1977; Taylor and Railton, 1977; Horton, 1979 and Reid & Wample, 1985)*. In other words, the stimulatory effect of GA_3 on germination percentage, which recorded more than 93% (Table,1) was related partiall to its acceleration effect on water absorption rate. However, such treatment slightly decreased the dry weight (Table 2) .

It must be mentioned here that during early germination stage many stored of organic components are consumed and utilized through respiration such as carbohydrates and lipids, as the germination processes depend upon the stored food in cotyledons. It could be stated that during the development of radical stage great decline in dry weight was observed. Such reduction was less by using GA_3 comparing to IAA or control treated seedlings. Also the reduction was continued during plumule emergency stage in control treated seedlings. However, GA_3 and IAA treated seedlings showed a positive increase in dry weight especially when IAA was used. Again both of GA_3 and IAA seemed to affect the different germination processes. The increase of dry weight during plumule emergency stage was due to the photosynthetic activity after the formation of photosynthetic pigments. In addition, both of GA_3 and IAA seemed to affect the consumption of organic matters during respiration of the seedlings.

The effect of GA_3 on dry matter content was also reported by many workers working on many plant species *(Ibrahim and Khafaga, 1986; Khafaga et al., 1986; Ibrahim and Khafagy, 1990 and Wanas, 1992)*. As both of fresh and dry weights per

Table (2): Effect of either GA_3 or IAA at 10 ppm. on fresh and dry weights per seedling during different stages of germination .

Treatments	Fresh weight						Dry weight					
	gr./ seedling		increase or * decrease		% increase * or decrease		gr./ seedling		increase or * decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Controle	1.2750	2.1556	0.6075+	1.4863+	90.5+	222.5+	0.6038	0.6171	0.0288-	0.0155-	4.6-	2.5-
GA_3	1.4594	2.3400	0.7901+	1.6807+	118.0+	251.1+	0.6139	0.6365	0.0187-	0.0039+	3.0-	0.6+
IAA	1.0563	1.5838	0.3870+	0.9145+	57.8+	136.6+	0.6036	0.6529	0.0290-	0.0203+	4.6-	3.2+
S.s	0.6693 gr/seed						0.6326 gr./seed					

* = as related to starting sample .
R.d.s = Radical developing stage (9 days after sowing).
P.e.s = Plumule emergency stage (30 days after sowing).
S.s = Starting sample (seeds immediately before soaking).

seedling were changed during germination stages and that may be related partially to the absorption rate of different nutrients.

4.1.3 The effect on some organic components:

4.1.3.1 Carbohydrates:

As shown in Tables: (3 a & b) it is clear that non-reducing sugars are the dominant sugars during different stages of germination, followed by poly-hydroizable carbohydrate while reducing sugars are the lowest. Reducing sugars and poly-hydrolizable carbohydrates increased gradually till it reached their maximum during plumule emergency stage. On the other hand, non-reducing sugars were mostly decreased during germination stages.

It must be mentioned here that different carbohydrate fractions were in complete dynamic changes, as many are consumed during the release of vital energy. Many changed from type to another due to the enzymatic activity, while others formed from fats during the glyoxalate cycle *(Devlin and Witham, 1983)* . As mentioned before there is slight drop in dry weights during radical developing stage, and slight increase during plumule emergency stage.

The drop in dry weight may be related to the consumption of carbohydrates and lipids, while the increase was mainly due to the accumulation of either mineral nutrients and carbohydrate formation during photosynthesis of the developed plumule. In other words, the reduction in total carbohydrates during radical developing stage may be related to their consumption, while the increase during plumule stage was due to their formation from lipids or photosynthetic activity.

It could also be revealed that both GA_3 and IAA at the rate of 10 ppm. changed the accumulation of carbohydrate fractions, as both seemed to have a role on their consumption or utilization and formation as both reduced greatly the total amount of carbohydrates during radical developing stage and enhanced their accumulation during plumule emergency stage. The reduction or stimulatation effects were more pronounced with IAA as compared to the corresponding ones GA_3 of treated seedlings.

Weaver and Mc Cune, (1959) revealed that a correlation between exogenous applications of growth regulators and the increase in sink strength . *Patrick and Wareing, (1982)*, reported that utilizing decapitated plants with exogenous supplied of growth regulators, have clearly demonstrated that growth regulators influenced assimilate distribution. Many workers were also reported that application of GA_3 affected the carbohydrate contents of the different tested plants *(Leopold and Kriedemann, 1975; Sansavini, et al., 1988; Gehlot, et al., 1989; Sakr, et al., 1989 ; Ibrahim and Khafagy, 1990; Hussein, 1990 and Wanas, 1992)*, while others showed that IAA changed the accumulation of carbohydrate *(Weaver and Johnson, 1985)*.

4.1.3.2 The effect on protein fraction :

Before discussing the changes in protein fractions, it must be mentioned that different types of proteins are in complete dynamic changes during germination stages as *de novo* protein formation may be formed due to the enzymatic activities

Table (3,a):Effect of GA_3 or IAA at 10 ppm. on concentration and total amount of carbohydrate fractions during diferent stages of germination .

Treatments	Concentration (Mg / gr. dry matter)										Total amount (mg / seedling)									
	Reducing sugars		Non-reducing sugars		Total soluble sugars		hydrolizable carbohydrate		Total carbohydrate		Reducing sugars		Non-reducing sugars		Total soluble sugars		Hydrolizable carbohydrate		Total carbohydrate	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	31.00	32.25	116.00	67.50	147.00	99.75	47.25	63.00	194.25	162.75	18.72	19.90	70.04	41.65	88.76	61.56	28.53	38.88	117.29	100.43
GA_3	31.00	36.00	68.75	63.75	99.75	99.75	42.00	63.00	141.75	162.75	19.03	22.91	42.21	40.77	61.24	63.44	25.78	40.09	87.02	103.59
IAA	31.00	33.00	58.25	61.50	89.25	94.50	36.75	84.00	126.00	178.50	18.71	21.55	35.61	40.15	53.87	61.69	22.18	54.84	76.05	116.54
S, sample	21.50		88.75		110.25		42.00		152.25		13.60		56.14		69.74		26.57		96.13	

Table (3,b):Effect of GA_3 or IAA at 10 ppm. on concentration and total amount of carbohydrate fractions during diferent stages of germination .

Treatments	Increase or decrease as related to strting sample										% increase or decrease as related to starting sample									
	Reducing sugars		Non-reducing sugars		Total soluble sugars		Hydrolizable carbohydrate		Total carbohydrate		Reducing sugars		Non-reducing sugars		Total soluble sugars		Hydrolizable carbohydrate		Total carbohydrate	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	5.12+	6.30+	13.90+	14.49-	19.02+	8.18-	1.96+	12.31+	20.98+	4.12+	37.6+	46.3+	24.8+	25.8-	27.3+	11.7-	7.4+	46.3+	21.8+	4.3+
GA_3	5.43+	9.31+	13.93+	15.37-	8.50-	6.25-	0.79-	13.52+	9.29-	7.28+	40.0+	68.5+	24.8+	27.4-	12.2-	9.0-	3.0-	50.9+	9.6-	7.6+
IAA	5.11+	7.59+	20.90+	15.99-	15.87-	8.05-	4.39-	28.27+	20.26-	20.32+	37.6+	58.5+	37.4+	28.5-	22.8-	11.5-	16.5-	106.4+	21.8-	21.8+

(Devlin & Witham, 1983).

It was shown that water, salt and alkaline buffer soluble proteins increased during different stages of germination Tables: (4 a,b,c & d). The only exception was the reduction in water soluble fraction at the plumule emergency stage, while alcohol and hard non-soluble proteins are mostly decreased. This means that some protein fractions are formed while others are broaken and that depend on the stage of germination, i.e. radical developing and plumule emergency stages.

During germination it could be stated also that the dominant and abundant protein fraction is the hard non-soluble protein, followed in descending order by water, salt, alkaline-buffer soluble proteins, while alcohol fraction is the lowest in this respect.

It is clear also that GA_3 or IAA at the rate of 10 ppm stimulated the relatively high accumulation of water and alkaline soluble proteins, while other fraction seemed to be less than the corresponding ones of control. This again may be related to proteases enzymes activities *(Devlin & Witham, 1983)* **and that seemed to play more or less an important role in the germination processes especially during radical developing stage** *(Higgins, et al. 1982)*. **The difference in the effect of growth regulators on protein fractions during different stages of germination indicates that the mechanism of actions on germination percentage were quite variable. These differences could be attributed partially to the changes of endogenous hormones during the different stages of development** *(Burrows and Carr, 1970 and Eeuwens & Schwabe, 1975)* **or to the nutrient status;** *Millerd, et al., 1978; Randall, et al., 1979;*

Table : (4 a & b) Effect of GA_3 or IAA at 10 ppm. on concentration and total amount of protein fractions during different stages of germantion.

a :

Treatments	Concentration (mg/gr. dry matter).													
	Water Soulble proteins		Salt Soulble proteins		Alcohole Soluble proteins		Alkaline-buffer Soulble proteins		Total Soulble proteins		Residual (Non-Soulble proteins)		Total Protein contents	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	83.33	41.67	25.56	31.67	3.33	8.33	9.72	20.28	121.94	101.95	159.50	145.50	280.94	247.45
GA_3	100.00	47.78	35.56	46.67	3.61	5.83	13.06	17.22	152.23	117.50	126.25	141.50	278.48	259.00
IAA	94.44	45.00	42.78	21.67	2.50	12.50	10.00	26.67	149.72	105.84	131.00	152.88	280.72	258.72
Starting samble	47.22		17.78		7.22		6.94		79.16		156.00		235.16	

b :

Treatments	Total amount (mg/ Seedling).													
	Water Soulble proteins		Salt Soulble proteins		Alcohole Soluble proteins		Alkaline-buffer Soulble proteins		Total Soulble proteins		Residual (Non-Soulble proteins)		Total Protein contents	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	50.31	25.71	15.43	19.54	2.01	5.14	5.87	12.51	73.63	62.91	96.31	89.79	169.94	152.69
GA_3	61.39	30.41	21.83	29.71	2.22	3.71	8.02	10.96	93.45	74.79	77.50	90.06	170.95	164.85
IAA	57.00	29.30	25.82	14.15	1.51	8.16	6.04	17.41	90.37	69.10	79.07	99.82	169.44	168.92
Starting samble	29.87		11.25		4.52		4.39		50.08		98.69		148.77	

Table:(4 c & d) Effect of GA_3 or IAA at 10 ppm. on increase or decrease (c) and its % inrease or decrease during different stages of germantion(d).

c:

Treatments	Increase or decrease as related to starting sample													
	Water Soulble proteins		Salt Soulble proteins		Alcohole Soluble proteins		Alkaline-buffer Soulble proteins		Total Soulble proteins		Residual (Non-Soulble proteins)		Total Protein contents	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	20.44+	4.16-	4.10+	8.29+	2.56-	0.57+	1.48+	8.12+	23.55+	12.83+	2.38-	8.90-	21.17+	3.92+
GA_3	31.52+	0.54+	10.58+	18.46+	2.35-	0.86-	3.36+	3.57+	43.37+	24.71+	21.19-	8.63-	22.18+	16.08+
IAA	27.13+	0.49-	14.57+	2.90+	3.06-	3.59+	1.65+	13.82+	48.29+	19.82+	19.62-	1.13+	28.67+	20.15+

d:

Treatments	% increase or decrease as related to starting sample													
	Water Soulble proteins		Salt Soulble proteins		Alcohole Soluble proteins		Alkaline-buffer Soulble proteins		Total Soulble proteins		Residual (Non-Soulble proteins)		Total Protein contents	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	60.4+	13.9-	37.2+	73.7+	56.8-	12.5+	33.7+	185.8+	47.8+	25.6+	2.4-	9.8-	14.2+	2.6+
GA_3	105.5+	1.8+	94.8+	164.1+	51.4-	18.8-	82.7+	149.7+	86.6+	49.3+	21.5-	8.7-	14.9+	10.8+
IAA	90.8+	1.6-	129.5+	25.8+	67.8-	78.6+	37.6+	296.6+	88.5+	38.8+	19.9-	1.1+	13.9+	13.5+

Thomson, et al., 1979; Schroeder, 1982; Sponsel, 1982 and Schroeder, 1984).

As the changes of protein fraction are greatly variable, thus it was thought advisable to extend our study to include the changes in conjugated and free amino acids.

4.1.3.3: The effect on amino acid fractions :

As shown in Tables (5 & 6 a , b & c) free and bound amino acids are greatly variable during seedling emergency stages of cv. El-Hamawy apricot, and the applied growth substances affected such changes.

Generally it is clear that glutamine is the more dominant bound amid mostly followed by leucine & isoleucine, aspartic, valine, alanine, arginine, phenylalanine, histidine, and the lowest one is proline. It is also clear that free amino acids are mostly in trace amounts during different germination stages while the bound ones are greatly dominant. In addition, arginine and histidine were notdetected in free amino acid in the seeds while both are present in proteinous (bound) amino acids.The presence of these two amino acids during later germination stages indicated that both are released from bound ones. This may lead to the assumption that free arginine and histidine seemed to play an important role in the processes of nitrogenous compounds metabolism including these enzymes which may be related to seedling emergency *(Devlin and Witham, 1983).* **THe effect of growth substances on such free two amino acids was greatly differed . In other words, the increase in the germination and seedling emergency percentage by GA_3 was associated by the**

decline in total free amino acids during radical developing stage and relatively higher ones during plumule emergency stage as compared to corresponding ones of control. However, such stimulatory effect of GA_3 on germination percentage was associated by stimulatory effect on total bound amino acids especially glutamine, alanine and valine (Table 5 b).

The very slight increase in total free and bound amino acids may be related to the limiting absorption of nitrogen . However the great variations in the individual amino acid either free or bound ones are involved with the process leading to seedling emergency . Results of the present study show that some amino acids as mentioned above were increased while others were decreased under GA_3 or IAA treatments. The most pronounced decrease was that bound proline. It is reported by many workers that GA_3 affected the picture of amino acids, as (*Singh, et al., 1973*) .

On the other hand, the increases of amino acids existed in the present study may be attributed to the increase in enzymes activities responsible for amino acids biosynthesis . Also, it is well established that IAA application stimulate de novo synthesis of both RNA and protein in many plant tissues *(Devlin and Witham, 1983).*

Besides the effect of GA_3 on protein synthesis as mentioned before; de novo enzymes are synthesized under treatment *(Varner, et al., 1965 and Jacobsen & Varner, 1967).* In addition, GA_3 reactivate the repressed genes that control enzymes metabolism *(Evins and Varner, 1972).*

Table:(6 a) Effect of GA_3 or IAA at 10 ppm. on the total amount of free amino acid fractions during different stages of germination .(Expressed as mg/gr. seedling)

Treatments	Aliphatic Amino Acids				Hydroxylic Amino Acids		Acidic Amino Acids								Basic Amino Acids		Aromatic Amino Acids				Total Free Amino Acids Contents	
	Alanine		Valine		Lucine + Isolucine		Aspartic		Glutamine		Arginine		Aminoputaric		Histidine		Phenylalanine		Proline			
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	0.95	0.42	0.40	0.35	0.68	0.35	0.89	0.42	1.16	0.28	0.88	0.56	0.14	0.14	0.68	0.98	0.34	0.14	0.05	0.09	6.26	3.72
GA_3	0.34	0.43	0.21	0.57	0.20	0.65	0.55	0.57	0.20	0.57	0.20	0.23	0.40	0.43	0.34	0.94	0.07	0.79	0.15	0.05	2.98	5.23
IAA	0.54	0.59	0.54	0.59	0.34	0.29	0.54	0.67	0.54	0.52	0.41	0.67	0.21	0.22	0.48	1.46	0.14	0.22	0.09	0.10	3.84	5.23
Starting Sample	0.35		0.15		0.15		0.35		0.71		Non-detected		0.07		Non-detected		0.15		0.10		2.83	

Table:(6 b) Effect of GA_3 or IAA at ppm. on the total amount of bound amino acid fractions during different stages of germination. (Expressed as mg/ seedling)

Treatments	Aliphatic Amino Acids				Hydroxylic Amino Acids		Acidic Amino Acids								Basic Amino Acids		Aromatic Amino Acids				Total Bound Amino Acids Contents	
	Alanine		Valine		Lucine + Isolucine		Aspartic		Glutamine		Arginine		Aminoputaric		Histidine		Phenylalanine		Proline			
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	11.66	13.86	14.15	16.73	22.84	28.22	20.86	21.53	32.25	28.29	11.04	13.37	4.63	3.69	6.14	7.73	8.19	8.57	0.92	1.14	140.59	143.15
GA_3	15.25	12.86	19.55	19.91	28.24	26.31	25.88	23.87	35.07	32.85	12.54	8.04	5.86	5.67	6.59	9.48	9.29	9.63	1.32	0.28	159.31	148.82
IAA	15.82	12.68	18.55	17.84	33.05	27.73	21.27	23.85	34.22	27.50	13.22	8.91	5.58	6.79	10.77	8.86	9.85	13.05	0.88	0.16	162.40	146.45
Starting Sample	9.65		15.56		27.71		22.20		36.44		7.86		2.07		11.44		4.84		1.92		139.69	

Table:(6 c) Effect of GA_3 or IAA at 10 ppm. on the total amount of total amino acid fractions during different stages of germination. (Expressed as mg/ Seedling).

Treatments	Aliphatic Amino Acids				Hydroxylic Amino Acids		Acidic Amino Acids								Basic Amino Acids		Aromatic Amino Acids				Total Amino Acids Contents	
	Alanine		Valine		Lucine + Isolucine		Aspartic		Glutamine		Arginine		Aminoputaric		Histidine		Phenylalanine		Proline			
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	12.61	14.29	14.99	17.08	23.52	28.57	28.95	21.95	33.41	28.57	12.28	13.93	4.77	3.83	6.82	8.71	8.53	8.71	0.97	1.23	146.85	146.87
GA_3	15.59	13.29	19.76	20.48	29.12	26.96	26.34	24.44	35.35	33.42	12.82	8.27	5.54	6.10	6.93	10.42	9.36	10.42	1.47	0.25	162.29	154.05
IAA	16.36	13.27	19.09	18.43	33.39	28.82	29.81	23.59	34.76	28.02	13.63	9.58	5.79	7.01	11.25	10.32	9.19	13.27	0.97	0.26	166.24	151.77
Starting Sample	10.00		15.71		27.86		22.55		37.15		7.86		2.14		11.44		4.99		2.02		141.72	

4.1.4 The effect on macro- and micro-nutrients :

The present study was extended to show the different nutrient status during germination stages in the terms of concentration (mg/gr. or μg/gm dry weight) and the total amount per seedling.

It was shown that during early germination stages, (i.e.) radical developing and plumule emergency stages, the developing seedlings absorbed variable rate of different nutrients as the stored amounts are not sufficient to perform the natural development.

It is clear that most nutrients, as a general, either on concentration or total amounts per seedling increased during the germination stages as related to the initial stored amounts in the embryo. This increment reached the maximum rates during plumule emergency stage as the primary root development was increased during the plumule emergency stage and the requirement of such nutrients increased for the vital processes of germinated seedlings. However, the absorption rate was differed from one nutrient to another. In addition, it was shown that the rate of nitrogen absorption during different periods of germination stage was in its lowest values, as the stored nitrogenous compounds seemed to be more less sufficient for supplying the germinated seeds (Table 7 a). The same conclusion was also observed in other elements such as Cu (Table 8 b). On the other hand, relative higher absorption rate may occur in many other elements such as P (Table 7 b), K & Ca (Tables 7 , 8 b), Mg (Table 7 c), Fe & Mn (Table 8 a & b) and Zn (Table 8 c), however, these rates were the highest during plumule emergency stage. The highest absorption rate was shown with Fe, Mn and Zn while the moderate rates were observed by p, k, ca and Mg. This leads us to the assumption that many nutrients may be found in stored seed organ of apricot with relative high amounts while others are found with relatively less amounts and that affected the germination processes. However, the supplying of apricot seeds with many nutrients is essential for good germination.

The higher germination rate of GA_3 treated-apricot seeds over the control is associated with the higher absorption rate of N, K and Mg over the control or IAA treated ones. Thus it could be assumed that such element may stimulate the seedling emergency. However, the absorption rate of other elements with GA_3 treated seeds may be more that IAA treated ones such as P, Ca, Fe, Mn, Zn or Cu and that may also interfere with the highest germination rate of GA_3 treated seeds. At any way, GA_3 and IAA play an important role in the absorption rates of different nutrients either macro-or micro ones. The need of different nutrients for developing apricot seedling seemed to be more during the plumule emergency stage than during the radical developing stage. The highest proportion (Table, 9 a) of macro-nutrients was observed by N followed by k, p, ca, and the lowest was found in Mg during different periods of germination stages. It was found also that Fe was the most prevalent element in seedling followed by Mn and Cu while Zn was the lowest one (Table, 9 b).

The proportion of micro-elements in apricot seeds and seedling were as follows : Fe was more than the double of Mn and Zn was about the half of Mn and Cu. Different treatments with growth regulators seemed to regulate the proportional

Table (7,a,..& e):Effect of GA or IAA at 10 ppm. on some makro-nutrients status .

7,a) nitrogen

Treatments	Nitrogen							
	concentration mg/gr. D.W.		total amount mg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.d.s	R.d.s	P.d.s	R.d.s	P.e.s
Control	44.60	40.88	26.93	25.23	3.21+	1.51+	13.5+	06.4+
GA3	45.01	41.11	27.63	26.17	3.91+	2.45+	16.9+	10.3+
IAA	49.91	41.87	26.50	26.81	2.78+	3.09+	11.7+	13.0+
S. sample	37.50		23.72					

7,b) phosphorus

Treatments	Phosphorus							
	concentration mg/gr. D.W.		total amount mg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	4.38	5.63	2.46	3.47	0.58+	1.33+	23.4+	62.1+
GA3	4.25	5.38	2.61	3.42	0.47+	1.06+	22.0+	49.5+
IAA	4.38	5.75	2.64	3.75	0.58+	1.61+	23.4+	75.2+
S. sample	3.38		2.14					

7, c) potassium .

Treatments	Potassium							
	concentration mg/gr D.W.		total amount mg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	15.76	19.78	9.52	12.06	1.42+	3.96+	17.5+	48.9+
GA3	16.06	20.94	9.86	13.33	1.76+	5.23+	21.7+	64.6+
IAA	15.94	18.28	9.62	11.94	1.52+	3.84+	18.8+	47.4+
S. sample	12.81		8.10					

7, d) Calcium .

Treatments	Calcium							
	concentration mg/gr. D.W.		total amount mg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	4. 00	4.00	2.42	2.47	0.53+	0.58+	28.0+	30.7+
GA3	3.00	4.00	1.84	2.55	0.05-	0.66+	2.6-	34.9+
IAA	3.00	4.00	1.81	2.61	0.08-	0.72+	4.2+	38.1+
S. sample	3.00		1.89					

7, e) magnezium .

Treatments	Magnesium							
	concentration mg/gr. D.W.		total amount mg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.d.s	R.d.s	P.d.s	R.d.s	P.e.s
Control	2.13	2.71	1.29	1.67	0.01+	0.39+	0.8+	30.5+
GA3	2.78	3.06	1.71	1.95	0.43+	0.67+	33.6+	52.3+
IAA	2.96	2.99	1.79	1.95	0.51+	0.67+	39.8+	52.3+
S. sample	2.83		1.28					

D.W. = Dry weight * = as related to starting sample .

Table (8,a,..,d): Effect of GA_3 or IAA on some micro-nutrients status .

8,a) iron

Treatments	Iron							
	concentration Ug/gr. D.W.		total amount µg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.d.s	R.d.s	P.d.s	R.d.s	P.e.s
Control	422.88	625.88	254.88	385.69	16.86+	192.8+	32.1+	99.9+
GA_3	468.88	638.88	282.39	488.99	89.54+	288.1+	46.4 +	187.8+
IAA	498.88	688.88	295.76	443.97	66.82+	251.8+	34.6+	138.1+
S. sample	385.88		192.94					

8,b) manganese

Treatments	Manganese							
	concentration µg/gr. D.W.		total amount Ug/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	198.88	287.58	141.72	177.42	19.83+	82.53+	28.9+	87.8+
GA_3	218.88	382.58	128.92	192.54	34.83+	97.65+	35.9+	182.9+
IAA	232.58	414.58	148.34	278.63	45.45+	175.7+	47.9+	185.2+
S. sample	158.88		94.89					

8, c) zinc

Treatments	Zinc							
	concentration Ug/gr D.W.		total amount µg/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	88.88	125.88	48.38	77.14	8.85+	29.69+	1.8+	62.6+
GA_3	98.88	145.88	55.25	92.92	7.88+	44.84+	16.4+	94.6+
IAA	188.88	191.88	68.36	142.78	12.91+	77.25+	27.2+	162.8+
S. sample	75.88		47.45					

8, d) copper

Treatments	Copper							
	concentration µg/gr. D.W.		total amount Ug/seedling		increase or* decrease		% increase * or decrease	
	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s	R.d.s	P.e.s
Control	148.88	132.88	84.53	81.46	8.71+	23.6−	8.8+	2.8−
GA_3	118.88	118.58	67.53	78.33	16.29−	13.49−	19.4−	16.1−
IAA	142.58	225.88	86.81	146.98	2.19+	63.88+	2.6+	75.3+
S. sample	132.58		83.82					

D.W. = Dry weight * = as related to strating sample .

balance between different nutrients and that may play an important role in many endogenous processes leading to seeding emergency and its development.

The effect of GA_3 on different nutrient status was also reported by many workers using different plant species among them *(El-Zawily and Zayed, 1985; Zayed, et al., 1985 b; Kafaga, et al., 1986; Ibrahim and Kafaga, 1986; Ibrahim, 1987 and Mohsen, et al., 1987).* **This difference was related mainly to the effect of either GA_3 or IAA on the absorption rates of such nutrients** *(Seth and Wareing, 1967 and Saks & Ilan, 1984).*

Table (9,a): Effect of GA_3 or IAA at 10 ppm. on the proportion of the macro-nutrients N, P,K,Ca & Mg as related to their total amounts per seedling .

Treatments	N		P		K		Ca		Mg	
	R.d.s	P.o.s	R.d.s	P.o.s	R.d.s	P.o.s	R.d.s	P.o.s	R.d.s	P.o.s
Control	62.9	56.2	6.2	7.7	22.2	26.9	5.7	5.5	3.0	3.7
GA_3	63.3	55.2	6.0	7.2	22.6	28.1	4.2	5.4	3.9	4.1
IAA	62.6	57.0	6.2	8.0	22.7	25.4	4.3	5.5	4.2	4.1
S. sample	63.9		5.8		21.8		5.1		3.4	

Table (9,b): Effect of GA_3 or IAA at 10 ppm. on the proportion of the micro-nutrients Fe,Mn,Zn & Cu as related to their total amounts per seedling .

Treatments	Fe		Mn		Zn		Cu	
	R.d.s	P.o.s	R.d.s	P.o.s	R.d.s	P.o.s	R.d.s	P.o.s
Control	50.7	53.4	22.8	24.6	9.6	10.7	16.8	11.3
GA_3	52.9	53.0	24.1	25.5	10.3	12.2	12.6	9.3
IAA	50.8	45.0	24.1	27.4	10.4	12.6	14.8	14.9
S. sample	46.0		22.6		11.3		20.0	

Experiment II

4.2. Effect of soaking apricot seeds cv. El-Amar in some growth regulators on germination and seedling growth behaviour :

As has been discussed in the first experiment the growth regulators gibberellic acid (GA_3) and Indole-acetic acid (IAA) greatly affected different aspects of germination of apricot cv. El. Hamawy. These effects were more or less related to the effects of growth promoters (i.e. GA_3 & IAA) on different reactions leading to starting the germination and the appearance of both the radicle and plumule. In other words, the metabolic activity was altered during germination process of El-Hamawy apricot seeds.

Accordingly, it is of interest to extend the previous study to include El-Amar apricot. The common local cultivar is mainly propagated by seeds. Germination of this cultivar seeds generally needs long period in addition to low percentage of germinated seeds under local natural conditions in the apricot cultivated regions. Also, with this cultivar two other growth regulators were used, i.e. Maleic hydrazide (MH) and cycocel (CCC). Growth regulators were used separately or in combinations as previously described. Seeds were soaked for 24 hours in different assigned growth regulators and in their combination, as well as other group of seeds was soaked in distilled water as control. Then treated and untreated seeds were sown in the previously described sand culture and the following data were recorded :

1- germination percentage and rate index .

2- seedling growth including root & stem length and number of leaves as well as fresh and dry weights.

3- Organic components i.e. total carbohydrates, total soluble sugars and protein fractions, total amino acids and content of some Macro- and micro-nutrients.

4.2.1. <u>Germination criteria</u> (Table 10):

It could be revealed that different growth regulators affected the germination percentage during different periods of seedling emergency, and the total of germination percentage as well as germination index (mean days required for germination).

It could be noticed from the data that some treatments greatly minimized the total germination percentage (GA_3, 5 ppm CCC, 5 ppm). Many other treatments slightly lowered such percentage (IAA, 5 and 10 ppm; MH 5 ppm and ccc + MH, 5 + 5 ppm). The most reduction effect was gained by soaking apricot seeds in 5 ppm GA_3. On the other hand, many treatments slightly enhanced the germination percentage (GA_3, 10 ppm; GA_3 + IAA, 5 + 5 ppm). Many others greatly stimulated such percentage (GA_3 + IAA, 10 + ppm or 5 + 10 respectively).

These data indicate that different growth regulators affected the germination percentage through their effects on the metabolic process of the germinated seeds. The retardant effect of some treatments exhibits their effect on both the metabolic and seedling emergency, while others stimulated both processes. As most treatments minimized germination rate index, the most pronounced one in this respect was GA_3, 10 ppm . The role of GA_3, IAA, CCC and MH on germination process was also recorded by many workers previously mentioned by *Makarem, 1978 and Khalil, 1978* in some fruit varaieties .

Table (10): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on germination criteria .

Treatments		Days after soaking				Total % of germination	Germination rate index
Substance	ppm.	13	16	23	30		
Control	0	16.7	10.0	20.0	10.0	56.7	20.06
GA_3	5	11.7	01.7	20.0	05.0	38.4	20.57
	10	33.3	18.3	03.3	03.3	58.2	15.49
IAA	5	20.0	15.0	11.7	05.0	51.7	17.77
	10	13.3	15.0	20.0	05.0	53.5	19.19
GA_3 +IAA	5+5	18.3	16.7	15.0	08.3	58.3	18.88
	5+10	15.0	16.7	31.7	06.7	70.1	19.86
	10+5	15.0	23.3	15.0	03.3	56.6	17.88
	10+10	15.0	13.3	35.0	03.3	66.6	19.78
CCC	5	16.7	06.7	13.3	05.0	41.7	18.72
MH	5	16.7	06.7	18.3	08.3	50.0	19.90
CCC+MH	5+5	15.0	05.0	28.3	05.0	53.3	20.18

4.2.2. Root length and number of lateral roots: (Table, 11)

The followings could be revealed :

a) many treatments reduced root length and number of lateral roots, while others increased such parameters as related to the control treated seedlings .

b) IAA at 10 ppm or GA_3 + IAA, 5 + 5 ppm increased root length and the formation of lateral roots.

c) GA_3 + IAA, 5 + 10 ppm greatly stimulated lateral root formation.

d) CCC + MH, 5 + 5 ppm reduced the root length and the number of lateral roots. Also IAA affected the initiation of root and the elongation of root cell.

e) It could be noticed that GA_3 at the rate of 5 ppm combined with IAA at 10 ppm has a synergistic effect on lateral root formation.

Table (11): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on root length and number of lateral roots per seedling at the plumule emergency stage .

Treatments	Control	GA_3		IAA		GA_3 + IAA				CCC	MH	CCC+MH
		5	10	5	10	5+5	5+10	10+5	10+10	5	5	5+5
Root length (cm.)	9.6 +1.43	7.7 +1.65	8.8 +1.79	6.9 +1.21	10.6 +0.82	10.6 +0.97	9.1 +0.51	8.8 +0.17	8.6 +0.75	9.4 +2.02	7.9 +1.83	5.5 +1.66
No.of lateral roots	25 +5.13	22 +5.68	22 +4.16	22 +6.16	30 +5.45	27 +4.48	36 +3.37	27 +3.53	29 +2.42	24 +4.76	18 +4.75	15 +4.72

Concerning the effect of different growth regulators on the root length and the lateral root formation as shown in Table (11) it could be shown that the auxin was the most effective in this respect. It gives the highest length and more lateral root formation followed by its combination with GA_3. While the growth inhibitors CCC and MH separately or in combinations significantly decreased both the two characters.

These recorded observations could be attributed to variable changes in the endogenous hormones under the exogenous application of experimented growth regulators. For example the exogenous applied IAA is known to increase the endogenous cytokinins *(Hradilik, 1973 & 1974)*. In turn, increase of endogenous cytokinins led to increase in the lateral root formation *(Devlin and Witham, 1983 and Wanas, 1992).*

4.2.3. Effect of the growth regulators GA_3, IAA , CCC and MH in the assigned concentration and different combinations on seedling growth of apricot cv. El-Amar.

4.2.3.1. Stem length (Table 12) and number of internodes:(Table, 13)

It could be stated that different treatments with GA_3 , IAA , CCC and MH or the combinations with each other affected seedling stem length during different periods of growth. Most treatments enhanced the stem length over the control ones during most periods of growth. After 72 days from soaking, CCC 5 ppm treated seedlings possessed the taller stems over any other treatments. At such date most treatments stimulated the elongation of stems as compared to control ones, as most treatments regulate the rate of stem growth during different periods of growth.

As stem length was affected by different treatments, the internodes number was also changed. It could be mentioned that most treatments lowered the number of internodes. Thus, it could be mentioned that different treatments seemed to stimulate the internode length rather than increase the number of internodes. The only exceptions are those treated with CCC at 5 ppm and MH at 5 ppm. This indicates that CCC affected both internode number and the length of internode

Table (12): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on stem length and its percentage increase during different periods of of seedling growth .

Treatments		Stem length (cm.)				% increase of S. length			
		Days after soaking				Days after soaking			
Substance	ppm	30	45	65	72	30	45	65	72
Control	0	7.6 $\pm$0.67	15.6 $\pm$0.86	18.6 $\pm$1.85	22.3 $\pm$1.14	34.0	69.9	83.4	100
GA_3	5	7.3 $\pm$0.99	21.0 $\pm$2.14	26.4 $\pm$1.81	29.8 $\pm$1.60	24.4	70.4	66.5	100
	10	10.2 $\pm$0.37	20.3 $\pm$1.05	22.3 $\pm$0.96	23.6 $\pm$0.98	43.2	86.0	94.4	100
IAA	5	9.2 $\pm$0.55	17.6 $\pm$1.21	19.9 $\pm$1.79	20.1 $\pm$2.34	45.7	87.5	99.0	100
	10	8.5 $\pm$0.64	15.2 $\pm$1.30	17.4 $\pm$1.64	20.7 $\pm$1.24	41.0	73.4	84.0	100
GA_3 + IAA	5+5	8.1 $\pm$0.58	16.8 $\pm$1.31	21.2 $\pm$1.37	22.0 $\pm$1.37	36.8	76.3	96.3	100
	5+10	8.3 $\pm$0.44	18.4 $\pm$0.96	20.9 $\pm$0.89	24.7 $\pm$0.88	33.6	74.4	84.6	100
	10+5	8.2 $\pm$0.74	16.0 $\pm$0.98	20.6 $\pm$1.22	24.0 $\pm$1.28	34.1	66.6	85.8	100
	10+10	7.7 $\pm$0.46	16.7 $\pm$1.02	19.9 $\pm$1.11	23.0 $\pm$0.97	33.3	72.6	86.5	100
CCC	5	8.5 $\pm$1.42	20.5 $\pm$3.43	26.0 $\pm$1.35	39.5 $\pm$4.33	21.5	51.8	65.8	100
MH	5	7.2 $\pm$0.92	19.0 $\pm$2.51	27.4 $\pm$2.97	31.8 $\pm$1.52	22.6	59.7	86.1	100
CCC+MH	5	7.4 $\pm$0.76	23.8 $\pm$1.01	26.6 $\pm$1.36	30.5 $\pm$1.43	24.2	78.0	87.2	100

Table (13): Effect Of soaking of cv. El-Amar apricot seeds in some growth regulators on internode number and its percentage increase during different periods of seedling growth .

Treatments		Internode number								% increase of intern.n.			
		Days after soaking								Days after soaking			
Substance	ppm	30		45		65		72		30	45	65	72
Control	0	9	±0.66	16	±0.52	17	±0.72	19	±0.67	47.4	84.2	89.5	100
GA_3	5	7	±0.84	14	±1.48	16	±0.34	17	±1.63	41.2	82.4	94.1	100
	10	12	±0.31	17	±0.59	17	±0.47	17	±1.85	70.6	100	100	100
IAA	5	11	±0.55	15	±0.59	15	±0.89	16	±1.57	68.8	93.8	93.8	100
	10	11	±0.41	14	±1.85	14	±1.89	17	±1.89	64.7	82.4	82.4	100
GA_3 + IAA	5+5	11	±0.52	15	±0.61	16	±0.57	18	±0.81	61.1	83.3	88.9	100
	5+10	10	±0.46	15	±0.74	16	±0.64	18	±0.79	55.6	83.3	88.9	100
	10+5	9	±0.72	15	±0.91	16	±0.88	19	±1.89	47.4	78.9	84.2	100
	10+10	9	±0.48	15	±0.57	17	±0.76	18	±0.88	50.0	83.3	94.4	100
CCC	5	9	±0.87	16	±2.71	23	±0.71	25	±1.03	36.0	64.0	92.0	100
MH	5	7	±0.75	16	±1.79	19	±3.37	22	±1.00	31.8	72.7	86.4	100
CCC+MH	5	6	±0.63	17	±0.79	20	±0.97	20	±1.08	30.0	85.0	100	100

Table (14): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on internode length and its percentage increase during different periods of seedling growth .

Treatments		Internode length (cm.)				% increase of intern.l.			
		Days after soaking				Days after soaking			
Substance	ppm	30	45	65	72	30	45	65	72
Control	0	0.83 ±0.07	0.96 ±0.04	1.09 ±0.04	1.11 ±0.04	74.8	86.5	98.2	100
GA_3	5	1.08 ±0.09	1.44 ±0.05	1.60 ±0.08	1.77 ±0.12	61.0	81.4	90.4	100
	10	0.81 ±0.03	1.15 ±0.04	1.28 ±0.03	1.49 ±0.08	54.4	77.2	85.9	100
IAA	5	0.79 ±0.03	1.11 ±0.05	1.30 ±0.06	1.25 ±0.09	63.2	88.8	104.0	100
	10	0.82 ±0.03	1.02 ±0.05	1.16 ±0.05	1.19 ±0.08	68.9	85.7	97.5	100
GA_3 + IAA	5+5	0.77 ±0.03	1.04 ±0.05	1.34 ±0.09	1.22 ±0.07	63.1	85.2	109.8	100
	5+10	0.79 ±0.03	1.19 ±0.05	1.29 ±0.05	1.38 ±0.07	57.2	86.2	93.5	100
	10+5	0.84 ±0.03	1.01 ±0.05	1.24 ±0.04	1.28 ±0.07	65.6	78.9	69.9	100
	10+10	0.89 ±0.08	1.08 ±0.05	1.15 ±0.06	1.29 ±0.06	68.9	83.7	89.1	100
CCC	5	1.05 ±0.07	1.09 ±0.10	1.14 ±0.08	1.52 ±0.12	69.1	71.7	75.0	100
MH	5	0.96 ±0.06	1.16 ±0.05	2.02 ±0.62	1.49 ±0.09	64.4	77.9	135.6	100
CCC+MH	5	1.22 ±0.16	1.37 ±0.04	1.31 ±0.04	1.59 ±0.07	76.7	86.2	82.4	100

which resulted into higher stem elongation (Table 14).

4.2.3.2. Number of leaves: (Table, 15)

It could be stated that leaves number showed the same trend of internodes number, as most treatments slightly retarded leaf formation under the control level after 72 days from soaking. However, some treatments stimulated such production, as CCC at 5 ppm seemed to increase leaves formation. MH also gave the same stimulatory effect.

It could be also mentioned that different treatments influenced the rate of leaves formation during different periods of seedling growth, as many treatments stimulated early formation of leaves (GA_3, 10 ppm; IAA, 5 & 10 ppm), while other treatments retarded such early formation of leaves (CCC or MH at 5 ppm or the combination of them). At present, ongoing research in this field has shown that the stem length as well as all other vegetative characters were markedly by affected the experimented growth regulators (i.e. GA_3 , IAA , CCC & MH).

The stimulating effect of GA_3 on stem height, internode length, leaf area, etc. of apricot cv. El-Amar seedling obtained in the present study was also recorded by many workers in other plants e.g. *Omar, et al., 1985 a,b; El-Zawily, et al., 1985 b; El-Zawily and Zayed, 1985; Okasha, et al., 1985; Zayed, et al., 1985 a & b; Sakr, et al., 1986; Ibrahim & Khafagy, 1990; Wanas, 1992 and El-Desouky, 1992).*

The effect of GA_3 on internode length may be clearly and intimately explained by studies carried out by *Schwabe, 1976 ; Potts, et al.,1982; Ingram, et al., 1983; Reid, et al., 1983; Potts and Reid, 1983 and Ingram, et al., 1984* **. They reported that there are at least five major loci, Le, La, Cry, Na and Lm. Genes at these loci are interacting to determine the internode length in the garden pea. Genes at the first**

four Loci produce the variations in internode length. Their effects were similar to that of the applied GA_3 . The genes Le and Na directly influence GA_3 metabolism. Le gene allows the conversion of GA_1 and results in the tall phenotype while le plants are dwarf. The Na gene block the production of the biologically active GA_3 resulting in the extremely short nana (genetic line of pisum) phenotype being produced.

On the other hand, the obvious significant reduction of growth (i.e. stem length, internode length & internode numbers) which is recorded in the present study with the application of CCC (one of anti-gibberellins) was formerly recorded by *Potts, et al., (1985)* **using three phenotypes of pisum. CCC is known to inhibit the biosynthesis of gibberellin** *(Dalziel and Lawrence, 1984; Rademacher, et al., 1984 and Hedden & Graebe, 1985)* **.**

The dominant effect of IAA was generally stimulation of measured growth parameters. It is not surprising that IAA stimulated stem length in addition to increase of internodes length and numbers. IAA, has been reported its effects on cell wall structures and the osmotic and water potential in the cells of IAA-treated organs. These established effects among them are the substitution or alteration of bonds between different components of the cell wall. Since, after IAA treatment the weak hydrogen bonds would be the dominant bonds in cell walls, hence, the elasticity of walls would be increased. In addition to the synthesis of de novo enzymes of modifying cell walls; the increase of osmotic potential in IAA-treated cells has been reported, *(Devlin and Witham, 1983)* **.**

As for the anti-gibberellin CCC affected the growth process ; also MH, the antiauxin showed its inhibitory effects on apricot seedling growth. From numerous experiments, it is known that the initial growth inhibition later disappears or changes into stimulation *(Dostàl, 1967)* **. It could also be shown in the present study**

Table (15): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on number, percentage of increase and periodic increase percentage of leaves at different periods of seedling growth.

Treatments		Number of leaves								% increase of leaves n.				Periodic increase %			
		Days after soaking								Days after soaking				Days after soaking			
Substance	ppm	30		45		65		72		30	45	65	72	0-30	30-45	45-65	65-72
Control	0	10	±0.66	17	±0.52	17	±0.76	20	±0.69	50	85	85	100	50	35	0	15
GA_3	5	8	±0.84	15	±1.48	17	±1.42	18	±1.63	44	83	94	100	44	39	11	6
	10	13	±0.31	18	±0.59	18	±0.47	18	±0.94	72	100	100	100	72	28	0	0
IAA	5	12	±0.55	16	±0.62	16	±0.88	18	±1.47	66	88	88	100	66	22	0	12
	10	12	±0.39	15	±1.86	15	±1.88	18	±1.89	66	83	83	100	66	17	0	17
GA_3 + IAA	5+5	12	±0.52	16	±0.61	17	±0.56	19	±1.87	63	84	89	100	63	21	5	11
	5+10	11	±0.46	16	±0.74	17	±1.88	19	±0.78	57	84	89	100	57	27	5	11
	10+5	10	±0.72	16	±0.91	18	±0.87	19	±1.27	52	84	94	100	52	32	10	6
	10+10	10	±0.47	16	±0.75	18	±0.68	19	±0.88	52	84	94	100	52	32	10	6
CCC	5	9	±1.12	17	±2.71	24	±0.78	26	±1.83	34	65	92	100	34	31	27	8
MH	5	8	±0.75	17	±1.79	20	±2.89	23	±1.88	34	73	86	100	34	39	13	14
CCC+MH	5	7	±0.68	18	±0.79	22	±1.10	22	±1.18	31	81	100	100	31	50	19	0

that where the application of both CCC or MH in the all assigned concentrations used showed a tendency to reduce the rate of the morphological growth of apricot seedlings, during early periods of growth , however, this retarding effect was desappeared completly and replased by stimulatory effect later periods of growth .

Also, various aspects of vegetative development of many plants are controlled by growth regulators in the environment, other plant growth regulators are widely applied to induce favorable changes in germination, vegetative and reprodutive characters of many plants *(Lang, 1957 ; Lang & Reinhard, 1961 ; Phinney & West, 1961 ; Stuart & Cathy, 1961 ; Rikin, et al., 1978 ; Webber, et al., 1979 ; Seele & Powell, 1981 ; Walser, et al., 1981 and Mousdale, 1983)* .

4.2.4.1. Fresh and dry weights of seedlings at 30 days : (Table, 16):

As the different treatments affected the germination process their effect was extended to the growth criteria of the resulted seedlings. Many treatments retarded the growth of different seedling parts, while others stimulated the growth of such seedlings . Most treatments with GA_3, IAA, CCC, MH or the combination with each others reduced root fresh and dry weights under the level of control one, while such treatments increased fresh & dry weights of cotyledons, but shoots showed unregular trends in this respect.

This could be discussed on the bases that most treatments seemed to have a regulatory effect on the reserved food in cotyledons and that affected the translocation of such foods to the developing roots and shoots. Also, it was concluded that most treatments with growth substances affected root growth by minimizing the translocation of nutrients from cotyledons into the developing radical. It must be mentioned that fresh weight took the same trend of dry weight.

Table (17) : Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on frish and dry weights, distribution as related to the whole seedling and root/shoot ratio at late stage of seedling growth .

Treatments		Fresh weight							Dry weight							Root/ shoot ratio
		gr./ seedling				% distribution			gr./ seedling				% distribution			
Subst-ance	ppm.	Root	Stem	Leaves	W.seed.*	Root	Stem	Leaves	Root	Stem	Leaves	W.seed.*	Root	Stem	Leaves	
Control	0	1.14 ± 0.14	0.34 ± 0.04	1.04 ± 0.11	2.52	45.2	13.5	41.3	0.1506 ±0.0249	0.0968 +0.0009	0.2273 +0.0277	0.4747	31.7	20.4	47.9	82.6
GA_3	5	0.95 ± 0.12	0.95 ± 0.06	1.57 ± 0.23	3.06	31.0	17.6	51.3	0.1119 ±0.0413	0.1483 +0.0220	0.3569 +0.0588	0.6171	18.1	24.0	57.8	45.0
	10	1.10 ± 0.12	0.33 ± 0.02	0.78 ± 0.15	2.21	49.8	14.9	35.3	0.1175 ±0.0127	0.1003 +0.0116	0.2301 +0.0253	0.4479	26.2	22.4	51.4	99.1
IAA	5	0.99 ± 0.12	0.38 ± 0.07	1.01 ± 0.15	2.38	41.6	15.9	42.4	0.0902 ±0.0119	0.0956 ±0.0158	0.2092 ±0.0306	0.3950	22.8	24.2	53.0	71.2
	10	1.14 ± 0.14	0.35 ± 0.03	1.18 ± 0.11	2.67	42.7	13.1	44.2	0.1052 ±0.0119	0.0892 ±0.0008	0.2299 ±0.0214	0.4243	24.8	21.0	54.2	74.5
	5+5	1.32 ± 0.13	0.41 ± 0.03	1.26 ± 0.09	2.99	44.1	13.7	42.1	0.1264 ±0.0192	0.1028 ±0.0103	0.2486 ±0.0169	0.4778	26.5	21.5	52.0	63.5
GA_3 + IAA	5+10	1.38 ± 0.07	0.42 ± 0.04	1.27 ± 0.07	3.07	44.9	13.7	41.4	0.1689 ±0.0119	0.1106 ±0.0062	0.2754 ±0.0164	0.5549	30.4	19.9	49.6	81.7
	10+5	1.33 ± 0.11	0.39 ± 0.02	1.33 ± 0.11	3.05	43.6	12.8	43.6	0.1956 ±0.0250	0.1080 ±0.0095	0.2755 ±0.0215	0.5791	33.8	18.6	47.6	77.3
	10+10	1.25 ± 0.08	0.36 ± 0.02	1.30 ± 0.08	2.91	42.9	12.4	44.7	0.1612 ±0.0149	0.1024 ±0.0071	0.2543 ±0.0165	0.5179	31.1	19.8	49.1	75.3
CCC	5	1.12 ± 0.32	1.03 ± 0.21	2.47 ± 0.47	4.89	22.9	21.1	56.0	0.1575 ±0.0500	0.3062 ±0.0773	0.6127 ±0.1299	1.0764	14.6	28.4	56.9	29.7
MH	5	1.25 ± 0.12	0.80 ± 0.08	2.29 ± 0.29	4.34	28.8	18.4	52.8	0.1325 ±0.0154	0.2380 ±0.0333	0.5037 ±0.0673	0.8742	15.2	27.2	57.6	40.5
CCC + MH	5+5	0.90 ± 0.11	0.58 ± 0.04	1.62 ± 0.17	3.10	29.0	18.7	52.3	0.1171 ±0.0138	0.1502 ±0.0167	0.3406 ±0.0403	0.6079	19.3	24.7	56.0	40.9

* W. seedling

According to the above mentioned results percentage distribution of fresh and dry weights of different seedling parts as related to whole seedling was also changed. Thus different treatments regulate seedling growth in addition to their effects on various seedling parts.

4.2.4.2 Fresh and dry weights : at 72 days (Table,17) .

It could be stated that many treatments minimized fresh weight of whole seedling (GA_3 & IAA at different rates) while others greatly increased such weight (CCC or MH at 5 ppm). This indicates that different treatments affected the growth of seedling after 72 days from sowing. This regulatory effect was related to themodification in the growth of individual seedling organs (root, stem or leaves). Many treatments increased root, stem and leaves fresh weights (GA_3 + IAA, 5 + 5 and 5 + 10; CCC or MH at 5 ppm). It could be revealed that CCC or MH at the rate of 5 ppm reduced the percentage of root fresh weight and increased those of stem and leaves proportions as related to whole seedling. This indicates that CCC or MH at 5 ppm increased fresh weight of different seedling parts at 72 days from soaking, but such increments associated with a regulatory effect on the percentage distribution in different seedling organs, as the most proportion of fresh weight was due to the higher increments in stem and leaves.

Accordingly, it could be stated that CCC or MH at 5 ppm exhibited their stimulatory effect leaves on stem and leaves more than other on root. Very slight effect was noticed with other treatments on root, stem and leaves fresh weight proportions, as the changes in fresh weight proportion of different seedling organs were limited as compared to corresponding ones of control in most cases.

The same conclusions were also shown with regard to dry weight, as most

Table (16):Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on frish and dry weight, distribution as related to the whole seedling of didfferent seedling organs and root/shoot ratio at plumule emergency stage .

Treatments		Fresh weight							Dry weight							Root/ shoot ratio
		gr./ seedling				% distribution			gr./ seedling				% distribution			
Subst-ance	ppm.	Root	Cotyledons	Leaves	W.seed.*	Root	Stem	Leaves	Root	Cotyledons	Leaves	W.seed.*	Root	Cotyle-dons	Leaves	
Control	0	0.72 ±0.15	1.08 ±0.08	0.43 ±0.06	2.23	32.3	48.4	19.3	0.1020 ±0.0513	0.2861 ±0.0229	0.0716 ±0.0331	0.5397	33.7	53.0	13.3	167.4
GA$_3$	5	0.29 ±0.06	1.46 ±0.09	0.34 ±0.08	2.09	13.9	69.9	16.2	0.0586 ±0.0152	0.3644 ±0.0208	0.0542 ±0.0137	0.4772	12.3	76.4	11.3	85.3
	10	0.53 ±0.10	1.53 ±0.07	0.38 ±0.04	2.44	21.7	62.7	15.6	0.1042 ±0.016	0.3988 ±0.0409	0.0713 ±0.0008	0.5743	18.1	69.4	12.4	139.5
IAA	5	0.71 ±0.20	1.47 ±0.14	0.51 ±0.04	2.69	26.4	54.6	18.9	0.1216 ±0.0229	0.3945 ±0.0392	0.0977 ±0.0008	0.6138	19.8	64.3	15.9	139.2
	10	0.42 ±0.08	1.02 ±0.10	0.44 ±0.06	1.88	22.3	54.3	23.4	0.1026 ±0.0272	0.2346 ±0.0273	0.0754 ±0.0097	0.4126	24.9	56.9	18.2	95.5
GA$_3$ + IAA	5+5	0.63 ±0.01	1.39 ±0.10	0.53 ±0.06	2.55	24.7	54.5	20.8	0.1209 ±0.0179	0.3356 ±0.0392	0.0997 ±0.0129	0.5562	21.7	60.3	17.9	118.9
	5+10	0.67 ±0.09	1.41 ±0.10	0.48 ±0.02	2.56	26.2	55.1	18.7	0.1489 ±0.0223	0.3624 ±0.0378	0.0926 ±0.0044	0.6039	24.7	60.0	15.3	139.6
	10+5	0.51 ±0.10	1.43 ±0.10	0.48 ±0.08	2.42	21.1	59.1	19.8	0.1004 ±0.0206	0.3530 ±0.0401	0.0955 ±0.0104	0.5489	18.3	64.3	17.4	106.3
	10+10	0.66 ±0.06	1.27 ±0.10	0.42 ±0.03	2.35	28.1	54.0	17.9	0.1159 ±0.0142	0.3667 ±0.0328	0.0798 ±0.0008	0.5624	20.6	65.2	14.2	157.1
CCC	5	0.34 ±0.04	1.33 ±0.26	0.52 ±0.10	2.19	15.5	60.7	23.7	0.0945 ±0.0249	0.4027 ±0.0470	0.0936 ±0.0104	0.5908	15.9	68.2	15.8	65.4
MH	5	0.26 ±0.08	1.43 ±0.10	0.31 ±0.04	2.00	13.0	71.5	15.5	0.0509 ±0.0142	0.3207 ±0.0323	0.0540 ±0.0970	0.4256	11.9	75.4	12.7	83.9
CCC + MH	5+5	0.19 ±0.03	1.61 ±0.14	0.32 ±0.04	2.12	8.9	75.9	15.1	0.0404 ±0.0009	0.4640 ±0.0364	0.0570 ±0.0075	0.5614	7.2	82.7	10.2	59.4

* Whole seedling

treatments regulate dry weight (as gr/seedling) or the distribution proportion of dry weight in different seedling organs as related to the whole seedling. Accordingly, root shoot ratio was also changed.

From the different foregoing results, it could be revealed that different treatments with growth regulators exhibit their regulatory effect on plant growth through their effect on different organs which changed from one to another. In other words, GA_3, IAA, CCC and MH or combination with each other have a great regulatory effect on the formation of different seedling organs and that affected the growth of whole seedling.

The effect of some growth regulators on dry matter accumulation in some other plants was reported by many workers *(e.g. Ibrahim and Khafaga, 1986; Khafaga et al., 1986; Ibrahim and Khafagy, 1990 and Wanas, 1992)* .

4.2.5. Carbohydrate fractions in different seedling organs: (Tables, 18 a & b).

The followings could be revealed:

a) The change in total carbohydrate concentration in whole seedling after 72 days was more or less very limited in most treatments. However, many treatments reduced such accumulation (GA_3 + IAA, 5 + 5 ppm).

b) It must be mentioned that all treatments greatly reduced the concentration of reducing sugars, however, many other treatments increased non-soluble ones (CCC, MH or CCC + MH at 5 or 5 + 5 ppm). CCC or MH at 5 ppm of each increased the total hydrolyzable carbohydrate (polysaccharides).

This result indicates that all treatments exhibit their regulatory effect on plant growth through their effects on plant metabolism, as CCC at 5 ppm greatly

Table (18, a) : Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on carbohydrate fraction contents in different organs as well as to the whole seedling at the late stage of seedling growth .

(expressed as mg. glucose/ gr. dry matter)

Treatments		Reducing sugars				Non-reducing sugars				Total soluble sugars				Hydrolizable carbohydrate				Total carbohydrate			
Subst-ance	ppm.	Root	Stem	Leaves	Whole* seedli.	Root	Stem	Leaves	Whole* seedli.	Root	Stem	Leaves	Whole* seedli.	Root	Stem	Leaves	Whole* seedli.	Root	Stem	Leaves	Whole* seedli.
Control	0	36.75	126.00	26.25	49.91	63.00	47.25	42.00	49.74	99.75	173.25	68.25	99.64	57.75	42.00	141.75	94.75	157.50	215.25	210.00	194.42
GA_3	5	36.75	10.50	36.75	30.45	31.50	136.50	42.00	62.79	68.25	147.00	78.75	93.26	105.00	89.25	110.25	104.26	173.25	236.25	189.00	197.50
	10	26.25	15.75	42.00	31.97	73.50	52.50	31.50	74.22	99.75	68.25	73.50	79.21	52.50	175.50	105.00	107.01	152.25	243.75	178.50	186.22
IAA	5	31.50	31.50	42.00	37.09	47.25	31.50	31.50	35.11	78.75	63.00	73.50	72.15	63.00	141.75	99.75	101.52	141.75	204.75	173.25	173.67
	10	36.75	15.75	26.25	26.39	57.75	57.75	31.50	43.15	94.50	73.50	57.75	69.55	36.75	115.50	173.25	127.03	131.25	189.00	231.00	196.61
GA_3 + IAA	5+5	26.25	31.50	26.25	27.39	42.00	26.25	36.75	35.87	68.25	57.75	63.00	63.27	63.00	136.50	173.25	136.17	131.25	194.25	236.25	199.43
	5+10	10.50	42.00	21.00	21.99	57.75	47.25	36.75	45.23	68.25	89.25	57.75	67.22	52.50	99.75	105.00	87.98	120.75	189.00	162.75	155.10
	10+5	21.00	42.00	26.25	27.42	68.25	52.50	42.00	52.82	89.25	94.50	68.25	80.25	36.75	120.75	120.75	92.38	126.00	215.25	189.00	172.66
	10+10	05.25	15.75	36.75	22.00	63.00	63.00	36.75	58.13	68.25	78.75	73.50	72.89	57.75	126.00	99.75	91.87	126.00	204.75	173.25	164.70
CCC	5	36.75	15.75	05.25	12.05	73.50	63.00	73.50	70.51	110.25	78.75	78.75	83.35	31.50	115.50	136.50	115.16	141.75	194.25	215.25	198.52
M H	5	21.00	21.00	15.75	17.96	52.50	63.00	63.00	61.40	73.50	84.00	78.75	79.39	68.25	131.25	99.75	103.55	141.75	215.25	178.50	182.93
CCC + M H	5+5	21.00	21.00	15.75	18.03	57.75	47.25	136.5	99.26	78.75	68.25	152.25	117.34	78.75	131.25	85.25	50.53	157.50	199.50	157.50	167.86

$$* \text{Whole seedling} = \frac{\text{Total amount/seedling}}{\text{Dry weight/ seedling}}$$

Table (10, b) : Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on the total amount of carbohydrate fraction in different organs as well as to the whole seedling at the late stage of seedling growth .

(expressed as mg/seedling)

Treatments		Reducing sugars				Non-reducing sugars				Total soluble sugars				Hydrolizable carbohydrate				Total carbohydrate			
Substance	ppm.	Root	Stem	Leaves	Whole seedli.	Root	Stem	Leaves	Whole seedli.	Root	Stem	Leaves	Whole seedli.	Root	Stem	Leaves	Whole seedli.	Root	Stem	Leaves	Whole seedli.
Control	0	5.53	12.19	5.97	23.69	9.49	4.57	9.55	23.61	15.02	16.77	15.51	47.30	8.69	4.07	32.22	44.98	23.72	20.84	47.73	92.29
GA_3	5	4.11	1.56	13.12	18.79	3.53	20.24	14.99	38.75	7.64	21.80	28.11	57.55	11.75	13.24	39.35	64.34	19.39	35.04	67.45	121.88
	10	3.00	1.58	9.66	14.23	8.64	5.27	7.24	21.15	11.72	6.85	16.91	35.48	6.17	17.60	24.16	47.93	17.89	24.45	41.07	83.41
IAA	5	2.84	3.02	8.79	14.65	4.26	3.02	6.59	13.87	7.10	6.02	15.38	28.50	5.68	13.55	20.87	40.10	12.79	19.57	36.24	68.60
	10	3.77	1.40	6.03	11.20	5.92	5.15	7.24	18.31	9.69	6.56	13.28	29.51	3.77	10.30	39.83	53.90	13.45	16.86	53.11	83.42
GA_3 + IAA	5+5	3.32	3.24	6.53	13.09	5.31	2.69	9.14	17.14	8.63	5.94	15.66	30.23	7.96	14.03	43.07	65.06	16.59	19.97	58.73	95.29
	5+10	1.77	4.65	5.78	12.20	9.75	5.23	10.12	25.10	11.53	9.87	15.90	37.30	8.07	11.03	28.92	48.02	20.39	20.90	44.82	86.11
	10+5	4.11	4.54	7.23	15.88	13.35	5.67	11.57	30.59	17.46	10.21	18.80	46.47	7.19	13.04	33.27	53.50	24.65	23.25	52.07	99.99
	10+10	0.85	1.61	9.35	11.81	10.16	6.45	9.35	2.96	11.00	8.06	18.69	37.75	9.31	12.90	25.37	47.58	20.31	20.97	44.06	85.34
CCC	5	5.79	4.82	3.22	13.83	11.58	19.29	45.03	75.90	17.36	24.11	48.25	89.72	4.96	35.37	83.63	123.96	22.33	59.84	131.88	213.69
M H	5	2.78	4.99	7.93	15.70	6.96	14.99	31.73	53.68	9.74	19.99	39.67	96.40	9.04	31.24	50.24	90.52	18.78	51.23	89.91	159.92
CCC + M H	5+5	2.36	3.15	5.36	10.96	6.76	7.89	46.49	60.34	9.22	10.25	51.86	71.33	9.22	19.71	1.79	30.72	18.44	29.96	53.64	102.04

decreased the reducing sugars while such substances greatly increased non-reducing sugars and total carbohydrate in most seedling parts.

c) All treatments regulate the concentration of carbohydrate fractions in different seedling parts.

d) The same trend was also concluded in the case of total amounts per seedling organs.

Also, the effect of some growth regulators on total carbohydrate and / or total soluble sugars was previously reported *(Sansavini, et. al., 1988 and Gehlot, et al., 1989).*

4.2.6. Protein fractions in different seedling at 72 days after soaking in different growth regulators: (Table,19,a).

The following conclusions could be revaled:

a) Different treatments seemed to control the protein concentrations in different seedling organs. Thus it could be concluded that the treatments with various rates of growth substances affected protein synthesis in different apricot seedling organs.

b) As a general the non-soluble protein was the highest in whole seedling followed mostly by water soluble, salt soluble, alcohol soluble, while alkaline-buffer soluble was the lowest one in this respect.

c) Leaves possessed the highest concentration of water soluble protein followed by root while stem ranked the third in this respect.

d) Root possessed the highest levels of salt and buffer soluble proteins followed by stem and leaves which ranked the third in this respect.

The same conclusion was also noticed in the case of alcohol soluble proteins, but leaves possessed the higher levels than stem. With regard to the non-soluble protein; leaves possessed the highest concentration of such protein fraction followed mostly by stem and roots which ranked the third in this respect.

e) The treatments with growth regulators greatly affected the protein fractions in different apricot seedling organs, as it was shown that many treatments increased water soluble protein in whole seedling (GA_3, 5 ppm; IAA, 5, 10 ppm; GA_3 + IAA, 5 + 5 ppm; GA_3 + IAA, 10 + 5; CCC, 5 ppm and CCC + MH, 5 + 5 ppm). However, many other treatments reduced the concentration of water soluble protein in whole seedling (GA_3, 10 ppm; GA_3 + IAA, 5 + 10 ppm; GA_3 + IAA, 10 + 10 ppm and MH 5 ppm). IAA at 10 ppm possessed treated seedling organs the highest water soluble protein in seedling different organs as well as whole seedling while the lowest ones were gained by GA_3 + IAA, 10 + 10 ppm treated seedling. This indicates that GA_3 at 10 ppm depressed the stimulatory effect of IAA at 10 ppm on water soluble protein in different seedling organs when GA_3 applied with IAA. The same conclusion was also noticed in the case of salt soluble protein as the application of IAA at the rate of 10 ppm greatly increased salt soluble protein in different seedling organs. However, GA_3 at the rate of 10 ppm + IAA at the same rate greatly reduced the salt soluble protein and buffer soluble one in different seedling organs as well as whole seedling. At the same time GA_3 at the rate of 10 ppm greatly increased the alcohol soluble protein, GA_3 + IAA at the rate of 10 + 10 ppm stimulated the concentration of non-soluble protein in different seedling organs. In other words, while it was found that GA_3 + IAA at the rate of 10 + 10 ppm reduced the concentration of water, salt, alcohol and buffer soluble proteins, it was found that such treatment increased the non-soluble protein. Again different treatments controlled the protein fraction accumulation in different seedling organs

Table (19, a) : Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on the protein fraction contents in different organs as well as to the whole seedling at the late stage of seedling growth .

(expressed as mg/ gr. dry matter)

Treatments		Water soluble proteins				Salt soluble proteins				Alcohol soluble proteins				Alkline-buffer soluble proteins				Total soluble proteins				Residual (non-soluble proteins)				Total protein contents			
Substance	ppm.	Root	Stem	Leaves	W. seed.*	Root	Stem	Leaves	W. seed.*	Root	Stem	Leaves	W. Seed.*	Root	Stem	Leaves	W. seed.*	Root	Stem	Leaves	W. seed.*	Root	Stem	Leaves	W. seed.*	Root	Stem	Leaves	W. seed.*
Control	8	38.43	28.47	41.11	37.68	28.83	15.28	87.22	13.19	24.87	86.25	83.89	18.76	24.87	86.25	83.89	18.76	893.85	68.42	59.16	78.17	861.31	878.88	215.25	136.88	154.36	138.42	274.41	286.95
GA$_3$	5	51.39	25.69	42.78	48.24	24.31	13.19	87.78	12.89	44.44	81.39	87.78	12.89	44.44	81.39	87.78	12.89	136.11	58.33	78.28	76.43	878.88	891.88	218.75	161.29	286.11	158.21	289.83	248.63
	18	32.46	34.83	33.89	33.51	28.83	16.67	88.61	13.62	31.94	84.86	18.83	15.83	31.94	84.86	18.83	15.83	892.87	78.14	62.22	72.85	875.88	181.25	288.25	149.43	167.87	171.39	278.47	221.37
IAA	5	38.89	35.42	51.11	44.53	43.86	89.83	89.17	16.86	15.28	84.17	86.39	87.87	15.28	84.17	86.39	87.87	185.56	57.47	73.86	76.68	878.75	898.88	227.58	168.23	184.31	147.47	388.56	236.94
	18	48.61	34.83	55.88	48.69	56.94	89.72	12.58	22.58	18.86	87.64	88.33	18.49	18.86	87.64	88.33	18.49	131.94	64.58	89.16	93.73	866.25	189.38	164.58	128.14	198.19	173.96	253.66	221.89
GA$_3$ + IAA	5+5	32.64	25.42	49.44	39.83	26.39	18.42	88.86	13.42	24.31	84.86	86.94	11.87	24.31	84.86	86.94	11.87	888.82	49.73	71.94	71.41	893.75	883.13	194.25	143.76	181.77	132.86	266.19	215.17
	5+18	18.61	29.17	43.33	32.98	86.11	87.64	18.83	88.47	12.22	86.25	89.17	89.52	12.22	86.25	89.17	89.52	846.66	51.39	78.27	59.31	188.25	148.88	215.25	165.24	146.91	191.39	285.52	224.56
	18+5	27.88	39.58	55.88	42.67	14.58	12.58	88.86	11.89	27.78	83.47	86.39	13.89	27.78	83.47	86.39	13.89	875.69	63.88	76.12	73.67	189.38	887.58	283.88	149.84	185.87	151.38	279.12	223.58
	18+18	28.56	31.94	36.11	38.43	18.88	89.72	87.78	88.84	28.28	84.86	86.39	18.39	28.28	84.86	86.39	1839	868.81	55.55	57.78	58.82	181.58	883.13	211.75	151.99	161.51	138.68	269.53	218.84
CCC	5	65.28	22.92	44.44	41.37	33.33	22.92	12.78	18.67	48.28	87.22	88.33	12.68	48.28	87.22	88.33	12.68	148.61	62.78	84.16	87.58	878.75	865.63	288.75	149.81	227.36	128.41	292.91	236.53
M H	5	56.49	24.31	33.33	34.39	38.89	18.42	89.17	14.81	45.83	86.25	85.83	12.81	45.83	86.25	86.25	85.83	153.71	52.79	68.55	72.55	896.25	878.88	281.75	149.89	249.96	122.79	262.38	222.44
CCC + M H	5+5	49.31	28.47	48.56	39.25	29.17	11.81	12.58	15.55	48.28	82.88	88.61	13.89	48.25	82.88	88.61	13.89	134.84	54.17	78.34	78.61	878.88	878.88	217.25	152.48	284.84	124.17	287.59	231.11

* Whole seedling = $\frac{\text{Total amount/ seedling}}{\text{Dry weight/ seedling}}$

as well as whole seedling.

In this connection the regulatory effect of IAA & GA_3 on protein synthesis was also demonstrated by many workers working on many plant species among them are *Burrous & Carr, 1970; Eeuwens and Schawabe, 1975; Millerd et al., 1978; Randall et al., 1979; Thomson et al., 1979, Higgins et al., 1982; Schroeder, 1982, Sponsel, 1982; Devlin and Witham, 1983; Schroeder, 1984 and Gehlot, 1989.*

Protein fractions (mg / seedling): (Table, 19, b)

As the different treatments greatly affected seedling growth, thus, it was thought advisable to study the protein fraction as mg / seedling organs to explain their effects as related to their growth behaviour.

As for CCC at 5 ppm. increased seedling growth, this increment was associated with higher total protein accumulation in different seedling organs, also CCC, at 5 ppm. treated seedling possessed the highest protein fractions either soluble ones or non-soluble. All of treatments with various growth regulators stimulated the various protein fractions in different seedling organs. It may be also concluded that the effects of different tested growth regulators which applied seperatly or with combinations with each other on seedling growth associated with the great variation in accumulation of different protein fraction in various seedling organs when determined at 72 days from soaking.

As a general, leaves possessed the highest amounts of water soluble, buffer-soluble and non-soluble proteins followed mostly by those were found in roots, while stems ranked the third in this respect. On the other hand roots possessed the highest amounts of salt soluble proteins followed mostly by those of leaves, while stems ranked the third in this respect. This means that the distribution of different protein

Table (19,b): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on the total amount of protein fraction in different seedling organs as well as to the whole seedling at the late stage of seedling growth .

(expressed as mg/seedling)

Treatments		Water soluble proteins				Salt soluble proteins				Alcohol soluble proteins				Alkline-buffer soluble proteins				Total soluble proteins				Residual (non-soluble proteins)				Total protein contents			
Substance	ppm.	Root	Stem	Leaves	Whole seed.	Root	Stem	Leaves	Whole seed.	Root	Stem	Leaves	Whole seed.	Root	Stem	Leaves	Whole seed.	Root	Stem	Leaves	Whole seed.	Root	Stem	Leaves	Whole seedl.	Root	Stem	Leaves	Whole seedl.
Control	0	5.79	2.76	9.34	17.89	3.14	1.48	1.64	6.26	3.62	0.61	0.88	5.11	1.46	1.81	1.58	4.85	14.01	5.85	13.45	33.31	9.23	6.78	48.93	64.94	23.25	12.62	62.37	98.24
GA_3	5	5.75	3.81	15.27	24.83	2.72	1.96	2.78	7.46	4.97	0.21	2.78	7.96	1.79	2.68	4.26	8.73	15.23	8.65	25.08	48.96	7.83	13.63	78.07	99.53	23.06	22.28	103.15	148.49
	10	3.81	3.41	7.79	15.01	2.45	1.67	1.98	6.10	3.75	0.49	2.49	6.73	0.89	1.46	2.05	4.40	10.91	7.04	14.32	32.27	8.81	10.16	47.92	66.93	19.72	17.19	62.24	99.15
IAA	5	3.51	3.39	10.69	17.59	3.88	0.86	1.92	6.66	1.38	0.39	1.34	3.11	0.75	0.86	1.34	2.95	9.52	5.49	15.28	30.29	7.10	8.60	47.59	63.29	16.62	14.09	62.88	93.59
	10	4.98	3.04	12.64	20.66	5.84	0.87	2.87	9.58	1.85	0.68	1.92	4.45	0.85	1.18	3.86	5.89	13.52	5.76	20.49	39.77	6.79	9.76	37.82	45.37	20.31	15.52	58.32	94.15
GA_3 + IAA	5+5	4.13	2.61	12.29	19.03	3.34	1.07	2.00	6.41	3.07	0.49	1.73	5.29	0.59	0.93	1.86	3.38	11.13	5.11	17.88	34.12	11.85	8.55	48.29	68.69	22.98	13.66	66.17	102.81
	5+10	3.14	3.23	11.93	18.30	1.03	0.84	2.98	4.85	2.06	0.69	2.53	5.28	1.64	0.92	1.91	4.47	7.88	5.68	19.35	32.91	16.93	15.48	59.28	91.69	24.81	21.17	78.63	124.61
	10+5	5.29	4.27	15.15	24.71	2.85	1.35	2.22	6.42	5.43	0.37	1.76	7.58	1.22	0.89	1.84	3.95	14.80	6.89	20.97	42.66	21.39	9.45	55.93	86.77	36.19	16.35	76.89	129.43
	10+10	3.31	3.27	9.18	15.76	1.61	0.99	1.98	4.58	3.27	0.49	1.62	5.38	1.48	0.92	1.91	4.31	9.67	5.69	14.69	30.05	16.36	8.51	53.85	78.72	26.04	14.20	68.54	108.78
CCC	5	10.28	7.02	27.23	44.53	5.25	7.02	7.83	20.10	6.34	2.21	5.10	13.65	1.53	2.98	11.40	15.91	23.41	19.22	51.56	94.19	12.40	20.09	127.90	160.39	35.81	39.32	179.47	254.60
M H	5	7.48	5.79	16.79	30.06	5.15	2.48	4.62	12.25	6.07	1.49	2.94	10.50	1.66	2.81	6.16	10.63	20.37	12.56	30.49	63.42	12.75	16.66	101.62	131.03	33.12	29.22	132.12	194.46
CCC + M H	5+5	5.77	4.28	13.81	23.86	3.42	1.77	4.26	9.45	4.72	0.31	2.93	7.96	1.79	1.77	2.95	6.51	15.69	8.14	23.96	47.79	8.19	10.51	73.99	92.69	23.89	18.65	97.95	140.49

Whole seed. = Whole seedling

fractions in various seedling organs were greatly differed according to the function of the organ, and that may play a role in various physiological processes and finally the seedling growth behaviour. In addition, the use of growth regulators affected such accumulation and that reflected on the seedling growth behaviour through their regulation effect on protein fraction assimilations.

4.2.7 Picture of total amino acids fractions (free + bound) in seedling of apricot as affected by some growth regulators: (Tables, 20, a & b).

The following conclusions could be revealed:

a) Aspartic acid was by far the more abundant component in different seedling organs followed by glutamine, leucine & isoleucine, alanine, arginine, valine and histidine, while other amino acids (phenylalanine, aminobutaric and proline) were the lowest. In addition, methionine was the lowest in this respect, as it was found in very trace amount in roots only.

b) Leaves possessed the highest concentration of total amino acids followed by those found in roots, while stems ranked the third in this respect .

c) The great variable in the concentration of amino acids in different seedling organs may be dependent on the role and the function of the organ which may be lead to the variable metabolic processes.

d) It could be concluded as a general that growth regulators controlled the accumulation of amino acid fractions in apricot seedling organs. Thus, it may be stated that the tested growth substances under the conditions of this experiment regulate the metabolic process of amino acids metabolism in different apricot seedling. *(Singh et al., 1973 and Devlin and Witham, 1983* **came to the same conclusion) . This regulation may play a role in seedling growth, or associate with**

Table (20,a) : Effect of soaking of cv. El-Amar apricot seeds in some growth regulators in amino acid fraction contents in different organs as well as to the whole seedling at the late stage of seedling growth.

(expressed as mg/gr. dry matter)

Amino Acids / Treatments: Substance	ppm.	Seedling organs	Aliphatic A.A. Alanine	Aliphatic A.A. Valine	Hydro. A.A. Lucine & Isolucine	Sulpher A.A. Methionine	Acidic A.A. Aspartic	Acidic A.A. Glutamine	Acidic A.A. Arginine	Acidic A.A. Aminobutric	Basic A.A. Histidine	Aromatic A.A. Phenylalanine	Aromatic A.A. Proline	Total amino acids content
Control	0	Root	15.81	11.29	21.45	1.13	39.52	24.84	22.58	02.26	13.55	03.39	3.20	159.82
		Stem	12.42	10.16	14.68	*	38.39	18.06	12.42	03.39	09.03	06.78	4.00	129.33
		Leaves	29.36	22.58	45.17	*	51.19	36.13	18.07	05.65	16.94	10.19	2.67	237.95
		W.seedling"	21.59	16.45	31.43	0.36	44.09	28.06	18.35	04.11	14.24	07.35	3.12	190.75
GA_3	5	Root	15.81	11.29	24.84	2.26	56.46	27.10	24.84	02.26	11.29	04.52	6.40	187.07
		Stem	12.42	10.16	19.19	*	47.43	16.94	12.42	05.65	11.29	04.52	4.00	144.02
		Leaves	41.40	28.61	58.44	*	56.46	46.67	10.02	07.53	18.07	07.15	2.13	277.20
		W.Seedling"	29.70	21.03	38.29	0.41	54.24	35.99	10.30	06.13	15.20	06.04	3.55	229.01
	10	Root	21.40	09.03	21.45	2.25	39.52	24.84	19.19	03.39	21.45	02.26	3.20	159.00
		Stem	07.90	05.65	15.81	*	47.43	21.45	24.84	05.65	11.29	04.52	2.40	146.94
		Leaves	31.62	23.71	42.91	*	57.59	40.65	14.12	09.59	15.81	09.59	2.80	248.39
		W.Seedling"	21.20	15.03	31.21	0.50	50.55	32.19	17.04	07.00	16.20	06.54	2.81	202.19
IAA	5	Root	16.94	13.55	20.33	2.26	41.78	28.23	25.97	03.39	13.55	04.52	4.00	174.52
		Stem	07.90	05.65	15.81	*	56.46	15.81	25.97	03.39	11.29	01.13	4.00	148.21
		Leaves	36.13	24.84	42.91	9.03	49.68	42.91	18.07	11.29	27.10	11.29	4.00	278.02
		W.Seedling"	24.94	17.95	31.39	5.29	49.49	33.01	21.77	07.57	20.10	07.29	4.61	222.94
	10	Root	18.07	15.81	20.33	1.13	41.78	28.23	21.45	03.39	20.53	03.39	4.00	178.11
		Stem	13.55	06.78	18.07	*	56.46	20.33	19.19	05.65	12.42	02.26	4.00	159.51
		Leaves	05.65	33.88	44.04	*	49.68	25.97	21.45	11.29	25.97	07.90	4.00	230.63
		W.Seedling"	10.37	23.69	32.69	0.20	49.14	25.34	20.90	08.13	21.70	05.61	4.59	202.59
GA_3 + IAA	5+5	Root	20.33	18.07	24.84	*	29.36	33.88	11.29	04.52	15.81	06.07	5.75	170.63
		Stem	15.81	19.91	14.68	3.39	14.68	19.19	22.58	*	10.16	04.52	3.20	128.12
		Leaves	30.49	22.58	37.03	*	42.36	33.31	12.99	10.16	12.42	12.99	2.80	217.13
		W.Seedling"	24.63	20.00	29.41	0.73	32.96	30.41	14.61	06.49	12.01	09.52	3.24	185.62
	5+10	Root	09.03	11.29	24.84	9.03	27.10	18.07	13.55	04.52	11.29	04.52	4.0	138.04
		Stem	13.55	12.42	18.07	3.39	65.49	16.94	25.97	*	12.42	04.52	4.00	176.77
		Leaves	28.23	22.02	40.89	*	51.94	30.94	20.33	09.59	20.09	17.50	2.40	243.93
		W.Seedling"	19.44	16.03	31.33	3.42	47.07	24.22	19.37	06.13	16.27	10.93	3.44	190.10
GA_3+IAA	10+5	Root	11.29	16.94	28.23	2.26	39.52	24.84	18.07	02.26	11.29	04.52	3.20	162.42
		Stem	10.16	06.78	11.29	2.26	56.46	13.55	28.23	*	06.76	01.13	4.00	141.44
		Leaves	31.05	25.41	42.35	*	49.68	28.09	10.63	10.16	10.63	09.59	2.80	220.39
		W.seedling"	20.46	19.06	31.79	1.17	47.50	20.06	20.22	05.50	13.94	06.29	2.94	189.01
	10+10	Root	13.55	13.55	20.33	6.78	30.49	16.94	19.19	06.78	10.16	03.39	3.20	144.36
		Stem	07.90	06.78	11.29	*	47.43	16.94	24.84	03.39	10.16	4.52	4.00	138.05
		Leaves	31.62	24.84	43.47	*	44.04	23.71	19.19	06.78	20.33	10.16	2.80	226.94
		W.Seedling"	21.29	17.74	29.91	2.10	40.47	20.25	20.29	06.10	15.16	06.93	3.32	183.59
CCC	5	Root	22.58	18.07	31.62	9.03	40.65	22.58	24.84	09.03	18.07	09.03	6.40	211.90
		Stem	13.55	05.65	13.55	5.65	38.43	15.81	18.07	*	11.29	04.52	*	126.52
		Leaves	33.88	22.58	56.46	*	47.43	31.62	21.45	13.55	29.36	07.90	4.00	268.23
		W.Seedling"	26.45	17.10	40.62	2.93	43.00	25.79	20.90	09.03	22.50	07.09	3.21	219.67
MH	5	Root	16.94	20.33	47.43	6.78	47.43	22.58	24.84	06.78	20.33	18.07	3.20	234.71
		Stem	09.03	07.90	12.42	9.03	36.13	14.68	22.58	*	07.90	04.52	3.20	127.39
		Leaves	36.16	16.37	36.13	*	44.04	46.29	16.37	07.34	21.45	10.73	2.40	237.28
		W.Seedling"	25.05	14.66	31.30	3.40	42.30	34.09	19.34	05.24	17.50	10.15	2.73	206.09
CCC+MH	5+5	Root	13.55	23.71	31.62	9.03	31.26	18.07	15.81	06.78	13.55	19.94	3.20	186.89
		Stem	11.29	07.90	11.29	*	38.43	13.55	18.07	05.65	06.78	04.52	2.40	119.88
		Leaves	17.82	34.42	38.11	*	55.31	51.63	17.21	07.99	20.28	14.75	4.00	261.52
		W.Seedling"	15.30	25.01	30.22	1.74	46.57	35.70	17.24	07.17	15.66	13.21	3.44	212.22

A.A. = Amino acids Hydro. = Hydroxylic " Whole seedling = $\frac{\text{Total amount/seedling}}{\text{Dry weight/seedling}}$ * = Non-detected

Table (20,b) : Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on total amount of amino acid fraction contents in different organs as well as to the whole seedling at the late stage of seedling growth.
(expressed as mg/seedling)

Amino Acids / Treatments: Substance	ppm.	Seedling organs	Aliphatic A.A.: Alanine	Aliphatic A.A.: Valine	Hydro. A.A.: Lucine & Isolucine	Sulpher A.A.: Methionine	Acidic A.A.: Aspartic	Acidic A.A.: Glutamine	Acidic A.A.: Arginine	Acidic A.A.: Aminobutric	Basic A.A.: Histidine	Aromatic A.A.: Phenylal. anine	Aromatic A.A.: Proline	Total amino acids content
Control	0	Root	02.30	01.70	03.23	00.17	05.95	03.74	03.40	0.34	02.04	00.51	00.40	23.91
		Stem	01.20	00.90	01.42	*	03.72	01.75	01.20	00.33	00.07	00.66	00.39	12.52
		Leaves	06.67	05.13	10.27	*	11.64	00.21	04.11	01.20	03.05	02.32	00.61	54.09
		W.seedling	10.25	07.01	14.92	00.17	21.31	13.70	00.71	01.95	06.76	03.49	01.40	90.55
GA₃	5	Root	01.71	01.26	20.70	00.25	06.32	03.03	02.70	00.25	10.26	00.51	00.72	20.07
		Stem	01.04	01.51	02.05	*	07.03	02.51	01.04	00.04	01.67	00.67	07.71	21.47
		Leaves	14.70	10.21	10.00	*	20.15	16.67	06.72	02.69	06.45	02.55	00.76	90.90
		W.Seedling	10.33	12.90	23.63	00.25	33.50	22.21	11.34	03.70	9.30	03.73	02.19	141.32
	10	Root	01.46	01.06	02.52	00.26	04.64	02.92	02.25	00.39	02.52	00.27	00.30	10.67
		Stem	00.79	00.57	01.59	*	04.75	02.15	02.49	00.57	01.13	00.45	00.24	14.74
		Leaves	07.20	05.46	09.07	*	13.25	09.35	03.25	02.21	03.64	02.21	00.64	57.15
		W.Seedling	09.53	07.09	13.90	00.26	22.64	14.42	07.99	03.17	07.29	02.93	01.26	90.56
IAA	5	Root	01.53	01.22	01.03	00.20	03.77	02.66	02.34	00.31	01.22	00.41	00.36	15.74
		Stem	00.76	00.54	01.51	*	05.39	01.51	02.40	00.32	01.00	00.11	00.46	14.16
		Leaves	07.56	05.19	00.90	01.09	10.39	00.90	03.70	02.36	05.67	02.36	01.00	50.16
		W.Seedling	09.05	06.95	12.32	02.09	19.55	13.04	00.60	02.99	07.97	02.00	01.02	00.06
	10	Root	01.90	01.66	02.14	00.12	04.39	02.97	02.26	00.36	02.16	00.36	00.42	10.74
		Stem	01.21	00.60	01.61	*	05.04	01.01	01.71	00.50	01.11	00.20	00.43	14.22
		Leaves	01.29	07.79	10.12	*	11.42	05.97	04.93	02.59	05.97	01.02	01.10	53.00
		W.Seedling	04.45	10.05	13.70	00.12	20.05	10.75	00.90	03.45	09.24	02.30	01.95	05.96
GA₃ + IAA	5+5	Root	02.57	02.20	03.14	*	03.71	04.20	01.43	00.57	01.99	00.06	00.73	21.56
		Stem	01.62	02.05	01.51	00.35	01.51	01.97	02.32	*	01.04	00.46	00.33	13.16
		Leaves	07.50	05.61	09.40	*	10.53	00.20	03.23	02.53	03.09	03.23	04.49	53.97
		W.Seedling	11.77	09.94	14.05	00.35	15.75	14.53	06.90	03.10	06.12	04.55	01.55	00.71
	5+10	Root	01.53	01.91	04.19	01.53	04.50	03.05	02.29	00.76	01.91	01.76	00.01	23.32
		Stem	01.49	01.37	01.99	00.37	07.24	01.07	02.07	*	01.37	00.49	00.49	19.50
		Leaves	07.77	06.06	11.04	*	14.30	00.52	05.59	02.64	05.75	04.02	00.66	67.15
		W.Seedling	10.79	09.34	17.22	01.90	26.12	13.44	10.75	03.40	09.03	06.07	01.91	109.97
GA_3 + IAA	10+5	Root	02.21	03.31	05.52	00.44	07.73	04.06	03.53	00.44	02.21	00.00	00.63	31.76
		Stem	01.09	00.73	01.22	00.24	06.09	01.46	03.05	*	00.73	00.12	00.52	15.25
		Leaves	00.55	07.00	11.67	*	13.69	05.76	05.13	02.79	05.13	02.64	00.55	62.91
		W.seedling*	11.05	11.04	10.14	00.60	27.51	12.00	11.71	03.23	00.07	03.64	01.70	109.92
	10+10	Root	02.10	02.10	03.20	01.09	04.91	02.73	03.09	01.19	01.64	00.55	00.52	23.26
		Stem	00.01	00.69	01.16	*	04.06	01.37	02.54	00.35	01.04	00.46	00.49	14.13
		Leaves	00.04	06.32	11.05	*	11.19	06.03	04.00	01.72	05.17	02.50	00.71	57.79
		W.Seedling*	11.03	09.19	15.49	01.09	20.96	10.49	10.51	03.16	07.05	03.59	01.72	95.00
CCC	5	Root	03.56	02.05	04.90	01.42	06.40	03.53	03.91	01.42	02.05	01.42	01.01	33.37
		Stem	04.15	01.73	04.15	01.73	11.77	04.04	05.53	*	03.46	01.30	*	30.47
		Leaves	20.76	13.03	34.59	*	29.06	19.37	13.14	00.30	17.99	04.04	02.42	164.34
		W.Seedling*	20.47	10.41	43.72	03.15	47.23	27.77	22.50	09.72	24.30	07.64	03.46	236.45
M.H.	5	Root	02.24	02.69	06.20	00.09	06.20	02.99	03.29	00.09	02.69	02.39	00.42	31.05
		Stem	02.15	01.00	02.96	02.15	00.59	03.49	05.37	*	01.00	01.00	00.76	30.31
		Leaves	10.21	00.25	10.19	*	22.10	23.32	00.25	03.69	10.00	05.40	01.21	119.50
		W.Seedling*	22.60	12.02	27.43	03.04	37.05	29.00	16.91	04.50	15.37	08.87	02.39	100.06
CCC+M.H.	5+5	Root	01.52	02.70	03.70	01.06	03.70	02.12	01.05	00.79	01.59	02.33	00.37	21.08
		Stem	01.69	01.19	01.69	*	05.77	02.04	02.71	00.05	01.02	00.	00.36	10.00
		Leaves	06.07	11.72	12.09	*	10.40	17.59	05.06	02.72	06.91	05.02	01.36	89.07
		W.Seedling*	09.35	15.69	10.37	01.06	20.31	21.75	10.42	04.34	09.52	00.03	2.09	120.95

A.A. = Amino acids   Hydr. = Hydroxylic   * W.seedling = Whole Seedling   * = Non detected the control of seedling growth behaviour. CCC at the rate of 5 ppm stimulated higher accumulation of total amino acids in seedling tissues. Accordingly, the stimulatory effect of such treatment on seedling growth may be related to the highest synthesis of amino acids especially in seedling leaves and roots. Such effect was greatly variable within amino acid fractions, as some amino acids increased, while others were decreased as compared to those corresponding ones of control seedlings.

e) Other substances, i.e. GA_3, IAA, or MH at different rates either alone or in combinations with each other controlled also the synthesis of amino acids as GA_3 & IAA at 5 ppm have the same stimulatory effect on total amino acid concentrations. However, such stimulatory effect was greatly different in the amino acid fractions when compared with the corresponding ones of CCC treated seedling. But, when GA_3 was applied beside IAA such accumulation greatly depressed . Accordingly, GA_3 and or IAA suppressed the stimulatory effect of every one on the synthesis of different amino acid fractions.

f) The same conclusions were also revealed when the concentration of amino acids (mg/gr.) were turned out into the total amounts (mg/seedling organs).

g) The great variations in protein fractions as the result of the substance treatments were due to the great variations in the synthesis and the accumulation of amino acid fractions, and the balance between such vital acids.

4.2.8. Nutrient changes during different periods of seedling growth:

Nutrient status in apricot seedling during different periods of growth as affected by different treatments with growth regulators in terms of concentration per one gram, actual amount per seedling, percentage distribution in different seedling organs at 72 days from soaking and percentage increase or decrease as related to the

maximum amount attained during the period of growth is shown in Tables (21,a,..& e ; 22,a,..& d and 23). It must be mentioned that during early periods of growth, the first 30 days (i.e. 7 days was considered as early stage of radical emergency and 30 days was considered as the stage of plumule emergency) the status of the nutrients was estimated in whole seedling as it was difficult to separate its organs, also the main organ in such period was the large cotyledons, the stored organ. During the later period of growth 72 days (i.e. late stage of leaves and branching formation) the seedling was differentiated into root, stem and leaves, while the cotyledons were either decayed in many treatments or in many other treatments were still attached to the seedling without complete changing. Thus, the total dry weight of seedling at 72 days after soaking may be decreased, or increased as related to those were found during early periods of growth (7 or 30 days after soaking) and that affected the whole amounts which were found in whole seedling according to the amounts in the disintegrated cotyledons.

Also, the effect of some growth regulators on the uptake and accumulation of different nutrients in other plants was previously reported by other workers *(e.g. Seth and Wareing, 1967 ; Saks and Ilan, 1984 ; El-Zawily and Zayed, 1985; Zayed et al., 1985 b; Khafaga et al., 1986; Ibrahim and Khafaga, 1986)* **.**

Nitrogen: (Table,21,a)

Nitrogen concentration seemed to slightly decrease from 7 to 30 days after soaking and greatly decreased during 72 days. This decline was mainly due to the dilution of the initial N amounts with the growth of the developing seedling. In addition, during the later periods of growth such great decline was partially related to the redistribution of N in different seedling organs and partially to the loss

amounts in decayed cotyledons which discussed before.

With regard to the N concentration in different seedling organs during 72 days after soaking, as a general, leaves possessed the highest amounts of N followed by roots while stem possessed the lowest amounts. This is true with the actual amount per seedling organ as well as the percentage distribution. It could be stated also that different treatments with the tested substances greatly changed the N concentration, actual amount per seedling, percentage distribution and percentage increase during different periods of growth. It must be mentioned also that variable tested growth regulators under the conditions of such experiment affected the absorbed amount of N and that affected the nitrogen status in apricot seedling during the various periods of growth. The most stimulatory effect on nitrogen absorption was found when seeds were soaked in the growth retardant CCC at the rate of 5 ppm. Also, MH (antiauxin) at the rate of 5 ppm had the same stimulatory effect on N uptake by the developing seedling but that was less than the effect of CCC. Such phenomenon was based on the total amount in whole seedling which found during 72 days.

On the other hand, most treatments with growth substances seemed to decline such absorption into very limited amounts, as whole seedling nitrogen content during 72 days was less than those found at 30 days and that related to the losses of cotyledons. This leads us to the assumption that either IAA or GA_3 not only decreased the absorption of N but also retarded the translocation of nitrogenous compounds from the stored organ, the cotyledons, then to the developing parts of the seedling. In addition, such growth regulators, as a general, seemed to disturb the accumulation proportion of N in different seedling organs during 72 days after soaking, when compared to the corresponding ones of the control seedling.

Table (21,a,b,c &d): Effect of soaking of cv, El-Amar apricot seeds in some growth regulators on some macro-nutrient status during different periods of growth .

21,a) Nitroge

Treatments		Concentration mg/gr.dry weight						Total amount mg/seedling						% distribution			% increase as related to the highest value		
		7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
Substances	ppm.			Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	45.5	45.5	24.8	20.3	42.6	32.4	18.8	24.6	3.7	1.9	9.7	15.3	24.2	12.4	63.4	76.4	100.0	62.2
GA3	5	47.0	46.0	32.6	22.7	45.5	37.7	21.7	21.9	3.6	3.4	16.2	23.2	15.5	14.7	69.8	93.5	94.3	100.0
	10	46.8	45.5	26.5	25.4	41.9	34.2	23.4	26.1	3.1	2.5	9.7	15.3	20.3	16.3	63.4	89.7	100.0	58.6
IAA	5	54.3	50.8	20.1	23.1	46.9	36.2	22.3	31.2	2.5	2.0	9.8	14.3	17.5	13.9	68.5	71.5	100.0	45.8
	10	47.3	45.5	30.8	27.0	40.1	35.0	15.9	18.8	3.2	2.4	9.2	14.8	21.6	16.2	62.2	84.6	100.0	70.7
GA3 + IAA	5+5	49.1	40.8	29.0	21.1	41.8	33.9	22.3	22.7	3.7	2.2	10.4	16.3	22.7	13.5	63.8	98.2	100.0	71.8
	5+10	50.5	44.0	22.4	30.3	43.7	34.6	25.5	26.6	3.8	3.4	12.1	19.3	19.7	17.6	62.7	95.9	100.0	72.6
	10+5	45.3	44.2	20.5	23.2	42.8	34.3	23.0	24.3	5.6	2.5	11.8	19.9	28.1	12.6	59.3	94.7	100.0	81.9
	10+10	51.0	40.1	24.6	21.2	42.1	32.5	25.9	27.1	3.9	2.2	10.7	16.8	23.2	13.1	63.7	95.6	100.0	61.9
C C C	5	46.8	41.3	33.5	20.2	45.9	36.8	22.6	24.4	5.3	6.2	28.1	39.6	13.4	15.7	70.9	57.1	61.6	100.0
MH	5	44.5	44.3	30.1	19.1	40.8	34.4	18.3	18.8	5.1	4.5	28.5	38.1	16.9	14.9	68.1	75.1	81.1	100.0
CCC+MH	5+5	49.5	46.0	31.5	19.1	43.7	35.3	22.9	25.8	3.7	2.9	14.9	21.5	17.2	13.5	69.3	88.8	100.0	83.3

W.seedl. = Whole seedling * = $\frac{\text{Total amount /seedling}}{\text{Dry weight / seedling}}$

Phosphorus: (Table,21, b)

The following conclusions could be revealed:

a) As a general, phosphorus status increased gradually during different periods of seedling growth. Thus, the highest proportion was found at 72 days after soaking in different treated seedlings. This indicates that the developing seedlings required additional amount of P beside that which found in cotyledons. In other words, the stored phosphorus in cotyledon of apricot was not sufficient for maintaining the developing seedling and additional amounts must be present in the germinated medium of apricot. This also indicates that phosphorus application in the medium of apricot plays an important role in germination processes of such oily seeds . The absorption of P seemed to occur during early periods of growth (the first 30 days), as it was found, higher proportion of P in seedling from 7 to 30 days after soaking . During such periods the absorption of P seemed to reached into the maximum mostly and reached sometimes into more than 90 % under some treatments.

b) As in the case of N the highest proportion of P was found in leaves followed by those found in roots, while the lowest one was found in stem at 72 days.

As phosphorus plays an important role in photosynthesis beside respiration, thus the amount of P in leaves was higher than that found in roots, while that in roots plays an important role in the energy transport which affected the absorption of different elements during the active salt absorption phenomenon, thus, the amount in roots exceeded those found in stems. According to the above mentioned information different treatments with growth regulators affected the growth behavior of apricot seedling through their effects on the control of P uptake and distribution in different seedling organs.

21.b) Phosphorous .

Treatments		Concentration mg/gr.dry weight						Total amount mg/seedling						% distribution			% increase as related to the highest value		
				72 days						72 days				72 days			Days after sowing		
Substances	ppm.	7 days	30 days	Root	Stem	Leaves	* W.seedl.	7 days	30 days	Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	6.0	7.9	11.6	4.5	11.3	10.0	2.7	4.3	1.0	0.4	2.6	4.0	37.5	8.3	54.2	56.3	89.6	100.0
GA_3	5	9.0	9.8	12.0	6.0	12.4	11.1	4.2	4.7	1.4	1.0	4.4	6.8	20.6	14.7	64.7	61.0	69.1	100.0
	10	6.0	6.0	10.5	10.1	7.9	9.1	3.4	3.9	1.2	1.0	1.8	4.0	30.0	25.0	45.0	85.0	97.5	100.0
IAA	5	9.0	6.5	11.6	9.8	11.0	10.7	3.7	3.9	1.1	0.9	2.3	4.3	25.6	20.9	53.5	86.0	90.7	100.0
	10	6.0	8.0	11.3	5.6	10.1	9.5	2.3	3.6	1.2	0.5	2.3	4.0	30.0	12.5	57.5	57.5	90.0	100.0
GA_3 + IAA	5+5	3.4	5.8	11.3	11.0	10.3	10.7	1.5	3.2	1.4	1.1	2.5	5.0	28.0	22.0	50.0	30.0	64.0	100.0
	5+10	3.4	6.5	10.0	10.0	11.0	10.9	2.0	3.9	1.8	1.2	3.0	6.0	30.0	20.0	50.0	33.3	65.0	100.0
	10+5	6.0	8.5	11.1	11.3	14.1	12.6	3.4	4.7	2.2	1.2	3.9	7.3	30.1	16.4	53.4	48.6	64.4	100.0
	10+10	4.5	9.0	12.5	12.5	11.3	11.9	2.3	5.1	2.0	1.3	2.9	6.2	32.3	20.9	46.8	37.1	82.3	100.0
C C C	5	6.0	9.5	13.6	4.5	12.6	10.5	3.3	5.6	2.1	1.4	7.7	11.2	18.8	12.5	68.7	29.5	50.0	100.0
MH	5	5.6	7.9	12.1	10.1	11.4	11.2	2.3	3.4	1.6	2.4	5.7	9.7	16.5	24.7	58.8	23.7	35.1	100.0
CCC+MH	5+5	4.5	5.6	16.0	6.0	14.6	12.9	2.1	3.2	1.9	1.0	4.9	7.8	24.4	12.8	62.8	26.9	41.0	100.0

W. seedl. = Whole seedling $\quad * = \dfrac{\text{Total amount/seedling}}{\text{Dry weight /seedling}}$

c) As in N, phosphorus status in CCC treated seedling greatly exceeded those found in other treatments. Accordingly, the effect of CCC at the rate of 5 ppm on the acceleration of seedling growth may be related to the higher absorption of P which seemed to be more than the double of those found in control one which accumulated in roots or leaves, i.e. affected both of photosynthesis and the absorption of other elements and that led to exceeding of growth . MH also accelerates the accumulation of P but in less amounts. However, other growth substances disturb the accumulation of P in seedling without clear trend in this respect.

The higher absorption P proportion occurred during the period extended from 30 till 72 days in CCC treated seedling or CCC + MH treated ones . Most of such absorption was directed mainly into the developing leaves.

<u>Potassium</u>: (Table,21, c)

The behaviour of K was seemed to be more or less like those found in P trend. Again the stored amounts of K in seeds was not sufficient to the germination process of seedling, thus, it must be found in the germinated medium of apricot. CCC and MH increased the uptake of K and that plays an important role in the developing growth of seedling. The highest absorption rate occurred during the period extended from 30 till 72 days under such treatments. In addition, other treatments seemed to disturb the accumulation of K in seedling of apricot and that play an important role in the control of seedling growth. The highest accumulation proportion of K in leaves under different treatments indicates the higher needs of K for the different processes in leaves beside its role in the cell and tissue turgidity and leaf water balance.

21,c) Potassium .

Treatments		Concentration mg/gr.dry weight						Total amount mg/seedling						% distribution			% increase as related to the highest value		
Substances	ppm.	7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
				Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	8.6	13.1	13.5	19.1	27.5	21.3	3.6	7.1	2.0	1.8	6.3	10.1	19.8	17.8	62.4	35.6	70.3	100
GA3	5	8.5	14.7	16.7	18.3	30.5	25.1	3.9	7.0	1.9	2.7	10.9	15.5	12.3	17.4	70.3	25.2	45.2	100
	10	8.3	13.6	10.2	17.3	30.2	21.8	4.2	7.8	1.2	1.7	6.9	9.8	12.2	17.3	70.4	42.9	79.6	100
IAA	5	6.8	13.9	11.9	14.8	29.6	22.0	2.8	8.5	1.1	1.4	6.2	8.7	12.6	16.1	71.3	32.2	97.7	100
	10	9.3	14.6	13.2	16.9	31.1	23.6	3.1	6.8	1.4	1.5	7.1	10.0	14.0	15.0	71.0	31.0	68.0	100
GA3 + IAA	5+5	9.9	13.8	10.2	15.2	30.4	21.9	4.5	7.7	1.3	1.6	7.6	10.5	12.4	15.2	72.4	42.9	73.3	100
	5+10	9.8	9.5	10.4	14.6	33.3	22.7	5.4	5.7	1.8	1.6	9.2	12.6	14.3	12.7	73.0	42.9	45.2	100
	10+5	6.1	11.8	12.9	18.4	32.9	23.3	3.1	6.5	2.5	1.9	9.1	13.5	18.5	14.1	67.4	22.9	48.1	100
	10+10	9.6	15.2	14.4	16.4	32.9	23.9	4.9	8.5	2.3	1.7	8.4	12.4	18.5	13.7	67.7	39.5	68.5	100
C C C	5	7.9	13.5	20.9	15.3	29.8	24.4	3.8	7.9	3.3	4.7	18.3	26.3	12.5	17.9	69.6	14.4	30.0	100
MH	5	11.6	14.3	16.7	20.1	30.1	25.4	4.8	6.0	2.2	4.8	15.2	22.2	9.9	21.6	68.5	21.6	27.0	100
CCC+MH	5+5	9.8	10.5	19.6	29.8	28.9	27.3	4.5	5.9	2.3	4.5	9.8	16.6	13.9	27.1	59.0	27.1	35.5	100

W. seedl. = Whole Seedling. $* = \frac{\text{Total amount / seedling}}{\text{Dry weight / seedling}}$

21,d) Calcium .

Treatments		Concentration mg/gr.dry weight						Total amount mg/seedling						% distribution			% increase as related to the highest value		
Substances	ppm.	7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
				Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	6.0	8.0	11.0	11.0	14.0	12.4	2.5	4.3	1.7	1.1	3.2	6.0	28.3	18.3	53.3	41.7	71.7	100
GA₃	5	6.0	9.0	12.0	8.0	17.0	13.9	2.8	4.3	1.3	1.2	6.1	8.6	15.1	13.9	70.9	32.6	50.0	100
	10	5.0	9.0	9.0	10.0	18.0	13.8	2.5	5.2	1.1	1.0	4.1	6.2	17.7	16.1	66.1	40.3	83.9	100
IAA	5	6.0	6.0	9.0	9.0	11.0	10.1	2.5	3.7	0.8	0.9	2.3	4.0	20.0	22.5	57.5	62.5	92.5	100
	10	6.0	9.0	8.0	8.0	14.0	11.2	2.0	3.7	0.8	0.7	3.2	4.7	17.0	14.9	63.8	42.6	78.7	100
GA₃ + IAA	5+5	5.0	9.0	10.0	12.0	14.0	12.5	2.3	4.1	1.3	1.2	3.5	6.0	21.7	20.0	58.3	38.3	68.3	100
	5+10	6.0	7.0	10.0	13.0	18.0	14.6	3.6	4.2	1.7	1.4	4.9	8.0	21.3	17.5	61.3	45.0	52.5	100
	10+5	7.0	9.0	12.0	15.0	17.0	14.9	3.6	4.9	2.4	1.6	4.7	8.7	27.6	18.4	54.0	41.4	59.3	100
	10+10	7.0	10.0	10.0	12.0	13.0	11.9	3.6	5.6	1.6	1.2	3.3	6.1	26.2	19.7	54.1	59.0	91.8	100
C C C	5	7.0	8.0	9.0	10.0	16.0	13.3	3.4	4.7	1.4	3.1	9.8	14.3	9.8	21.7	68.5	23.8	32.9	100
MH	5	5.0	8.0	10.0	10.0	21.0	16.3	2.1	3.4	1.3	2.4	10.6	14.3	9.1	16.8	74.1	14.7	23.8	100
CCC+MH	5+5	7.0	8.0	12.0	12.0	15.0	13.7	3.2	4.5	1.4	1.8	5.1	8.3	16.9	21.7	61.4	38.6	54.2	100

W. seedl.= Whole Seedling. $* = \frac{\text{Total amount / seedling}}{\text{Dry weight / seedling}}$

21,e) Magnezium .

Treatments		Concentration mg/gr.dry weight						Total amount mg/seedling						% distribution			% increase as related to the highest value		
Substances	ppm.	7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
				Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	2.1	2.6	3.1	2.4	3.9	3.3	0.9	1.4	0.5	0.2	0.9	1.6	31.2	12.5	56.3	56.3	87.5	100
GA_3	5	2.3	2.7	3.3	2.5	3.8	3.4	1.1	1.3	0.4	0.4	1.4	2.2	18.2	18.2	63.6	50.0	59.1	100
	10	2.3	2.5	2.9	2.5	3.8	3.3	1.2	1.4	0.3	0.3	0.9	1.5	20.0	20.0	60.0	80.0	93.3	100
IAA	5	1.4	1.6	2.9	1.2	2.8	2.4	0.6	0.9	0.3	0.1	0.6	1.0	30.0	10.0	60.0	60.0	90.0	100
	10	2.4	2.5	2.2	2.1	2.9	2.6	0.8	1.0	0.2	0.2	0.7	1.1	18.2	18.2	63.6	72.7	90.9	100
GA_3 + IAA	5+5	2.0	2.0	2.2	2.1	2.5	2.3	0.9	1.1	0.3	0.2	0.6	1.1	27.3	18.2	54.5	81.8	100	100
	5+10	2.2	2.3	2.2	2.2	3.1	2.6	1.3	1.4	0.4	0.2	0.9	1.5	26.7	13.3	60.0	86.7	93.3	100
	10+5	2.1	2.2	2.1	1.7	2.4	2.2	1.1	1.2	0.4	0.2	0.7	1.3	30.8	15.4	53.8	84.6	92.3	100
	10+10	2.0	2.2	2.1	1.9	2.7	2.4	1.0	1.2	0.3	0.2	0.7	1.2	25.0	16.7	58.3	83.3	100	100
C C C	5	2.2	2.9	2.3	2.0	2.7	2.5	1.1	1.7	0.4	0.6	1.7	2.7	14.8	22.2	62.9	40.7	62.9	100
MH	5	2.9	2.9	2.1	1.9	3.0	2.6	1.2	1.3	0.3	0.4	1.5	2.2	13.6	18.2	68.2	63.6	59.1	100
CCC+MH	5+5	2.5	2.6	2.4	2.2	2.6	2.4	1.2	1.4	0.3	0.3	0.9	1.5	20.0	20.0	60.0	80.0	93.3	100

W. seedl.= Whole Seedling. * = $\frac{\text{Total amount / seedling}}{\text{Dry weight / seedling}}$

Calcium: (Table,21, d)

The behaviour of Ca in developing seedling of apricot seemed to be more or less the same of P and K under different treatments. As Ca is immobile element, therefore any absorbed amount is translocated directly into the new formed developed tissues. Accordingly, the absorbed Ca was accumulated in leaves which possessed highest amount of Ca than roots, while stem was the lowest. The continuous increase in Ca with advancing age indicates that Ca continues to be absorbed with increasing the growth of apricot seedling. The presence of Ca in the medium is very important for the development of the seedling. The variable need for such development was controlled by subjecting the seeds under soaking of the used growth regulators.

Magnesium: (Table, 21, e).

Changes in Mg status in seedling of apricot took the same trend of P,K and Ca.

Fe,Mn,Zn and Cu: (Tables, 22,a,..& d).

Changes in Fe, Mn, Zn and Cu status in seedling of apricot during different stages of growth were more or less the same trend of different macro elements. CCC treated seedling was superiour in Fe accumulation. leaves possessed the highest Fe followed by roots and the least was found in stem. Different treatments regulate such accumulation greatly and that affected the growth behaviour of apricot seedlings during different periods of growth. The higher of the growth rate is associated with the higher Fe need by the seedlings.

It is revealed from the different foregoing results that different elements were greatly changed by using various treatments. The balance between different elements in apricot tissues takes a role for the control of their growth behoviour. Accordingly, our study was extended to include the proportion accumulation of such elements under discussion in the term of percentage proportion as related to the total amounts of either macro- or micro-nutrients during different periods of growth of whole seedling (Table,23).

Ratio between members of macro-nutrients:

The following conclusions may be stated:

a) Nitrogen was the most dominant element with macro-nutrients, mostly followed by K,P,Ca and the lowest one was Mg during different periods of growth.

b) Proportion of nitrogen decreased continuously from 7 days till it reached the lowest after 72 days from soaking. At the same time continuous increase in P,K,Ca and Mg occurred with advancing age. The highest increase was shown in K as its proportion was more than the double at 72 days as its proportion found during 7 days. The change in the proportion of P,K,Ca and Mg was mainly due to the absorption of such nutrients which differ in their rates. Accordingly, we considered that the absorption of K exceeds any other element. The lowest rate of absorption seemed to be in Mg as the increase of the proportion of it was in its lowest amount.

c) Different treatments greatly affected macro-nutrients proportion as related to each other and that related to the control of absorption rate by such nutrient. This takes a part in the control of plant growth behaviour.

Micro-nutrients:

Fe proportion was the highest followed by Mn, Cu and Zn was the lowest one in this respect. This indicates that the need for Fe was the highest followed by Mn,Cu and the lowest one was Zn. This leads us to the assumption that the balance between micro-nutrients in apricot seedling may be as follows:

Mn was about the half of Fe,

Cu was about the half of Mn,

Zn was about the half of Cu

In other words, Cu was about the double of Zn, Mn was about the double of Cu and Fe was about the double of Mn in seedling of apricot.

With regard to the changes in the proportion of micro-nutrients as related to their total amount, it could be revealed that this change was very limited as those found in macro-nutrients. This leads us to the assumption that the need or the absorption rates of such elements during different periods of seedling growth seemed to be more or less the same during various stages of growth.

Different growth regulators slightly affected the proportions of different micronutrient to each others, as very limited changes were observed without clear trends. However, such limited changes may take part in their controlling effect of seedling growth behaviour.

Table (22,a,b,c & d): Effect of soaking of cv.El-Amar apricot seeds in some grpwth regulators on some micro-nutrients status during different periods of growth .

22,a) Iron .

Treatments		Concentration µg/gr.dry weight						Total amount µg/seedling						% distribution			% increase asrelated to the highest value		
		7 days	30 days	72 days				7 days	30 days	1 72 days				72 days			Days after sowing		
Substances	ppm.			Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	510.0	522.0	875.0	555.0	625.0	690.0	210.3	281.7	131.8	53.7	142.1	327.6	40.2	16.4	43.4	64.2	85.9	100
GA3	5	420.0	707.5	780.0	765.0	707.5	712.0	194.3	337.6	87.3	100.1	252.5	439.9	19.8	22.8	57.4	44.2	76.7	100
	10	440.0	655.0	925.5	762.5	900.0	875.9	220.9	376.2	108.8	76.5	207.1	392.4	27.7	19.5	52.8	56.3	95.9	100
IAA	5	457.5	581.0	870.0	695.0	850.0	817.0	188.0	307.5	78.5	66.4	177.8	322.7	24.3	20.6	55.1	58.3	95.3	100
	10	502.5	612.5	997.5	727.5	990.0	936.7	168.6	252.7	104.9	64.9	227.6	397.4	26.4	16.3	57.3	42.4	63.6	100
GA3 + IAA	5+5	592.5	617.5	872.5	487.5	830.0	767.6	269.6	341.2	110.3	50.1	206.3	366.7	30.1	13.7	56.3	73.5	93.0	100
	5+10	520.0	570.0	945.0	645.0	915.0	870.3	314.6	344.2	159.6	71.3	251.9	482.9	33.1	14.8	52.2	65.1	71.3	100
	10+5	570.0	570.0	885.0	630.0	632.0	717.0	289.9	312.9	173.1	68.0	174.1	415.2	41.7	16.4	41.9	69.8	75.4	100
	10+10	547.0	597.5	985.0	712.5	720.0	800.9	277.8	336.0	158.8	72.9	183.1	414.8	38.3	17.6	44.1	66.9	81.0	100
C C C	5	765.0	647.5	957.5	625.0	880.0	810.0	326.3	382.5	150.8	191.4	539.2	881.4	17.1	21.7	61.2	37.0	43.4	100
MH	5	542.5	587.5	827.5	670.0	710.0	716.9	222.4	250.0	109.6	159.5	357.6	626.7	17.5	25.4	57.1	35.5	39.9	100
CCC+MH	5+5	462.5	580.0	902.0	602.5	647.5	874.1	213.7	325.6	105.6	205.2	220.5	531.3	19.9	38.6	41.5	40.2	61.3	100

W. seedl. = Whole Seedling. * = $\frac{\text{Total amount / seedling}}{\text{Dry weight / seedling}}$

22,b) Manganese .

Treatments		Concentration µg/gr.dry weight						Total amount µg/seedling						% distribution			% increase as related to the whole seedling		
		7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
Substances	ppm.			Root	Stem	Leaves	W.seedl.*			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	195.0	250.5	342.5	307.5	317.5	323.4	80.4	135.2	51.6	29.8	72.2	153.6	33.6	19.4	47.0	52.3	88.0	100
GA₃	5	167.5	210.0	352.5	345.0	372.5	352.8	77.5	100.2	39.4	45.3	132.9	217.6	18.1	20.8	61.1	35.6	46.0	100
	10	177.5	250.0	342.5	307.5	432.5	380.9	89.1	143.6	40.2	30.8	99.5	170.5	23.6	18.1	58.3	52.3	84.2	100
IAA	5	177.5	210.0	385.5	259.0	360.0	341.4	72.9	128.9	34.8	24.8	75.3	134.9	25.8	18.4	55.9	54.0	95.6	100
	10	220.0	275.0	442.5	290.0	530.0	457.9	73.8	113.5	46.6	25.9	121.9	194.4	23.9	13.3	62.7	37.9	58.4	100
GA₃ + IAA	5+5	260.0	295.0	420.0	265.0	367.5	359.3	118.3	163.0	53.1	27.2	91.4	171.7	30.9	15.9	53.2	68.9	94.9	100
	5+10	179.5	267.5	525.0	267.0	405.0	414.0	108.6	161.5	88.7	29.5	111.5	229.7	38.6	12.9	48.6	47.3	70.3	100
	10+5	222.5	312.5	557.5	277.5	392.0	426.5	113.2	171.5	109.1	29.9	107.9	247.0	44.2	12.1	43.7	45.9	69.4	100
	10+10	260.0	282.5	547.5	277.5	407.5	425.4	132.0	158.9	88.3	28.4	103.6	220.3	40.1	12.9	47.0	59.9	72.1	100
C C C	5	255.0	272.5	542.5	362.5	335.0	373.2	123.3	160.9	85.4	110.9	205.3	401.6	21.3	27.6	51.1	30.7	40.1	100
MH	5	187.5	230.0	447.5	432.5	385.0	382.9	76.9	97.9	59.3	81.5	193.9	334.7	17.7	24.4	57.9	22.9	29.3	100
CCC+MH	5+5	260.0	285.0	280.0	342.5	352.0	500.9	120.1	159.9	67.9	116.6	119.9	304.4	22.3	38.3	39.4	39.5	52.5	100

W. seedl. = Whole Seedling. $* = \frac{\text{Total amount / seedling}}{\text{Dry weight / seedling}}$

22, c) Zinc .

Treatments		Concentration µg/gr.dry weight						Total amount µg/seedling						% distribution			% increase as related to the highest value		
		7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
Substances	ppm.			Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	45.0	50.0	100.0	81.0	60.0	76.9	18.6	26.9	15.1	7.8	13.6	36.5	41.4	21.4	37.3	50.9	73.7	100
GA₃	5	47.5	72.5	92.5	100.0	57.5	74.1	21.9	34.6	10.4	14.8	20.5	45.7	22.8	32.4	44.9	47.9	75.7	100
	10	50.0	50.0	75.5	92.5	67.5	68.5	25.1	28.7	8.9	6.3	15.5	30.7	28.9	20.5	50.5	81.8	93.5	100
IAA	5	38.5	40.0	70.0	82.5	50.0	62.4	15.8	24.6	6.3	7.9	10.5	24.7	25.5	31.9	42.5	63.9	99.6	100
	10	42.5	50.0	75.0	67.5	57.5	63.9	14.3	20.6	7.9	6.0	13.2	27.1	29.2	22.1	48.7	52.8	76.0	100
GA₃ + IAA	5+5	47.5	50.0	82.5	57.5	50.0	60.2	21.6	27.8	10.4	5.9	12.4	28.7	36.2	20.6	43.2	75.3	96.9	100
	5+10	49.0	50.5	80.0	57.5	45.0	50.1	29.6	30.5	13.5	6.4	12.4	32.3	41.8	19.8	38.4	91.6	94.4	100
	10+5	48.0	53.0	80.0	50.0	50.0	60.2	24.4	29.1	15.7	5.4	13.8	34.9	44.9	15.5	39.5	69.9	83.4	100
	10+10	44.5	51.5	82.5	50.5	50.5	60.1	22.6	28.6	13.3	5.1	12.7	31.1	42.8	16.4	40.8	72.7	91.9	100
C C C	5	67.5	60.0	92.5	92.5	50.0	60.3	32.6	35.5	14.6	28.3	30.6	73.5	19.9	38.5	41.6	44.4	48.3	100
MH	5	65.0	75.0	100.5	57.5	50.0	59.7	26.7	31.9	13.3	13.7	25.2	52.2	25.5	26.2	48.3	50.9	61.1	100
CCC+MH	5+5	50.0	55.0	82.5	67.5	57.5	85.9	23.1	30.9	9.7	22.9	19.6	52.2	18.6	43.9	37.5	44.3	59.2	100

W.seedling = Whole Seedling.

$$* = \frac{\text{Total amount /seedling}}{\text{Dry weight / seedling}}$$

22, d) Copper .

Treatments		Concentration μg/gr.dry weight						Total amount μg/seedling						% distribution			% increase as related to the highest value		
Substances	ppm.	7 days	30 days	72 days				7 days	30 days	72 days				72 days			Days after sowing		
				Root	Stem	Leaves	W.seedl. *			Root	Stem	Leaves	W.Seedl.	Root	Stem	Leaves	7	30	72
Control	0	115.0	127.5	155.0	140.0	202.5	174.7	47.4	60.0	23.3	13.9	46.0	82.9	28.1	16.3	55.5	57.2	82.9	100
GA_3	5	107.5	172.5	137.5	127.5	190.0	165.5	49.7	82.3	15.3	18.9	67.8	102.0	15.0	18.5	66.5	48.7	80.7	100
	10	100.5	120.0	162.5	142.5	187.5	175.5	54.5	68.9	19.1	16.3	43.1	78.5	24.3	20.7	54.9	69.3	87.0	100
IAA	5	107.5	100.0	180.0	165.0	192.5	183.0	44.2	66.3	16.2	15.0	40.3	72.3	22.4	21.9	55.7	61.1	91.7	100
	10	112.0	120.0	150.0	125.0	182.5	162.4	37.6	49.5	15.8	11.2	41.9	68.9	22.9	16.2	60.9	54.6	71.8	100
GA_3 + IAA	5+5	112.5	160.0	232.5	185.0	200.0	205.4	51.2	88.9	29.4	19.0	49.7	98.1	29.9	19.4	50.7	52.2	90.6	100
	5+10	125.5	165.0	205.0	197.5	195.0	198.5	75.9	99.6	34.6	21.8	53.7	110.2	31.4	19.8	48.7	68.9	98.4	100
	10+5	110.0	150.0	187.5	170.0	145.0	164.0	55.9	82.3	36.7	18.4	39.9	94.9	38.7	19.4	42.0	58.9	86.7	100
	10+10	122.5	155.5	205.0	167.5	177.5	184.1	62.2	87.5	33.1	17.2	45.1	95.4	34.7	17.9	47.3	65.2	91.7	100
C C C	5	177.5	185.0	205.0	182.5	152.5	168.7	85.8	109.3	32.3	55.9	93.4	181.6	17.8	30.8	51.4	47.2	60.2	100
MH	5	105.0	145.0	242.5	174.5	152.5	172.1	43.1	61.7	32.1	41.5	76.8	150.4	21.3	27.6	51.1	28.7	41.0	100
CCC+MH	5+5	177.5	195.0	200.0	155.5	122.5	194.3	82.0	109.5	23.4	52.9	41.7	118.0	19.8	44.8	35.3	69.5	92.8	100

W. seeedl.= Whole seedling

$$* = \frac{\text{Total amount / seedling}}{\text{Dry weight / seedling}}$$

Table (23): Effect of soaking of cv. El-Amar apricot seeds in some growth regulators on the balance of different nutrients in the terms of percentage to the total amounts/seedling during different periods of growth .

Treatments		Macronutrient															Micronutrient											
		7					30					72 days					7				30				72 days			
Substance	ppm	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Control	0	65.9	09.5	12.6	08.8	3.2	58.9	10.3	17.0	10.3	3.4	40.7	12.7	26.8	15.6	4.2	58.9	22.5	5.2	13.3	54.9	26.4	5.2	13.4	54.6	25.6	6.0	13.8
GA_3	5	64.4	12.5	11.6	08.3	3.3	55.9	11.9	17.9	10.9	3.3	41.3	12.2	27.5	15.3	7.1	56.6	22.6	6.4	14.5	60.9	18.1	6.2	14.8	54.6	27.0	5.7	12.7
	10	67.4	09.8	12.1	07.2	3.5	58.8	08.8	17.6	11.7	3.2	41.4	11.1	26.6	16.8	4.1	56.7	22.9	6.4	13.9	60.9	23.3	4.6	11.2	58.4	25.3	4.6	11.7
IAA	5	69.9	11.5	08.8	07.8	1.9	64.7	08.1	17.6	07.7	1.4	44.6	13.0	26.9	12.4	3.1	58.3	22.7	4.9	13.8	58.3	24.4	4.7	12.6	58.2	24.3	4.5	13.0
	10	65.9	09.5	12.9	08.3	3.3	56.8	10.8	18.1	11.2	3.0	42.8	11.5	28.7	13.8	3.2	57.3	25.1	4.9	12.8	57.9	26.0	4.7	11.3	57.8	28.3	3.9	10.0
GA_3 + IAA	5+5	70.8	04.8	14.3	07.3	2.9	58.5	08.2	19.8	10.6	2.8	41.7	13.1	27.0	15.4	2.8	58.5	25.7	4.7	11.1	54.9	26.3	4.5	14.3	55.1	25.8	4.3	14.8
	5+10	67.5	05.3	14.3	09.5	3.4	63.6	9.3	13.6	10.0	3.3	40.5	12.7	26.6	17.1	3.1	59.5	20.5	5.6	14.4	54.1	25.4	4.8	15.7	56.5	26.9	3.7	12.9
	10+5	67.3	09.9	09.1	10.5	3.2	58.4	11.3	15.6	11.8	2.9	39.3	14.4	26.6	17.2	2.5	60.1	23.5	5.1	11.4	52.5	28.8	4.9	13.8	52.4	31.2	4.4	12.0
	10+10	68.7	06.1	12.9	09.5	2.7	57.1	10.7	17.9	11.8	2.5	39.2	14.5	29.0	14.5	2.8	56.2	26.7	4.6	12.6	54.9	26.0	4.7	14.3	54.5	28.9	4.1	12.5
CCC	5	66.1	09.6	11.1	09.9	3.2	55.1	12.6	17.8	11.1	3.8	42.0	12.0	27.9	15.2	2.9	57.5	21.7	5.7	15.1	55.6	23.4	5.2	1.9	57.3	26.1	4.8	11.8
MH	5	63.8	08.0	16.7	07.3	4.2	57.1	10.3	18.2	10.3	3.9	38.1	12.5	26.2	18.3	2.9	60.3	20.8	7.2	11.7	56.6	22.2	7.2	13.9	53.8	28.8	4.5	12.9
CCC+MH	5+5	67.6	06.2	13.3	09.4	3.5	63.2	07.8	14.5	11.0	3.4	38.5	14.2	29.9	14.8	2.6	48.7	27.4	5.3	18.6	52.0	25.5	4.9	17.5	52.8	30.3	5.2	11.7

Experiment III

Experiment III :

4.3. Effect of Zn, Mn and Fe Deficiencies on Germination, Growth and Some Chemical Composition of Apricot cv.El-Amar Seedlings.

There is no doubt that micro-nutrients play an important role in plant metabolism which leads to the production of healthy growing plants. However, very little is Known about the presence or absence of Zn, Mn and Fe in the media on the germination or on the seedling growth behaviour of apricot, as the problem of micro-nutrients deficiency under the natural Egyptian conditions increased from year to year during the last few decades. It was also concluded from the previous experiment that many nutrients uptake was varied greatly under different treatments with growth regulators . Accordingly, the present experiment aimed to getting some information about the response of apricot cv. El-Amar to the presence or absence of Zn, Mn and Fe during germination and seedling growth. The sand culture techniques were used under controlled conditions.

Irrigation with Hoagland & Arnon solution of different treatments was as follows:

1- Irrigation with complete Hoagland's solution (C.S).

2- Irrigation with Hoagland's solution without Zn (-Zn).

3- Irrigation with Hoagland's solution without Mn (-Mn).

4- Irrigation with Hoagland's solution without Fe (-Fe).

During this experiment germination percentage and rate were recorded. Also, different aspects of seedling growth (included roots, stems and leaves) were measured as well as the photosynthetic pigments. In addition, carbohydrate & protein fractions; total amino acids (at 120 days after sowing) and some nutrient contents were estimated.

4.3.1. Germination Process:

Germination of apricot cv. El-Amar seeds in the terms of percentage and rate index as affected by the presence or absence of Zn, Mn and Fe are tabulated in Table (24).

There is no clear variation in the percentage of germinated seeds with the presence or absence of the tested micro nutrients. Since, slight reduction of germination percentage was existed in -Zn and in -Mn treatments while, slight increase of germination percentage in -Fe treatment was observed.

The stimulation effect of -Fe on germination may indicate that the presence of Fe in the media may have some toxic effect on the germination process, thus its absence seemed to stimulate the germination process. With regard to -Mn and -Zn, it must be mentioned that both of these heavy metals are essential nutrient elements but the absence of any one may cause the unbalance between different nutrient elements in seed tissues. Thus such unbalance may bring an inhibiting effect on germination percentage.

Table (24): Effect of Zn, Mn and Fe deficiency on germination process of apricot cv. El-Amar seeds in terms of germination percentage and rate index .

Irrigation with or with out	% of germination				Total % of germination	Germination rate index
	12	17	21	30 days		
C.S	15.0	30.0	30.0	5.0	80.0	18.38
-Zn	12.5	32.5	30.0	2.5	77.5	18.16
-Mn	10.0	32.5	28.8	7.5	78.5	19.03
-Fe	15.0	53.0	27.5	5.0	82.5	18.21

A mineral nutrient can function as a constituent of an organic structure, as an activator of enzyme reactions, or as a charge carrier and osmoregulator *(Marschner, 1986)*. Of the micronutrient transition metals (manganese, iron, copper, zinc and molybdenum) manganese has the lowest complex stability constant and this forms the weakest bonds *(Clarkson and Hanson, 1980)*. It can therefore replace Mg^{2+} in many reactions- for example, its role as a bridge between ATP and enzyme complexes (e.g. in phosphokinases and phosphotransferases). From numerous studies it has been established that germination is enzymes controlled process . Manganese activates a number of enzymes in vitro, particularly decarboxylases and dehydrogenases of the tricarboxylic acid cycle. The specific requirement for manganese as mineral nutrient, however, is presumably related to its tightly bound form in metalloproteins, where it acts as a structural constituent, as an active binding site, or, like iron, as a redox system *(Marschner, 1986)*.

In general zinc, manganese and iron are required for the activity of various types of enzymes primarily including those key enzymes of germination process. Therefore, it is not surprisingly that Zn, Mn and Fe deficiencies are associated with an impairment of carbohydrate, protein and oil metabolism. Thus different reactions and subsequent steps leading to germination should be affected under deficiency of these micro-nutrients.

4.3.2. Seedling Growth:

4.3.2.1. Main Stem Length: Table (25):

It could be revealed from the data that the presence of all nutrient elements is very important for getting the highest stem length of seedling during most periods of growth. The absence of any micro-nutrient from the media slightly decreased the main stem length under the values of those supplied with all nutrients. This may indicates that seeds cotyledon have a good reserve of many micro-nutrients such as Zn, Mn and Fe for maintaining the growth of main stem. However, the absence of any one may slightly decrease the main stem length under those treated with complete nutrients.

It could also be revealed that the presence or absence of any tested nutrient regulated the rate of main stem length.

During the early periods of seedling growth the variation between the length of main stem was not clear, however, during the late two periods the variation was more obvious between those supplied with all nutrients or without any one of micro-nutrients. This could be discussed on the basis that the reserve nutrients during the early periods were sufficient for maintaining the natural growth of main stem, however, such nutrients were not sufficient during the last two periods of growth. Thus, the supplying of different elements during the later period is essential for the growth of main stem.

4.3.2.2. Internode Number of Main Stem: Table (26)

It could be revealed that changes of internode number behaved the same trend of main stem length. This adds more information about the behaviour of stem length as stem length is the expression of internode number and the main length of internode itself. Accordingly, our study was extended to estimate the average of internode length : Table (27) .

It could be revealed that both internode number and length affected the

Table (25) : Effect of Zn, Mn and Fe deficiency on main stem length and its percentage increase in relation to the highest value at different periods of apricot cv. El-Amar seedlig growth .

Irrigation with or without	Main stem length (cm.) Days after sowing						%increase of main stem length Days after sowing					
	30	45	65	80	100	120	30	45	65	80	100	120
C.S	8.6 ±0.69	16.9 ±0.94	23.2 ±1.41	31.7 ±1.33	42.5 ±1.50	50.7 ±1.00	16.9	33.3	45.8	62.5	83.8	100
-Zn	7.4 ±0.50	16.6 ±0.54	22.1 ±0.60	30.9 ±1.22	40.1 ±1.44	48.0 ±1.64	15.4	34.6	46.0	64.4	83.5	100
-Mn	8.1 ±0.49	16.2 ±0.81	21.5 ±0.92	29.4 ±0.80	37.5 ±1.12	46.0 ±1.36	17.6	35.2	46.7	63.9	81.5	100
-Fe	8.5 ±0.51	16.9 ±0.74	23.4 ±1.00	30.4 ±1.13	38.2 ±1.39	49.7 ±1.61	17.1	34.0	47.1	61.2	76.9	100

Table (26) : Effect Zn, Mn and Fe deficienccy on the internodes number of main stem and its percentage increase at different periods of apricot cv. El-Amar seedling growth .

Irrigation with or without	Internodes number of main stem Days after sowing						%increase of internode number Days after sowing					
	30	45	65	80	100	120	30	45	65	80	100	120
C.S	10 ±0.68	15 ±0.63	19 ±0.78	24 ±0.98	30 ±0.89	43 ±1.05	29.4	44.1	55.9	70.6	88.2	100
-Zn	11 ±0.61	16 ±0.54	19 ±0.61	26 ±0.90	30 ±0.85	36 ±0.89	30.6	44.4	52.8	72.2	83.3	100
-Mn	11 ±0.54	16 ±0.62	18 ±0.73	24 ±0.30	28 ±0.66	33 ±0.85	33.3	48.5	45.5	72.7	84.8	100
-Fe	12 ±0.46	16 ±0.48	19 ±0.55	24 ±0.60	30 ±0.86	33 ±1.41	36.4	48.5	57.6	72.7	90.9	100

Table (27): Effect of Zn,Mn and Fe deficiency on the inyernode length of main stem and its percentage increase at different periods of apricot cv. El-Amar seedling growth .

Irrigation with or without	Internode length (cm.) Days after sowing						%increase of internode length Days after sowing					
	30	45	65	80	100	120	30	45	65	80	100	120
C.S	0.80 ±0.05	1.08 ±0.04	1.18 ±0.04	1.31 ±0.07	1.42 ±0.05	1.47 ±0.07	54.4	73.5	80.3	89.1	96.9	100
-Zn	0.66 ±0.02	1.01 ±0.02	1.09 ±0.02	1.19 ±0.03	1.31 ±0.03	1.32 ±0.02	50.0	76.5	82.6	90.2	99.2	100
-Mn	0.73 ±0.02	0.97 ±0.02	1.13 ±0.04	1.22 ±0.03	1.34 ±0.04	1.40 ±0.04	52.1	69.3	80.7	87.1	95.7	100
-Fe	0.69 ±0.03	1.04 ±0.02	1.19 ±0.03	1.24 ±0.05	1.29 ±0.05	1.47 ±0.02	46.9	70.7	80.9	84.4	87.8	100

length of main stem as these parameters showed the same trend.

4.3.2.3. Number of branches per seedling at 120 days from sowing:

Table (28 and Figs. (1 , 2 & 3) show that, the presence or absence of any micro-nutrient seemed to affect the production of lateral branches, i.e. affected the development of lateral buds. Absence of Zinc stimulated the development of lateral buds over any other treatments Fig. (1). It is well known that zinc affected IAA formation and that control lateral bud development, i.e. may have a role in apical dominance.

4.3.2.4. Main stem diameter at 120 days from sowing (Table 28).

It could be revealed that the presence or absence of any micro-nutrient affected seedling stem diameter. However, the absence of any of them slightly minimized the stem diameter, as Fe or Zn deficiency in the growing media was superior than - Mn in this respect.

Accordingly, the presence or absence of one of the tested nutrients play a part in seedling stem diameter, and their effects were extended to stem thickness, beside other vegetative growth criteria.

Data of the present study showed also that Zn deficiencies decreased the apical dominance of main stem of apricot seedlings and the outgrowth of lateral buds took place table (28) and Figs. (1 ,2 & 3). These results were previously established by *(Skoog, 1940)* who found that the auxin content of the shoot apices of Zinc-deficient plants is extremely low . Low auxin levels in zinc-deficient plants may be the result of high IAA oxidase activity *(Skoog, 1940)*. Furthermore, the

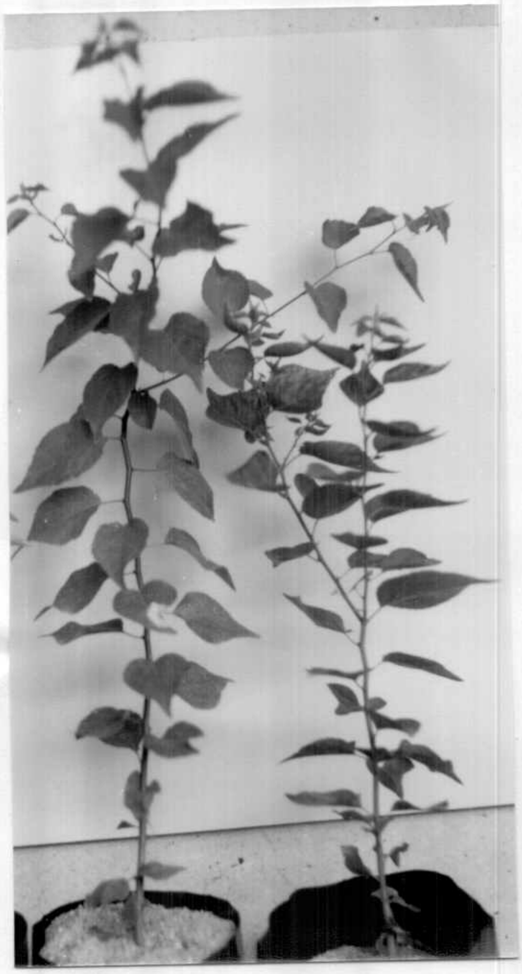

Fig. : (1) a b

Shows the effect of Zn deficiency on the growth of cv. El-Amar apricot seedlings at 120 days after sowing.

- a) Control plant (irrigated with complete nutrient solution).
- b) -Zn treatment (irrigated with complete nutrient solution without Zn).

Fig. :(2) a b

Shows the effect of Mn deficiency on the growth of cv. El-Amar apricot seedlings at 120 days after sowing.

a) Control plant.

b) -Mn treatment (irrigated with out Mn).

auxin level decreases before the appearance of deficiency symptoms, and after the supply of zinc is restored. Also, in maize mild Zinc-deficiency symptoms can be corrected by supplying either Zinc or tryptophan *(Salami and Kenefick, 1970).*

Table (28) Effect of Zn, MN and Fe deficiency on branches number and diameter of main stem of cv. El-Amar apricot seedling at 120 day after sowing.

Treatments	C.S	-Zn	-Mn	-Fe
Branches number	2 ± 0.62	5 ± 0.67	3 ± 0.48	4 ± 0.60
Diameter of main stem (cm)	0.35 ± 0.01	0.48 ± 0.01	0.51 ± 0.01	0.48 ± 0.01

According to the results of *Morgan et al. (1966)* and *(1976)* IAA oxidase activity is much higher in both manganese deficient tissues and those tissues with excessive manganese levels.

In addition, iron deficiency is caused by both inhibited uptake of iron *(Isermann, 1975)* and competition (or an imbalance) between manganese and iron at the cellular level. So, Fe-deficiency may bring the same effect of decreasing the apical dominance in Fe-deficient apricot seedlings.

4.3.2.5. Leaves number per seedling:

Data of (Table, 29) revealed that different treatments affected main stem length, number of internodes, also their effect extended to the number of leaves on main stem. Whole plant leaves number was also be controlled under different treatments. Absence of zinc stimulated higher leaves production . As this treatment

Fig. : (3) a b

Shows the effect of Fe deficiency on the growth of cv. El-Amar apricot at 120 days after sowing.

a) Control plants .

b) -Fe treatment (irrigated without Fe).

9

Table (29): Effect of Zn,Mn and Fe deficiency on the number of leaves,percentage increase and periodic increase percentage at different periods of apricot cv. El-Amar seedling growth .

Irrigation with or without	Number of leaves on main stem Days after sowing						Percentage increase						Periodic increase percentage .					
	30	45	65	80	100	120 days	30	45	65	80	100	120	(0-30)	(30-45)	(45-65)	(65-80)	(80-100)	100-120
C.S	12 ±0.49	16 ±0.63	20 ±0.78	25 ±0.98	31 ±0.89	35 ±1.05	34.3	45.7	57.1	71.4	88.5	100	34.3	11.4	11.4	14.3	17.1	11.5
-Zn	12 ±0.61	17 ±0.53	21 ±0.51	27 ±0.95	31 ±0.85	37 ±0.89	32.4	45.9	56.8	72.9	83.3	100	32.4	13.5	10.9	16.1	10.9	16.2
-Mn	12 ±0.54	17 ±0.65	20 ±0.96	25 ±0.37	29 ±0.66	34 ±0.85	35.3	50.0	58.8	73.5	85.3	100	35.3	14.7	08.8	14.7	11.8	14.7
-Fe	13 ±0.46	17 ±0.48	20 ±0.58	25 ±0.68	31 ±0.88	35 ±1.02	37.1	48.6	57.1	71.4	88.6	100	37.1	11.5	08.5	14.3	17.2	11.4

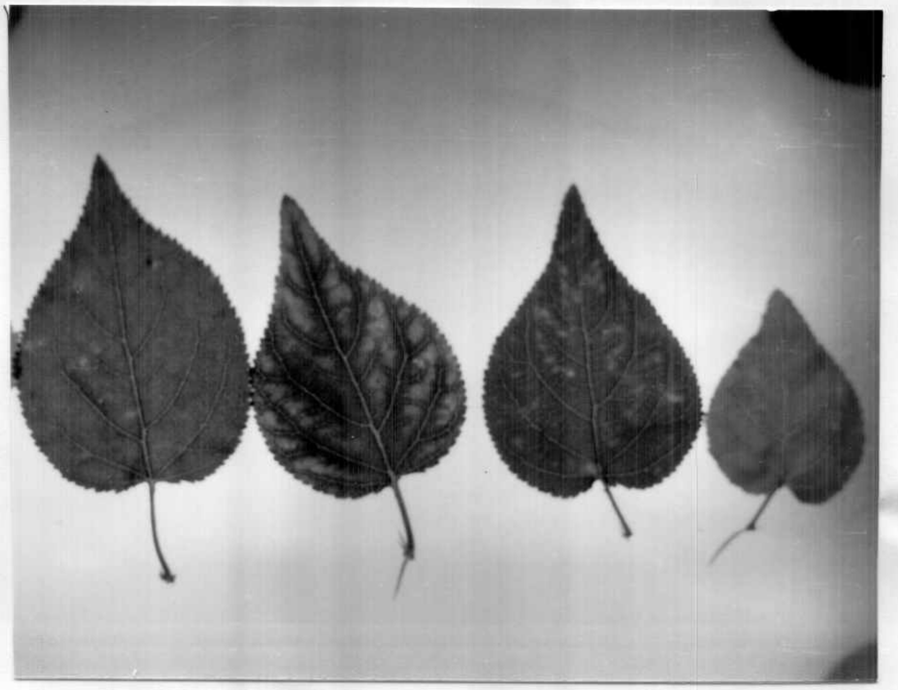

Fig. : (4) **a** **b** **c** **d**

show different symptoms of Zn, Mn and Fe deficiencies on leaves of cv. El-Amar apricot seedling at 120 days as a comparison with complete nutrient solution.

- **a)** **Control.**
- **b)** **-Zn.**
- **c)** **-Mn.**
- **d)** **-Fe.**

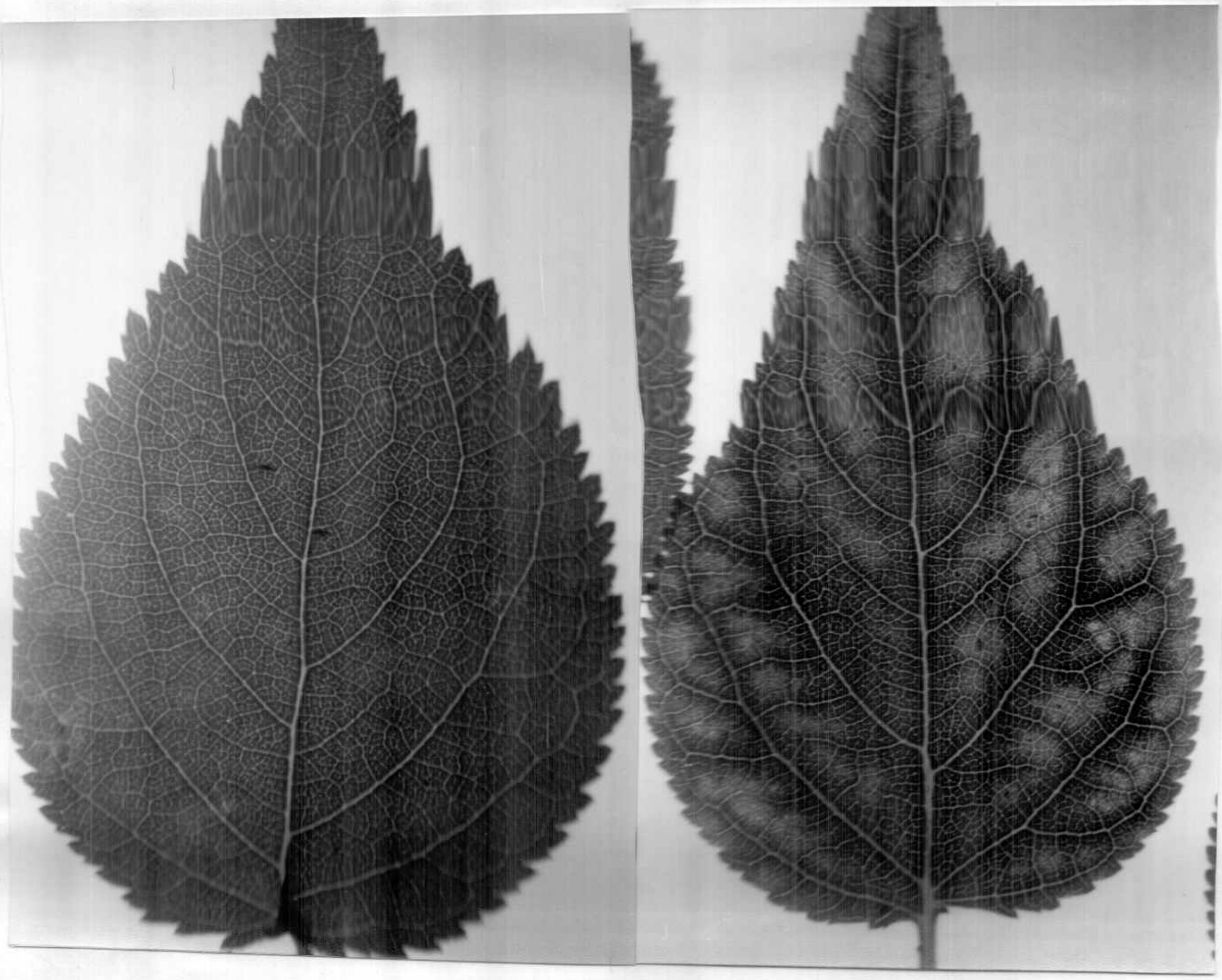

Fig. : (4) **a** **b**

a) **Control.**

b) **-Zn .**

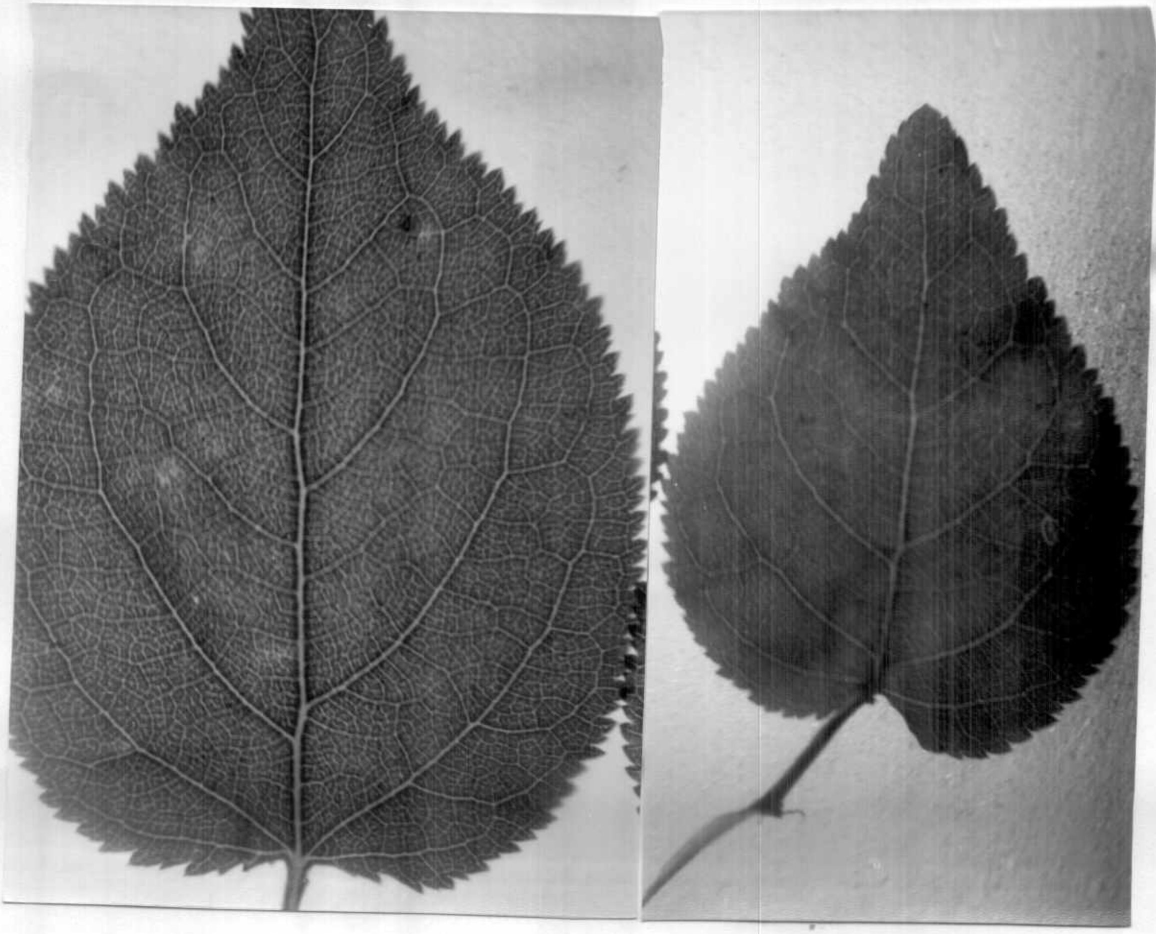

Fig (4) **c** **d**

c) **-Mn .**

d) **-Fe .**

greatly declined the apical dominance and stimulated more lateral branch production. The same conclusion was also noticed with regard to the absence of Fe.

The highest percentage of leaf formation occurred during the first period of growth (30 days after sowing) as more than 30% of leaves were expanded during such period. In addition, the rate of leaf production was slightly increased during the first period, then greatly declined during the last three periods (i.e. 80, 100 and 120 days).

The decrease of stem length resulted under Zn deficiency could be attributed to the stunted growth due to shortening of internodes and the drastic decrease in leaf area. This effect on growth was accompanied with chlorosis symptoms on the apricot leaves of Zinc-deficient seedlings Fig. (4) . The above mentioned results were also recorded with many other plants, in cereals such as maize, chlorotic bands along the midrib and a red, spot like discoloration on the leaves often occurred *(Rahimi and Bussler,1979).* Also *Schmidt et al ., 1972)* found the same symptoms in hop leaves (Humulus scandens).

In the case of Mn deficiency, (Fig.,4 c) reduction of main stem length of apricot seedlings were also found in other plants *(Abbott, 1967 and Neumann and Steward, 1968).* Also, the resulted effect of Fe deficiency gained with apricot seedlings (Fig., 4 d) was formerly registered with many plant species. The most pronounced effect of Fe deficiency includes inhibition of elongation and increase of stem diameter *(Römheld and Marschner, 1981 a)* .

4.3.3. Photosynthetic Pigments:

As shown in Table (30) the absence of Zn, Mn or Fe greatly depressed photosynthetic pigments formation, and that plays an important role in the growth of seedlings. The most depressive effect was gained when plants grown under Fe deficiency as Fe plays an important indirect role in chlorophylls formation. In addition, different omission of Zn, Mn or Fe stimulated the higher proportion of chlorophyll a to chlorophyll b over those corresponding ones which received complete nutrients.

The depressive effect was extended to the photosynthetic assessory pigments, i.e. carotenoids. The role of Zn, Mn or Fe on photosynthetic pigments was gained from their role as thy function as activators for different enzymes leads to chlorophylls and carotenoids synthesis and activities. For example bound zinc combined in carbonic anhydrase (CA) enzyme which catalyzes the hydration of CO_2. The enzyme is localized both in the cytoplasm and in the chloroplasts *(Sandmann and Böger, 1983)*. The function of CA, particularly that of chloroplast CA, in photosynthetic CO_2 assimilation was investigated by *Randall and Bouma (1973) and Edwards & Walker (1983)*. They reported that under conditions of extreme zinc deficiency CA activity is negligible and the CO_2 assimilation per unit leaf area is affected.

In the case of Mn; the most well known and extensively studied function in green plants is its involvement in photosynthetic O_2 evolution. Under the critical deficiency levels of manganese, net photosynthesis and chlorophyll content decline rapidly, whereas rates of respiration and transpiration remain unaffected *(Ohki, et al., 1981)*.

With regard to Fe it is combined in the well-defined iron-containing protein, the cytochromes *(Sandmann and Böger, 1983)*. Cytochromes are constituents of the redox systems in chloroplasts and mitochondria. Therefore, the inhibition of

Table (38): Effect of Zn,Mn and Fe deficiencyon the photosynthetic pigments of apricot cv. El-Amar seedling at 120 days after sowing (expressed as mg/gr. fresh weight or as mg /seedling .

Treatments	Chlorophylls mg/gr. fresh w.				Carot. mg/gr. F.w	Total chl./ carot.	Total pigments mg / seedling					
	Chl. a	Chl. b	Total Chl.a/b	Chl. a / b			Chl. a	Chl. b	Chl. (a+b)	Chl. a / b	Carot.	Chl. / Carot
C.S	1.978	0.684	2.662	2.892	1.024	2.599	11.116	3.844	14.960	2.892	5.755	2.599
-Zn	1.298	0.378	1.676	3.434	0.724	2.315	7.985	2.302	10.287	3.434	4.409	2.315
-Mn	1.372	0.343	1.715	4.000	0.761	2.254	7.766	1.941	9.707	4.001	4.307	2.254
-Fe	0.873	0.266	1.139	3.282	0.567	1.948	5.631	1.716	7.347	3.281	3.786	1.948

Chl. = Chlorophyll   Carot. = Carotinoides

chlorophyll formation under conditions of iron deficiency is, at least in part, the result of impaired protein synthesis. The requirement for iron in protein synthesis is reflected in leaves by a drastic decline in the number of ribosomes--the sites of protein synthesis *(Lin and stocking, 1978)* **and an increase in the amino acid concentration of chlorotic leaves** *(Gilfillan and Jones, 1968)*. **A peculiarity of iron deficiency is a greater decline in protein synthesis in the chloroplasts of leaf cells than in the cytoplasm . In this respect,** *Perur et al. (1961)* **found that in maize leaves suffering from severe iron deficiency, the total protein content was 25% lower than the normal value, whereas the chloroplast protein content was 82% lower. These differences indicate that the synthesis of certain chloroplast proteins, most likely structural proteins of the grana, in particularly impaired** *(Machold, 1972 and Funkhouser and Price, 1974).*

4.3.4. Dry weight in different plant organs at 120 days:

As shown in table (31) it could be concluded that leaves possessed the highest proportion of dry weight followed mostly by roots while stems were mostly the lowest in this connection.

Absence of Zn or Mn seemed to decrease the dry matter formation in different plant organs and hence plant growth especially root growth. The effect of Mn, Zn and Fe absence on dry weight was extended to the dry weight distribution in different plant organs. This means that the absence of Zn or Mn seemed to affect the growth and dry matter distribution in different plant organs .

Table (31) Effect of Zn, Mn and Fe deficiency on the dry weight average of different seedling organs of apricot cv. El-Amar seedling at 120 days after sowing.

Treatm-ents	Average dry weight gm/seedling				% of d.w.of different seedling organs to the whole seedling.		
	Root	Stem	Leaves	Whole seedling	Root	Stem	Leaves
C.S.	1.7889	1.5123	1.8207	5.1219	34.9	29.5	35.5
-Zn	1.6516	1.5316	1.8587	5.0419	32.8	30.4	36.8
-Mn	1.6559	1.4521	1.8164	4.9244	33.6	29.5	36.9
-Fe	1.8015	1.9516	2.0541	5.8072	31.0	33.6	35.4

On the other hand, absence of Fe seemed to stimulate slightly different plant organs dry weight. In spite of that, Fe deficiency disturbed dry weight distribution in different plant organs. Since, root dry weight proportion was less than the corresponding ones of complete nutrient treated plants, while dry weight proportion was higher. It must be mentioned that the omission of micro-nutrients, as a general, is not complete under sand culture technique, also the large seed like apricot contains some amounts of micro-nutrients as well as the used sand is also considered as a source of some micro-nutrients beside the used pure nutrient chemicals (Table 31).

As previously mentioned and as will be discussed later the absence of Zn, Mn and Fe greatly affected the growth of apricot seedlings; hence this obviously affected mineral accumulation, net photosynthates and in general metabolism processes. In agreement with this, dry matter accumulation is also affected with the omission of these micro-nutrients the decline of dry matter accumulation under deprivation of Zn and Mn obtained in the present study with apricot seedling was also found in

many plants *(Marschner, 1986)*.

With regard to Fe deficiency the increase of dry matter accumulation in iron-free treatment as shown in(Table, 31) may be related to the developed branches under such conditions. In addition, the accumulation of many organic compounds such as organic acids *(Brown et al., 1971; Venkat- Raju et al. 1972)* riboflavin *(Schlee et al., 1968; Nagarajah and Ulrich 1966 and venkat-Raju et al., 1972)* phenolic and lignin compounds *(Mueller and Beckman, 1978; Römheld and Marschner 1981 b ; Olsen et al., 1981)* is a well-documented general phenomenon under conditions of iron deficiency.

4.3.5. Carbohydrate fractions:

Tables (32, a, b & c) show that absence of Zn, Mn or Fe stimulated slightly reducing sugars, and the most pronounced effect was gained when Fe was lacking, when compared with those received complete nutrient solution, and the *vice versa* was gained with regard to non-reducing ones . Polysuccarides, i.e. hydrolyzable carbohydrate was at its lowest amounts when plants received complete nutrients. However, total carbohydrate concentration was superior under complete nutrient treated plants. The absence of Fe reduced greatly this accumulation.

As mentioned before different treatments affected photosynthetic pigments formation and that plays an important role in the accumulation of photosynthetic products, i.e. sugars and its related compounds.

It must be mentioned here that the transformation of different carbohydrate fractions is in complete dynamic changes, as they may be translocated,consumed, utilized in different plant metabolic processes. Under the absence of any micro-nutrient seemed to disturb or alter any one of the above mentioned dynamic process and hence regulate plant growth behaviour.

The above mentioned interpretation ; when different carbohydrate fractions were calculated as concentration (mg/gr dry weight) or as the absolute amounts per plant organ (mg / seedling).

With regard to the percentage distribution in different plant organs it could be revealed that the proportion of different fractions was an expression of the net accumulated fraction at the sampling date. However, the absence of Zn, Mn or Fe disturbed greatly the accumulation proportion of different fractions.

Also, it is well documented that zinc is required for the activity of various enzymes including those combined in carbohydrate metabolism. Therefore, it is spectable that zinc deficiency only greatly affected carbohydrate metabolism. A direct connection between zinc nutritional status and starch formation has been found only in bean *(Jyung et al., 1975)*, where zinc deficiency led to a decrease in both starch contents and starch synthase activity. As a rule, however, the carbohydrate content of leaves is either unaffected or even increased by zinc deficiency as a result of the concentration effect caused by impaired growth (i.e. lower sink activity). Furthermore *Rahimi and Bussler (1978)* reported that in extreme cases of zinc deficiency this can lead to excretion of sugars at the leaf surface. Generally sugars and starch accumulation in zinc deficient plants supports the view that zinc deficiency induced changes in carbohydrate metabolism is not primarily responsible for either growth retardation or the visible symptoms of zinc deficiency.

Although, manganese deficiency has the most severe effect on the level of soluble carbohydrates, which is drastically reduced, particularly in the roots

Total (32,a):Effect of Zn,Mn and Fe deficiency on the carbohydrate fraction content in different seedling organs as well as whole seedling of apricot cv. El-Amar at 120 days after sowing .

(expressed as mg/gr. dry matter)

Irrigation with or without	Reducing sugars				Non-reducing sugars				Total soluble sugars				Hydrolizable carbohydrate				Total carbohydrate			
	Root	Stem	Leaves	W.see*	Root	Stem	Leaves	W.see*	Root	Stem	Leaves	W.see*	Root	Stem	Leaves	W.see*	Root	Stem	Leaves	W.see*
C.S	42.00	26.25	65.25	46.60	141.75	120.75	157.50	141.15	183.75	147.00	225.75	187.83	21.00	026.25	105.00	052.41	204.75	173.25	330.75	240.24
-Zn	57.75	36.75	68.25	55.24	042.00	042.00	078.75	055.55	099.75	078.75	147.00	110.79	073.50	120.75	115.50	103.34	173.25	199.50	262.50	214.13
-Mn	52.50	26.25	78.75	54.44	042.00	063.00	089.25	065.62	094.50	089.25	168.00	120.86	110.25	120.75	021.00	080.42	204.75	210.00	189.99	200.49
-Fe	78.75	52.50	78.75	69.93	094.50	042.00	047.25	060.14	173.25	094.50	126.00	130.87	52.50	099.75	047.25	066.52	225.75	194.25	173.25	196.59

* Whole seedling - $\frac{\text{Total amount/seedling}}{\text{Dry weight/seedling}}$

Total (32,b): Effect of Zn,Mn and Fe deficiency on the total amount of carbohydrate fractions in different seedling organs as well as whole seedling of apricot cv. El-Amar at 120 days after sowing .

(expressed as mg/seedling)

Irrigation with or without	Reducing sugars				Non-reducing sugars				Total soluble sugars				Hydrolyzable carbohydrate				Total carbohydrate			
	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W. see.
C.S	075.13	039.69	124.26	239.08	253.50	182.61	286.76	722.95	328.91	222.31	411.82	962.04	037.57	039.69	191.17	268.43	366.28	262.01	602.19	1230.48
-Zn	095.38	056.29	125.86	278.53	069.37	064.33	146.37	280.07	164.75	120.61	273.23	558.59	121.39	184.94	214.68	521.01	286.14	305.55	487.91	1079.60
-Mn	086.93	038.12	143.04	268.89	069.55	091.48	162.11	323.14	156.48	129.59	305.15	591.22	182.56	175.34	038.14	396.04	339.05	304.94	343.29	0987.28
-Fe	141.87	182.46	161.76	406.89	170.24	081.97	097.06	349.27	312.11	184.43	258.82	755.36	094.58	194.67	097.06	386.31	406.69	379.09	355.87	1141.65

W. see. = whole seedling

Table (32,c):Effect of Zn,Mn and Fe deficiency on the percentage distribution of carbohydrate fractions in different seedling organs as well as whole of apricot cv. El-Amar at 120 days after sowing .

Irrigation with or without	Reducing sugars				Non-reducing sugars				Total soluble sugars				Hydrolizable carbohydrate				Total carbohydrate			
	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	R00t	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.
C.S	28.5	15.1	28.6	19.4	69.2	69.7	47.6	58.8	80.7	84.8	68.3	78.2	18.3	15.1	31.7	21.8	100	100	100	100
-Zn	33.3	18.4	26.8	25.8	24.2	21.1	29.9	25.9	57.5	39.5	56.0	51.7	42.4	60.5	43.9	48.3	100	100	100	100
-Mn	25.6	12.5	41.7	27.2	28.5	29.9	47.2	32.7	46.2	42.5	88.9	59.9	53.8	57.5	11.1	40.1	100	100	100	100
-Fe	34.9	27.8	45.5	35.6	41.9	21.6	27.3	38.6	76.7	48.7	72.7	66.2	23.3	51.4	27.3	33.8	100	100	100	100

(Marschner, 1986), **considering the role of manganese in photosynthesis as previously mentioned, this decline in carbohydrate level is to be expected.**

With regard to Fe-deficiency as previously mentioned greatly affected different aspects of growth and photosynthetic metabolism pigments e.g. increasing of dry matter accumulation and many organic compounds . Considering such role of iron deficiency, the alteration of carbohydrate contents and percentage distribution of each component also is to be expected.

4.3.6. Protein fractions:

As different treatments greatly affected the formation of carbohydrate fractions, and that affected different endogenous physiological activities, thus our study was extended to study the effect of Zn, Mn or Fe omission on protein fractions, in the terms of water, salt, alcohol, buffer and non soluble fractions in different plant organs. These data are tabulated in Tables (33, a, b & c) as concentration actual amount per plant and percentage distribution.

In general the highest concentration of protein fraction was the water soluble protein followed mostly by the non soluble in any used solvent, i.e. alcohol soluble, salt soluble and buffer soluble in descending order.

The absence of Zn, Mn or Fe disturb the accumulation of different protein fractions in different plant organs, as the absence of Zn or Mn relatively stimulated by higher accumulation of water soluble, alcohol soluble and buffer soluble fractions in some plant organs as well as whole plant. On the otherside, absence of Fe depressed some protein fractions in some plant organs and that affected greatly the concentration of total protein fractions.

The depressive effect of Fe, Mn and Zn omissions on plant growth was associated with the troubleness in protein fraction formation in plants beside the troubleness in carbohydrate fraction accumulations.

With regard to the total amounts as mg/seedling or the percentage distribution the results behaved the same trend as discussed before in the case of calculation concentration base.

As described above deficiency tested micro-nutrients clearly affected both protein synthesis and distribution in different plant organs. Considering the well established fact Zn, Mn and Fe are responsible for the activities of many enzymes including different enzymes of protein synthesis is therefore, the severe effect of the absence of these micro-nutrients on protein content is expected.

In many literatures, the rate of protein synthesis and the protein content of Zinc-deficient plants are drastically reduced *(e.g. prask and plocke 1971; Falchuk et al., 1977; Marschner, 1986)*

At least three distinct mechanisms are responsible for the adverse effect of zinc deficiency on protein synthesis and protein content. It is well established that zinc is an essential component of RNA polymerase and if zinc is removed, the enzyme is inactivated . Furthermore, zinc is a constituent of ribosomes and is essential for their structural integrity. Also, *Sharma et al. (1982)* **reported that the decrease in protein content of zinc-deficient plants is also the result of enhanced rates of RNA degradation. Although, manganese seems to be a structural constituent of ribosomes** *(lyttleton, 1960)* **and also activates RNA polymerase** *(Devlin and Witham, 1983; Marschner, 1986).*

Results of our study confirmed results of *Lerer and Bar-Akiva (1976)* **who reported that the protein content of deficient plants is either similar to or somewhat**

Table (33,a): Effect of Zn , Mn and Fe deficiency on total amount of protein fraction contents in different seedling organs as well as the intact seedling of apricot cv. El-Amar at 128 days after sowing .

(expressed as mg/gr. dry matter)

Irrigation with or without	Water soluble proteins				Salt soluble proteins				Alcohol soluble proteins				Alkline-buffer s.protien				Total soluble proteins				Residual(non-s. protein)				Total protein content			
	Root	Stem	Leaves	W.see.*	Root	Stem	Leaves	W.see.*	Root	Stem	Leaves	W.see.*	Root	Stem	Leaves	W.see.*	Root	Stem	Leaves	W.see.*	Root	Stem	Leaves	W.see.*	Root	Stem	Leaves	W.see.*
C.S	139.14	37.38	164.88	341.48	41.74	88.82	32.37	882.93	844.72	41.16	78.81	156.69	86.46	16.38	66.77	889.61	232.86	183.74	334.83	678.63	43.83	76.75	274.82	394.68	275.88	188.49	688.84	1865.21
-Zn	137.63	68.86	149.74	355.43	39.46	12.76	32.81	884.23	119.28	27.23	73.31	219.82	23.48	11.86	75.39	189.85	319.77	119.11	338.44	369.32	32.62	58.93	279.73	363.28	352.39	178.84	618.17	1132.68
-Mn	165.59	66.16	161.46	393.21	47.84	18.88	48.36	898.28	118.39	27.82	66.61	284.82	28.69	17.34	65.59	183.62	344.53	128.59	334.82	799.14	38.89	68.99	241.58	348.66	382.61	181.59	575.59	1139.79
-Fe	168.14	85.66	131.24	377.84	64.86	17.35	37.89	118.58	158.12	48.79	66.18	265.89	27.53	15.18	62.77	185.48	481.84	166.98	279.29	866.11	32.43	38.74	215.68	278.84	434.27	197.72	512.97	1144.96

$$* \text{ Whole seedling} = \frac{\text{Total amount/seedling}}{\text{Dry weight /seedling}}$$

Table (33,b): Effect of Zn, Mn and Fe deficiency on total amount of protein fraction contents in different organs as well as the intact seedling of apricot cv. El-Amar at 128 days after sowing .

(expressed as mg / seedling)

Irrigation with or without	Water soluble proteins				Salt soluble proteins				Alcohol soluble proteins				Alkline-buffer s.protein				Total soluble proteins				Residual (non-s.proteins)				Total protein content			
	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.
C.S	139.14	37.38	146.88	341.48	41.74	88.82	32.37	882.93	844.72	41.16	78.81	156.69	86.46	16.38	66.77	889.61	232.86	183.74	334.83	678.63	43.83	76.75	274.82	394.68	275.88	188.49	688.84	1865.21
-Zn	137.63	68.86	149.74	355.43	39.46	12.76	32.81	884.23	119.28	27.23	73.31	219.82	23.48	11.86	75.39	189.89	319.77	119.11	338.44	769.31	32.62	58.93	279.73	363.28	352.39	178.84	618.17	1132.68
-Mn	165.59	66.16	161.46	393.21	47.84	18.88	48.36	98.28	118.39	27.82	66.61	284.82	28.69	17.34	65.59	183.62	344.53	128.59	334.82	799.11	38.89	68.99	241.58	348.66	382.61	181.59	575.59	1139.79
-Fe	168.14	85.66	131.24	377.84	64.86	17.35	37.89	118.58	158.12	48.79	66.12	265.89	27.53	15.18	62.77	185.48	481.84	166.98	297.29	866.18	32.43	38.74	215.68	278.85	434.27	197.72	512.97	1144.96

W. see. = Whole seedling

Table (33,c): Effect of Zn, Mn and Fe deficiency on the percentage of protein fraction distribution in different seedling organs as well as the intact seedlig of apricot cv. El-Amar at 128 days after sowing .

Irrigation with or without	Water soluble proteins				Salt soluble proteins				Alcohol soluble proteins				Alkline-buffer s.protein				Total soluble proteins				Residual (non-s. protein)				Total soluble proteins			
	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.see.	Root	Stem	Leaves	W.ss.
C.S	58.4	28.7	27.1	32.1	15.1	4.9	5.3	87.8	16.2	22.8	11.6	14.7	2.3	9.1	18.9	8.4	84.1	57.5	54.9	62.9	15.9	42.5	45.8	37.8	188	188	188	188
-Zn	39.1	48.8	24.5	31.4	11.2	7.5	5.2	87.4	33.8	16.8	12.8	19.4	6.6	6.5	12.4	9.7	98.8	78.8	54.2	67.9	89.3	29.9	45.8	32.1	188	188	188	188
-Mn	43.3	36.4	28.1	34.5	12.5	5.6	7.8	88.6	28.9	14.9	11.6	17.9	5.4	9.5	11.4	9.8	98.8	66.4	58.8	78.1	89.9	33.6	41.9	29.9	188	188	188	188
-Fe	36.9	43.3	25.6	32.9	14.8	8.8	7.2	18.3	34.6	24.7	12.9	23.2	6.3	7.7	12.2	9.2	92.5	84.5	57.9	75.6	87.5	15.5	42.8	24.4	188	188	188	188

W. see. = whole seedling

higher than that of plants adequately supplied with manganese.

With regard to Fe-deficiency it may attributed to the principal and essentially role of Fe in the two groups of well-defined iron-containing proteins called hemoproteins and Iron-sulphur proteins *(Sandmann and Böger, 1983).*

4.3.7. Total amino acids at 120 days in different seedling organs :

As shown in Tables (34, a,b & c) it could be noticed that leaves possessed the highest amino acid content followed by roots while stem was the lowest in this respect. This could be detected, as concentration total amino acids per seedling and percentage distribution.

As a general, the main dominant amino acid was aspartic followed by glutamine, valine, histidine, leucine & isoleucine, proline or arginine, while others were found in trace amounts such as methionine and aminobutaric acids. This could be noticed as concentration or total amount per seedling or percentage distribution.

Also, the absence of Zn, Mn or Fe greatly affected the concentration of different amino acids in various seedling parts as great variable changes in such parameters were detected.

The absence of Zn, Mn or Fe seemed to increase slightly the total concentration of amino acids in whole seedling. In addition, the presence or absence of Zn, Mn or Fe seemed to regulate the accumulation of variable amino acids in different plant parts. Accordingly, the absence of any studied element seemed to affect the accumulation and the distribution of the major amino acids as well as the minor ones during the seedling stage of apricot and that takes a part in the growth behaviour of such seedling.

Table (34 , a) : Effect of Zn, Mn and Fe deficiency on amino acids fraction contents in different organs as well as the intact seedling of apricot cv. El-Amar at 120 days after sowing.
(expressed as mg/gr. dry matter)

Treatments	Seedl. organ	Aliphatic A.A		Hydro. A.A	Sulpher A.A	Acidic A.A				Basic A.A	Aromatic A.A		Total A.A content
		Alanine	Valine	Lucine & Isolucine	Methionine	Aspartic	Glutamine	Arginine	Aminobutric	Histidine	Phenylalanine	Proline	
C.S	Root	09.60	19.20	09.60	3.20	42.24	09.60	00.32	1.32	11.52	03.49	13.71	131.00
	Stem	00.00	12.80	09.60	4.80	23.04	09.60	05.49	#	19.20	05.24	10.98	100.75
	Leaves	19.20	35.20	32.00	#	65.28	44.80	21.94	3.31	34.56	08.73	05.49	270.51
	W.* seedl.	12.54	22.86	17.56	2.53	44.76	22.11	12.33	1.64	21.98	05.87	09.98	174.28
-Zn	Root	11.20	22.40	12.80	3.20	53.76	28.80	13.71	1.32	23.04	06.98	10.97	188.18
	Stem	00.00	09.60	00.00	3.20	23.04	19.20	00.23	2.65	11.52	06.98	05.49	105.91
	Leaves	24.00	35.20	25.60	#	65.28	44.80	16.46	4.63	38.40	08.73	05.49	268.59
	W.* seedl.	14.94	23.23	16.06	2.82	48.68	31.78	13.86	2.95	25.20	07.20	07.63	192.83
-Mn	Root	12.80	16.00	25.60	3.20	46.08	28.80	16.46	2.65	23.04	03.49	13.71	191.83
	Stem	00.00	09.60	00.00	3.20	23.04	22.40	00.23	#	19.20	12.22	05.49	119.30
	Leaves	22.40	35.20	33.60	#	42.24	41.60	16.46	3.97	30.72	12.22	08.23	24.64
	W.* seedl.	14.93	21.19	23.36	2.82	37.87	31.68	14.83	2.36	24.74	09.20	09.26	190.68
-Fe	Root	11.20	28.80	09.60	#	38.40	19.20	30.17	5.29	26.88	27.93	08.23	205.70
	Stem	09.60	06.40	06.40	1.60	26.88	16.00	00.23	0.66	15.36	03.49	05.49	100.11
	Leaves	16.00	35.20	33.60	#	46.08	38.40	10.97	4.63	30.72	08.73	02.74	227.87
	W.* seedl.	12.36	23.53	17.01	0.45	37.25	24.92	16.00	3.50	24.37	12.93	05.37	177.77

A.A. = Amino acids
\# = Non-detected

Hydro. = Hydroxylic *Whole seedling = $\frac{\text{Total amount /seedling}}{\text{Dry weight /seedling}}$

Table (34 ,b): Effect of Zn,Mn and Fe deficiency on total amount of amino acids fraction contents in different organs as well as the intact seedling of apricot cv. El-Amar at 120 days after sowing. (expressed as mg/seedling)

Treatments	Seedl. organ	Aliphatic A.A		Hydro. A.A	Sulpher A.A	Acidic A.A				Basic A.A	Aromatic A.A		Total
		Alanine	Valine	Lucine & Isolucine	Methionine	Aspartic	Glutamine	Arginine	Aminobutric	Histidine	Phenylalanine	Proline	A.A content
C.S	Root	17.17	034.35	17.17	05.72	075.56	017.17	14.88	02.36	028.61	06.24	24.53	235.76
	Stem	12.98	019.36	14.52	07.26	034.84	014.52	00.38	#	029.48	07.92	16.61	164.46
	Leaves	34.96	064.89	58.26	#	118.86	001.56	39.95	06.83	062.92	15.89	09.99	492.52
	W.* seedl.	64.22	117.88	98.95	12.98	229.26	113.26	63.13	08.39	112.57	38.05	51.13	892.74
-Zn	Root	18.49	036.99	21.14	05.29	088.79	047.57	22.64	02.18	038.05	11.53	18.12	318.79
	Stem	12.29	014.78	12.25	04.98	035.29	029.41	12.61	04.86	017.64	18.69	08.41	162.21
	Leaves	44.61	065.43	47.58	#	121.34	083.27	38.59	08.61	071.37	16.23	18.28	499.23
	W.* seedl.	75.35	117.12	88.97	18.19	245.42	168.25	65.84	14.85	127.86	38.45	36.73	972.23
-Mn	Root	21.19	026.49	42.39	05.29	076.38	047.69	27.26	04.39	038.15	05.78	22.78	317.63
	Stem	11.62	013.94	11.62	04.65	033.46	032.53	11.95	#	027.88	17.74	07.97	173.36
	Leaves	48.69	063.94	61.83	#	076.72	075.56	29.89	07.21	055.79	22.19	14.95	447.97
	W.* seedl.	73.58	104.37	115.84	09.94	186.48	155.78	69.18	11.68	121.82	45.71	45.62	938.96
-Fe	Root	28.18	051.88	017.2	#	069.1	034.5	54.35	09.53	048.42	58.32	14.83	378.57
	Stem	18.74	012.49	012.49	03.12	052.46	031.23	16.86	01.29	029.98	06.81	010.71	195.38
	Leaves	32.87	072.38	069.02	#	094.65	078.88	22.53	09.51	063.18	17.93	05.63	466.42
	W.* seedl.	71.79	136.67	098.88	03.12	216.29	144.78	92.94	28.33	141.58	75.86	31.13	1032.37

A.A = Amino acids Hydro. = Hydroxylic *Whole seedling # = Non-detected

Table (34,c): Effect of Zn,Mn and Fe deficiency on the percentage of amino acids fraction distribution in different organs as well as the intact seedling of apricot cv. El-Amar at 128 days after sowing.

Treatments	Seedl. organ	Aliphatic A.A		Hydro. A.A	Sulpher A.A	Acidic A.A				Basic A.A	Aromatic A.A		Total
		Alanine	Valine	Lucine & Isolucine	Methionine	Aspartic	Glutamine	Arginine	Aminobutric	Histidine	Phenylalanine	Proline	A.A content
C.S	Root	7.3	14.6	83.7	2.4	32.8	87.3	86.3	1.8	88.7	2.6	18.4	188
	Stem	7.4	11.8	88.8	4.4	21.2	88.8	85.8	*	17.7	4.8	18.1	188
	Leaves	7.1	13.8	11.8	*	24.1	16.1	88.1	1.2	12.8	3.2	82.8	188
	W.* seedl.	7.2	13.2	18.1	1.5	25.7	12.7	87.1	8.9	12.6	3.4	85.7	188
-Zn	Root	5.9	11.9	86.8	1.7	28.6	15.3	87.3	8.7	12.2	3.7	85.8	188
	Stem	7.6	89.1	87.6	3.8	21.8	18.1	87.8	2.5	18.9	6.6	85.2	188
	Leaves	8.9	13.1	89.5	*	24.3	16.7	86.1	1.7	14.3	3.3	82.8	188
	W.* seedl.	7.8	12.8	88.3	1.8	25.2	16.5	86.8	1.5	13.1	3.9	83.8	188
-Mn	Root	6.7	88.3	13.3	1.7	24.8	15.8	88.6	1.4	12.8	1.8	87.1	188
	Stem	6.7	8.8	86.7	2.7	19.3	18.8	86.9	*	16.1	18.2	84.6	188
	Leaves	9.1	14.3	13.6	*	17.1	16.9	86.7	1.6	12.5	84.9	83.3	188
	W.* seedl.	7.8	11.1	12.3	1.1	19.9	16.6	87.4	1.2	12.9	84.9	84.9	188
-Fe	Root	5.4	14.8	84.7	*	18.7	89.3	14.7	2.6	13.1	13.6	84.8	188
	Stem	9.6	6.4	86.4	1.6	26.9	15.9	88.2	6.6	15.3	83.5	85.5	188
	Leaves	7.8	15.5	14.8	*	28.3	16.9	84.8	2.8	13.5	83.8	81.2	188
	W.* seedl.	6.9	13.2	89.6	8.3	28.9	14.8	89.8	1.9	13.7	87.3	83.8	188

A.A = Amino acids Hydro. = Hydroxylic *Whole seedling * Non-dedected.

*

As discussed in the case of protein content, the rate of protein synthesis and the protein content of zinc-deficient plants are drastically reduced. The accumulation of amino acids and amides in these plants demonstrates the importance of zinc for protein synthesis, as does the fact that a similar degree of deficiency of other micro-nutrients such as manganese did not result in an accumulation of these precursors *(Marschner, 1986)*. Also, *Takagi (1976) and Fushiya et al., (1982)* reported that in iron deficient grasses nonproteinogenic amino acids accumulate in and are released from the roots. Some of them including avenic acid, have been identified.

4.3.8. The effect of Zn, Mn and Fe deficiency on macro- and some micro-nutrients status in apricot cv. El-Amar seedlings:

1- Macro-nutrients: Tables (35, a ,b, c, d and e),show that:

a- Nitrogen:

Nitrogen concentration decreased with advancing age, while the total accumulated amount increased. The continuous increase of total nitrogen is related to the continuous absorption amounts.

The absence of Zn, Mn or Fe greatly affected the concentration of N in seedlings of apricot (c.v.El-Amar) as its concentration at total accumulated amounts decreased during the early period of germination (7 & 21 days after sowing) as compared to those corresponding ones supplied with complete nutrient solution. However, such values were relatively higher either as concentration or total accumulated amount under the conditions of such micro nutrient lacking. In other words, the absence of Zn, Mn or Fe reduced the absorption rate of N at early periods of germination stage while increased such absorption at the late period of

Table (35,a,...& e): effect of Zn,Mn and Fe deficiency on the macro-nutrients status during different periods of seedling growth of apricot cv. El-Amar .

35,a) nitrogen .

Treatments	Concentration (mg/gr. dry matter)						Total amount (mg/seedling)						% distribution			%increase as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	7	21	120	7	21	120
C.S	52.8	48.8	21.5	19.8	43.8	28.4	31.6	32.7	38.5	28.7	78.3	145.5	26.5	19.7	53.8	21.7	22.5	100
-Zn	49.3	44.5	32.1	16.2	45.2	32.1	28.8	21.1	53.8	24.8	48.8	161.8	32.8	15.3	51.9	12.9	13.8	100
-Mn	54.5	48.8	33.2	18.8	44.1	32.7	28.2	23.5	54.9	26.2	80.1	161.2	34.1	16.3	49.7	12.5	14.6	100
-Fe	45.7	48.1	33.3	15.8	36.6	28.3	28.9	24.4	59.9	29.3	75.2	164.4	36.4	17.8	45.7	12.7	14.8	100

35,b) phosphorous

Treatments	Concentration (mg/gr. dry matter)						Total amount (mg/seedling)						% distribution			%increase as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	Root	Stem	Leaves	7	21	120
C.S	9.8	9.6	11.4	4.5	6.8	7.7	5.6	6.5	20.4	6.8	12.3	39.5	51.6	17.2	31.1	14.2	16.5	100
-Zn	10.8	10.2	11.4	6.8	7.9	8.7	4.3	4.8	18.8	10.3	14.7	43.8	42.9	23.5	33.6	8.9	10.9	100
-Mn	7.9	8.1	7.9	6.8	6.8	7.1	2.9	4.7	13.1	9.8	12.3	35.2	37.2	27.8	34.9	8.2	13.4	100
-Fe	6.8	6.9	4.5	3.4	9.8	5.7	3.1	4.2	8.1	6.6	18.5	33.2	24.4	19.9	55.7	9.3	12.7	100

W. seedl. = Whole seedling $\quad * = \frac{\text{total amount / seedling}}{\text{dry weight / seedling}}$

seedling growth,i.e. 120 days. This indicates that the presence or absence of such micro-nutrient affected the absorption rate of N and that is varied according to the stage of seedling development. This effect was clearly shown when the data were converted into percentage increase of N. Similar results were reported by *Iwata, et al., (1959) and El-Motaz, (1963).*

Also, it must be mentioned that some of nitrogenous compounds are stored in embryo but such amounts were not sufficient for maintaining the developing seedling as some of nitrogen was absorbed during the early periods of germination by those received complete nutrient solution. However, very rare changes in the total accumulated amounts of N when seedling were subjected to any micro nutrient deficiencies.

Leaves always possessed the highest N accumulation followed by roots, while stem ranked the third in this respect. In addition the absence of any studied micronutrient affected the distribution of nitrogenous compound in different seedling organs. This could be observed in the bases of N concentration, N total accumulated amounts or percentage distribution. The concentration of N, its total amount or its percentage distribution was always higher when seedlings were subjected to microdp-nutrient deficiency (as compared to those ones of control seedling).

At the same time unregular trend was observed in the case of stem and leaf amounts. This leads us to assume that the absence of any micronutrient may affect the translocation of nitrogen from the root to another organs, as the roots possessed higher nitrogen amount and proportion as compared to the corresponding ones of control seedling.

b- Phosphorous:

In general there is no clear difference between the P concentration during 7 and 21 days. However, such concentration slightly decreased when the seedling reached 21 days after sowing. At the same time, the uptake of phosphorous greatly increased from 21 to 120 days.

The absence of Zn, Mn or Fe greatly affected the accumulation of phosphorous. It was observed that absence of Zn seemed to be more or less slightly minimized the total phosphorous accumulated in seedling (as any other absence of Mn or Fe) during the early periods of germination as compared to those corresponding ones of the complete nutrients. However, such accumulation was higher than the control ones at 120 days under the deficiency of Zn, while such accumulation was lower when seedling was subjected under the deficiency of Mn or Fe. This result indicate that the absence of either Zn, Mn or Fe affected the absorption of phosphorus by the roots of apricot. Also it was found that the accumulation of phosphorus in the roots less under the deficiency of such micro-nutrients than those of control seedling.Also, *Mawardi, 1969* mentioned that the absence of Fe or other micro-nutrients reduced the absorption of phosphorous.

With regard to the distribution of phosphorus in different seedling parts, it could be stated that the absence of any tested micro-nutrient affected the proportion distribution of phosphorus in different seedling organs. Root of control seedling possessed the highest phosphorus followed by leaves, while stem ranked the third in this respect. The same conclusion was also observed under the deficiency of Zn or Mn, however, both treated seedling their roots possessed lower amount and proportion of phosphorous than the control. At the same time-Fe treated leaves

35,c)potassium

Treatments	Concentration (mg/gr. dry matter)						Total amount (mg/seedling)						% distribution			%increase as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	7	21	120	7	21	120
C.S	10.1	14.2	15.1	14.9	16.2	15.2	6.0	9.5	26.1	22.4	29.4	77.9	33.5	28.8	37.7	7.7	12.2	100
-Zn	11.0	11.5	14.7	13.7	09.2	12.4	4.6	5.4	24.3	20.9	17.2	62.4	38.9	33.5	27.6	7.4	8.7	100
-Mn	07.4	10.1	16.2	13.1	09.0	12.6	2.7	5.8	26.9	18.9	16.4	62.2	43.2	30.4	26.4	04.3	09.3	100
-Fe	11.6	12.2	14.1	12.6	09.2	11.9	5.3	7.4	25.4	24.6	18.9	68.8	36.9	35.8	27.5	7.7	10.8	100

35,d) Calcium

Treatments	Concentration (mg/gr. dry matter)						Total amount (mg/seedling)						% distribution			%increase as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W. * seedl.	days	days	Root	Stem	Leaves	W. seedl.	Root	Stem	Leaves	7	21	120
C.S	9.0	9.0	15.0	14.0	23.0	17.6	5.4	6.0	26.8	21.2	41.9	89.9	29.8	23.6	46.6	6.0	6.7	100
-Zn	5.0	9.0	10.0	15.0	17.0	14.1	2.1	4.3	16.5	22.9	31.6	71.0	23.2	32.3	44.5	2.9	6.1	100
-Mn	8.0	9.0	13.0	13.0	15.0	13.7	2.9	5.2	21.5	18.9	27.3	67.7	31.8	27.9	40.3	4.3	7.7	100
-Fe	6.0	8.0	14.0	16.0	15.0	15.0	2.7	4.9	25.2	31.2	30.8	87.2	28.9	35.8	35.3	3.1	5.6	100

W. seedl. = Whole seedling $* = \frac{\text{Total amount/seedling}}{\text{Dry weight/seedling}}$

35,e) Magnezium .

Treatments	Concentration (mg/gr. dry matter)						Total amount (mg/seedling)						% distribution			%increase as realted to highest value		
	7	21	128 days				7	21	128 days				128 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	7	21	128	7	21	128
C.S	2.7	3.5	4.2	3.1	4.5	3.9	1.6	2.3	7.6	4.6	8.2	28.4	37.3	22.5	48.2	7.8	11.3	188
-Zn	2.9	3.2	4.2	3.4	4.1	3.9	1.2	1.5	7.8	5.3	7.6	19.9	35.2	26.6	38.2	6.8	7.5	188
-Mn	2.8	3.8	4.6	2.9	3.8	3.8	1.8	1.7	7.6	4.3	6.8	18.7	48.6	22.9	36.4	5.3	9.1	188
-Fe	3.8	3.2	4.5	3.8	3.8	3.8	1.4	1.9	8.1	5.9	7.8	21.8	37.2	27.1	35.8	6.4	8.7	188

W. seedl. = Whole seedling $* = \frac{\text{total amount / seedling}}{\text{dry weight / seedling}}$

possessed the highest phosphorous content and proportion as compared to other treatments, and the *vice versa* was true in roots. This indicates that Absence of any nutrient not only affected the phosphorous absorption by apricot seedlings but also their effect extended to the proportion distribution of phosphorus in different seedling parts, i.e. may affect the phosphorous translocation from the roots into the shoots.

c- Potassium

It could be concluded that the absence of any micro-nutrient mostly minimized the accumulation of potassium in seedling of apricot under the level of those corresponding ones received complete nutrient solution. This leads to the assumption that absence of Zn, or Fe reduced the absorption of potassium. Their effect was extended to the distribution of potassium in different organs, as the lacking of such nutrient greatly reduced the potassium concentration and total amounts in leaves as compared to the control ones.

d- Calcium:

The same trend was observed in the case of calcium as discussed in the case of potassium, as the less in root calcium amounts of such immobile element was associated with the great less in leaves calcium. In addition, the absence of Fe stimulated the great accumulation of calcium in stem and greatly lowered accumulation in leaves.

e- Magnesium:

The absence of any tested micro-nutrient slightly affected the accumulation and absorption of magnesium as compared to the great differences in other element such as nitrogen, phosphorus, potassium and calcium.

2- Micro-nutrient: Tables (36, a,b,c & d).

Before discussing the effect of different tested micro-nutrients on the accumulation of some micro-nutrients in different seedling tissues of apricot, it must be mentioned that in spite of the complete care to prevent contamination with any tested micro-nutrient in the media, but that seemed to be impossible under sand culture technique. The amount of such nutrients which founded during early periods of germination was mainly related to the stored amounts in seeds. However, such amounts were not sufficient for maintaining the growth of apricot seedlings. It must be mentioned also that the absence of Zn, Mn or Fe affected the absorption of the tested micro-nutrients. Their effects were extended to the distribution of such nutrients in different apricot seedling parts, and that indicates that the absence of such nutrients may affected the translocation of such nutrient from roots to the other seedling organs.

Proportion of the different nutrient to each other: Table (37).

As the different treatments affected the accumulation, the distribution and may be the translocation of different nutrients, accordingly our study was extended to the balance between macro or micro-nutrient as related to the total amounts, as considered that the normal balance found in seedlings received the complete nutrients. The following conclusion could be stated as follows :

Under the normal and healthy seedling which received complete nutrient solution, the major and dominant nutrient was N during different periods of seedling development. However, such proportion decreased during seedling development, as the proportion of K and ca greatly increased during 120 days.

Table (36,a,...& d): Effect of Zn, Mn and Fe deficiency on some micro-nutrients status during different periods of seedling growth of apricot cv. El-Amar .

36,a) Iron .

Treatments	Concentration (Ug/gr. dry matter)						Total amount (Ug/seedling)						% distribution			%increase as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	7	21	120	7	21	120
C.S	462.5	770.5	815.0	512.0	562.0	635.0	276.9	517.1	1457.9	774.3	1024.1	3256.3	44.8	23.8	31.4	8.5	15.9	100
-Zn	425.5	630.5	757.5	575.0	880.0	747.2	198.8	298.7	1251.1	880.7	1635.7	3767.5	33.2	23.4	43.4	5.1	87.9	100
-Mn	547.5	592.5	842.5	680.0	815.0	768.9	283.2	341.4	1395.1	871.3	1480.4	3746.8	37.2	23.3	39.5	5.4	89.1	100
-Fe	330.0	280.0	287.5	275.5	272.5	287.2	151.1	170.1	517.9	537.7	559.7	1615.3	32.1	33.3	34.6	9.4	18.5	100

36,b) Manganese.

Treatments	Concentration (Ug/gr. dry matter)						Total amount (Ug/seedling)						% distribution			%increse as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W. * seedl.	days	days	Root	Stem	Leaves	W. seedl.	Root	Stem	Leaves	7	21	120
C.S	337.5	352.5	352.5	580.0	462.2	435.1	282.1	236.6	630.6	756.2	841.5	2228.3	28.3	33.9	37.8	9.1	18.6	100
-Zn	210.0	371.5	362.5	510.0	337.2	397.9	888.6	150.4	598.7	781.1	626.8	2006.6	29.8	38.9	31.2	4.4	7.5	100
-Mn	150.0	138.2	162.0	140.0	140.0	147.4	855.7	879.6	268.3	283.3	254.3	8725.9	36.9	28.0	35.0	7.7	18.9	100
-Fe	337.5	340.5	440.0	585.0	347.5	429.1	154.8	286.9	792.7	985.5	713.8	2492.0	31.8	39.5	28.6	6.2	88.3	100

W. seedl.= Whole seedling * = $\frac{\text{Total amount/ seedling}}{\text{Dry weight/ seedling}}$

36,c) zinc.

Treatments	Concentration (Ug/gr. dry matter)						Total amount (Ug/seedling)						% distribution			%increase as related to highest value		
	7	21	128 days				7	21	128 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	7	21	120	7	21	120
C.S	57.5	59.9	117.5	57.0	57.0	70.1	34.4	40.2	210.2	86.2	103.8	400.2	52.5	21.5	25.9	8.6	10.0	100
-Zn	45.9	44.0	25.0	25.0	25.0	25.0	19.4	28.1	41.3	38.3	46.5	126.1	32.8	30.4	36.9	15.4	15.9	100
-Mn	59.0	62.0	50.0	50.0	50.0	50.0	21.9	35.1	82.8	72.6	90.8	246.2	33.6	29.5	36.9	8.9	14.3	100
-Fe	47.5	50.5	50.5	50.5	50.5	50.5	21.7	30.4	90.1	97.6	105.7	293.4	30.7	33.3	36.0	7.4	10.4	100

36,d) Copper

Treatments	Concentration (Ug/gr. dry matter)						Total amount (Ug/seedling)						% distribution			%increase as related to highest value		
	7	21	120 days				7	21	120 days				120 days			Days after sowing		
	days	days	Root	Stem	Leaves	W.* seedl.	days	days	Root	Stem	Leaves	W. seedl.	Root	Stem	Leaves	7	21	120
C.S	100.0	200.0	225.5	310.0	242.0	256.3	107.0	134.4	403.4	468.0	440.6	1312.0	30.7	35.7	33.6	8.2	10.2	100
-Zn	145.0	185.0	220.0	245.0	192.5	213.9	61.2	87.6	363.4	357.2	357.8	1078.4	33.7	33.1	33.2	5.7	8.1	100
-Mn	167.5	162.0	210.0	252.0	167.5	206.7	62.2	93.3	374.7	365.9	304.3	1017.9	34.2	35.9	29.9	6.1	9.2	100
-Fe	145.0	150.0	210.0	215.0	232.5	219.6	66.4	91.1	378.3	419.6	477.6	1275.5	29.7	32.9	37.4	5.2	7.1	100

" " "' " "' total amount /seedling

While P proportion seemed to be more or less constant. In other words, the rates of different nutrients absorption were not constant during different periods of growth, as the requirement for each nutrient is dependent upon its role in growth. The requirement for nitrogen during early periods of growth was conspicuous, accordingly its accumulation proportion exceeded the sum of all other macro-nutrients, as it plays an important role in building out the new developing seedling tissues. At the same time the requirement for other macro-nutrients seemed to be more or less constant during such early periods of germinated seedling except K which proportion requirement slightly increased at 21 days. The proportion requirement of K, ca and Mn increased at 120 days while P requirement may be constant during different periods of seedling growth. At the same time the proportion need of N slightly decreased during 21 days and greatly decreased at 120 days.

From the available data, it could be revealed that the main dominant micro-nutrient was Fe followed by Mn, Cu and Zn was the lowest one. These proportions were greatly changed during different periods of seedling development, as the rate of their absorption was greatly changed from period to another according to their variable requirements.

It could be revealed that under the deficiency of Zn, Mn or Fe a disturbance in the accumulation proportion of macro-and micro-nutrients were observed, and that may be discussed on the bases that the absence of any micro-nutrient seemed to disturb the absorption balance of different nutrients and that affected the seedling growth behaviour. In other words, the absence of any micro-nutrient not only affected the seedling growth through the alteration in its role of metabolic processes, but also in the disturbance of the balance proportion of different nutrients which

may result from its role on the absorption of different nutrients macro or micro ones.

Table (37): Effect of Zn,Mn and Fe deficiency on the balance of different nutrients in the termsof percentage as related to the total amounts / seedling during different periods of growth .

Irrigation with or without	Macronutrients															Micronutrients											
	7 days					21 days					128 days					7 days				21 days				128 days			
	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
C.S	62.9	11.1	11.9	18.8	3.2	57.4	11.4	16.7	18.5	4.8	38.9	18.6	28.9	24.1	5.5	44.6	32.5	5.5	17.4	55.7	25.5	4.3	14.5	45.2	38.9	5.6	18.2
-Zn	62.8	13.1	14.8	86.4	3.7	56.9	12.9	14.6	11.6	4.8	45.1	12.2	17.4	19.8	5.5	53.8	24.6	5.4	16.9	53.6	27.8	3.6	15.7	53.9	28.8	1.8	15.5
-Mn	68.8	89.8	89.1	89.8	3.4	57.5	11.5	14.2	12.7	4.2	46.7	18.2	18.8	19.6	5.4	59.2	16.2	6.4	18.1	62.1	14.5	6.4	16.9	65.3	12.6	4.3	17.7
-Fe	62.6	89.3	15.9	88.1	4.2	57.8	89.8	17.3	11.4	4.4	43.8	88.8	18.3	23.2	5.8	38.4	39.3	5.5	16.9	34.1	41.5	6.1	18.3	28.5	43.9	5.2	22.5