4. RESULTS AND DISCUSSION

4.1 General soil characteristics:

4.1.1 Soils with calcic horizon.

The profile descriptions of profiles no. 3,4,5,6 and 7 which have calcic horizon are recorded as follows:

Profile No. (3)

Location : 1 Km from lake Qarun, Senoris, Fayoum.

Parent material : Lacustrine deposits.

Topography : Nearly level, the land lower than surroundings areas

Erosion : None.

Surface moisture : Dry.

Vegetation : Cultivated with clover.

Irrigation : Tersa canal.

Drainage : Imperfectly drained.

Water table : 110 cm. from the surface.

Remarks : Cracks on the surface (1-2 cm. width, and 5cm depth). The farmer added agricultural gypsum (photo 1).

Horizon	Depth (cm)	Description
A_{Pca}	0-30	Dark brown (10YR 3/3, dry) dark grayish brown (10YR 4/2, moist); clay, weak subangular blocky structure; very sticky; very plastic; violent effervescence with HCl; healthy roots; diffuse boundary
Ap/C_{1ca}	30-70	Dark brown (10 YR 3/3 dry); dark grayish brown (10YR 4/2, moist); clay; massive; very sticky, very plastic; violent effervescence with HCl; distinct common blue mottles; few medium; few medium roots; diffuse boundary.

no 3 at Senoris,

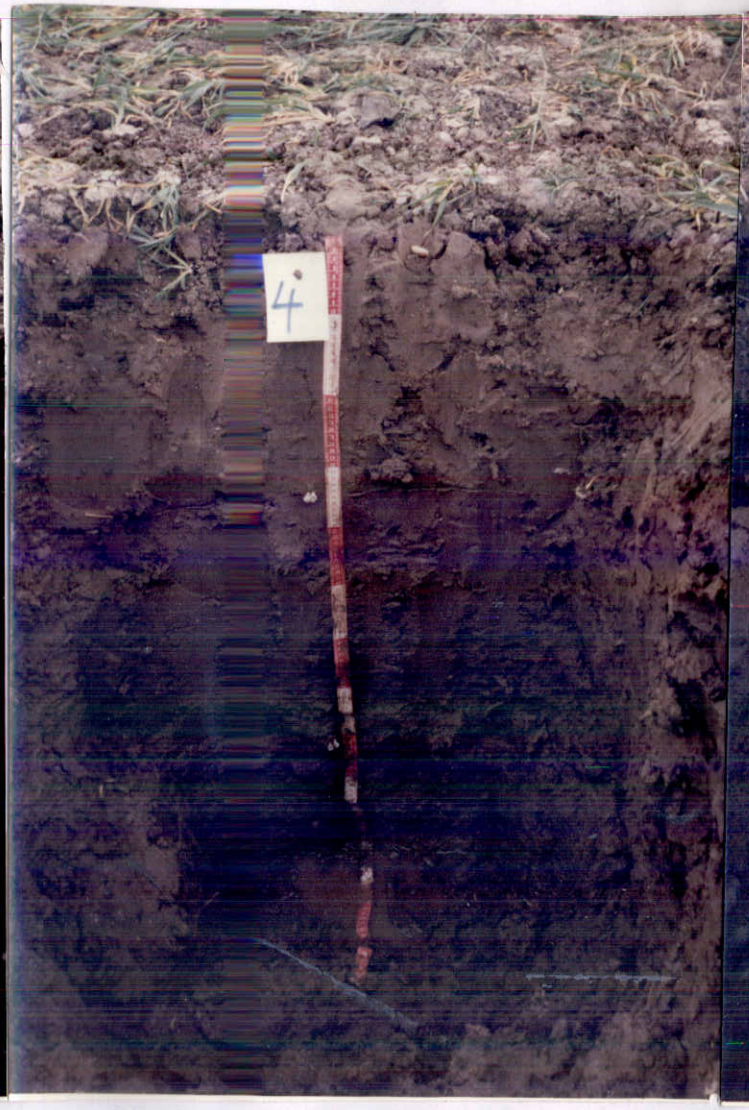

Photo 2: Profile no 4 at Ezbet Shamata, Fayoum.

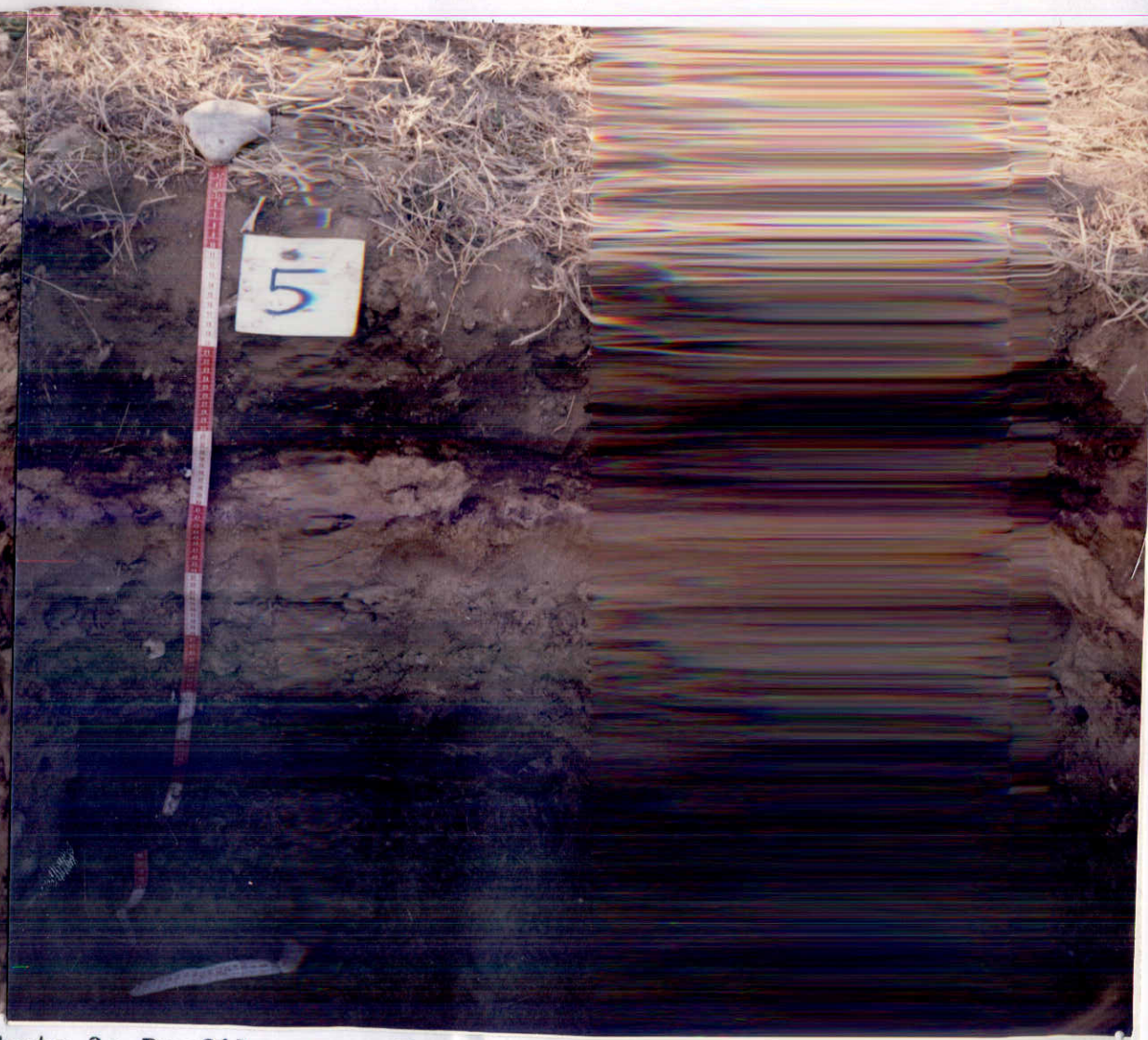

Photo 3: Profile no 5 at Tamiya, Fayoum.

C_{2ca}	70-110	Brown (10YR 4/3 dry); dark gray (10YR 4/1,moist); clay; sticky ; plastic, strong effervescence with HCl; distinct common blue green mottles , no roots; 110 + water table

Profile No. (4).

Location : 1 km from lake Qarun, Ez. Shamata, Senoris, Fayoum.

Parent material : Lacustrine deposits.

Topography : Nearly level.

Erosion : None.

Surface moisture : Dry.

Vegetation : Cultivated with barley.

Irrigation : El-Rafie canal.

Drainage : Freely drained.

Water table : At 120 cm .

Remarks : Cracks on the surface (2-3 cm) width, and 15 cm . depth also fine spots. Salts accumulation on the surrounding areas (photo 2).

Horizon	Depth (cm.)	Description
Ap_{ca}	0-35	Brown (10 YR 4/3, dry). grayish brown (10YR 5/2 moist.); clay; weak subangular blocky structure; very sticky, very plastic; violent effervescence with HCl; few fine roots; diffuse boundary.
Ap/C_{1ca}	35-80	Brown (10 YR 4/3, dry and wet); clay; massive ; very sticky, very plastic, violent effervescence with HCl; slickensides; few medium roots; diffuse boundary.

C_{2ca}	80-120	Brown (10YR 4/3, dry); dark yellowish brown (10 YR 4/4, moist), silty clay; sticky; plastic violent effervescence with HCl; few medium roots.

Profile No. (5)

Location : El Fahmiya, Tamiya, Fayoum.

Parent material : Calcareous sediments.

Topography : Nearly level, the land lower than the surrounding area.

Erosion : None.

Surface moisture : Dry.

Vegetation : Was cultivated with barley.

Irrigation : Bahr Wahba canal.

Drainage : Fairly perfect

Water table : > 150 cm.

Remarks : Cultivated since 8 years, some stones (5 - 10 cm . diameter) on the surface (photo 3).

Horizon	Depth cm.	Description
Ap_{ca}	0-35	Yellowish brown (10 YR 5/4, dry) ; dark yellowish brown (10 YR 4/4, moist); sandy clay loam; moderate subangular blocky structure; non sticky; non plastic; violent effervescence with HCl; some $CaCO_3$ concretions; common medium roots; clear boundary.
C_{ca}	35-70	Very pale brown (10 YR 8/4, dry and moist); sandy loam, single grains mixed with different stones (3-10 cm. diameter); violent effervescence with HCl; few fine roots; clear boundary.

II C_{ca}	**70-110**	Very pale brown (10YR 7/4, dry and moist) ; sandy clay (shale); platy, sticky; plastic, violent effervescence with HCl; distinct medium brown mottles, few fine roots.

Profile No. (6)

Location : 176 km. Cairo- Alexandria desert road at the right side, North of Tahrir province.

Parent material : Mixed calcareous deposits.

Topography : Nearly flat.

Erosion : Few.

Surface moisture : Dry.

Vegetation : Wheat.

Irrigation : Branch No. 6, from Nubaria canal .

Drainage : Imperfect

Water table : > 150 cm.

Remarks : There is an open drain in the west and the south sides of the land (photo 4).

Horizon	Depth (cm.)	Description
Ap_{ca}	**0-20**	Yellow (10YR 7/8, dry), brownish yellow (10YR 6/8, moist), silty loam, weak medium subangular blocky structure; sticky; plastic; violent effervescence with HCl, many fine and medium roots; clear boundary.
Ap/C_{1ca}	**20-60**	Yellow (10YR 7/8, dry), brownish Yellow (10YR 6/8, moist) silty clay loam; weak medium subungalar blocky structure; sticky, plastic; violent effervescence with HCl ; many $CaCO_3$ concertions; few medium roots; diffuse boundary.

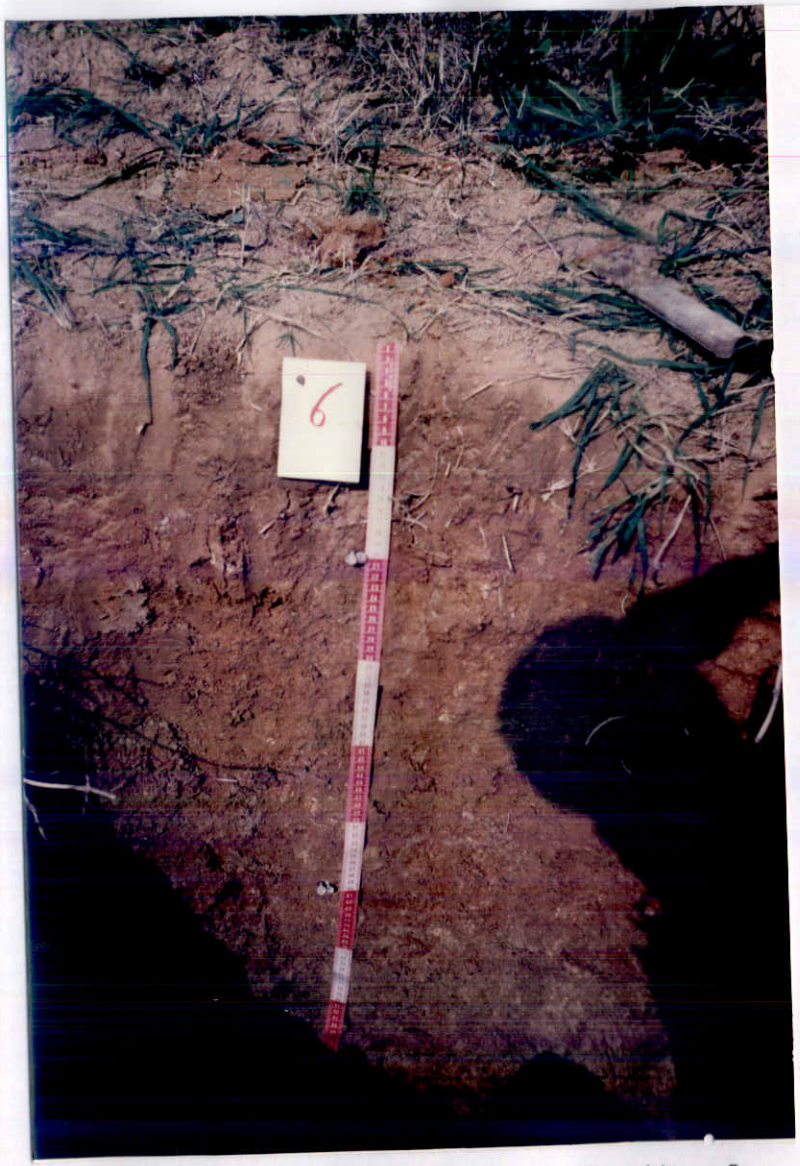

Photo 4: profile no 6 at North of

Tahrir Province

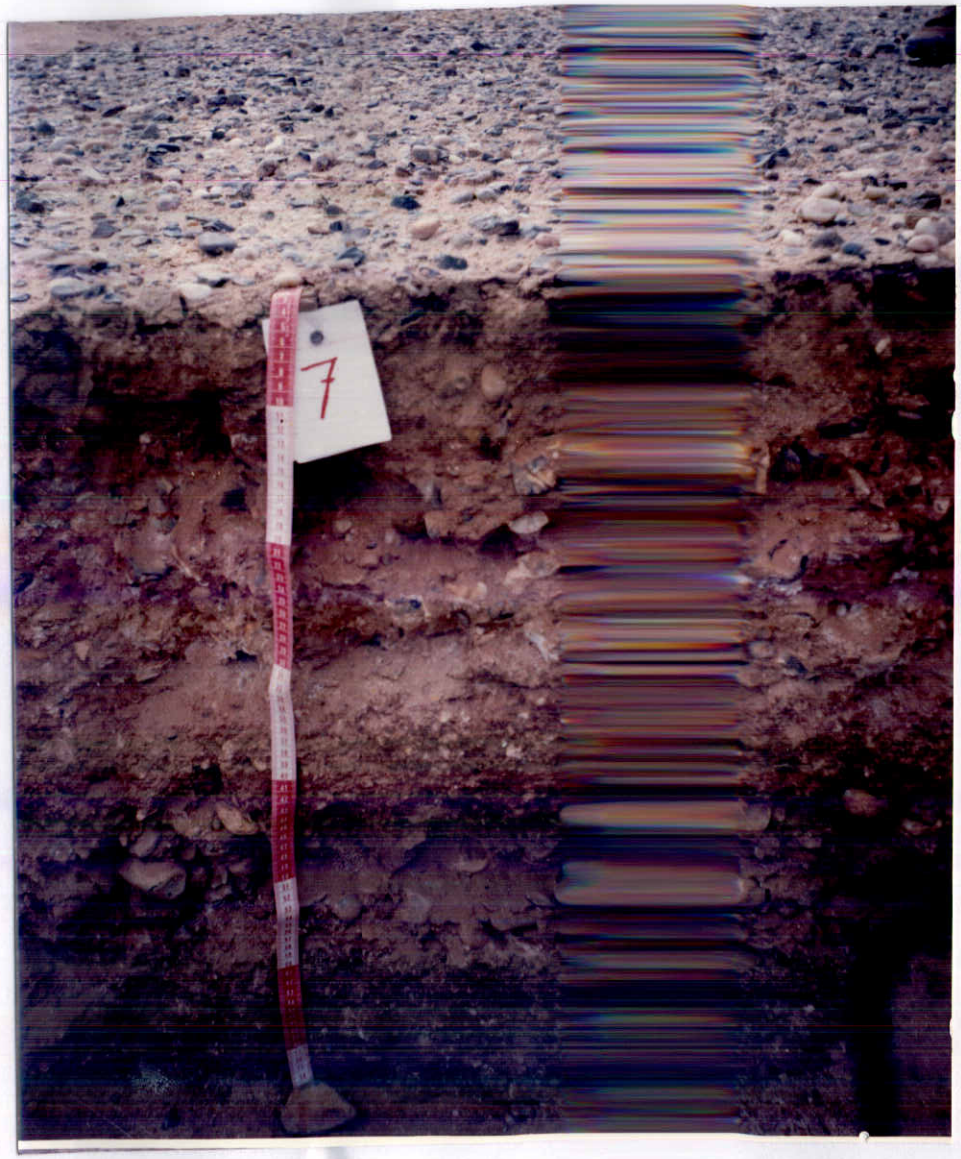

Photo 5: profile no 7 at [redacted] North of

Wadi El Natrun

C_{1ca}	60-120	Yellow (10 YR 8, dry), brownish yellow (10YR 6/8, moist) silty clay loam; weak medium subangular blocky structure; sticky; plastic; violent effervescence with HCl; many $CaCO_3$ concretions; no roots.

Profile No.(7)

Location : 114 km. Cairo - Alexandria desert road at (The left side) North of Wadi El - Natrun

Parent material : Aeolian deposits.

Topography : Undulating.

Erosion : Moderate.

Surface moisture : Dry.

Vegetation : Virgin, Some natural vegetation.

Drainage : Freely.

Water table : > 150 cm.

Remarks : The surface is covered with many, different sizes of gravels and stones (photo 5).

Horizon	Depth (cm.)	Description
C_{1ca}	0-10	Yellow (10YR 7/6,dry), brownish yellow (10 YR 6/6, moist) ; loamy sand, single grains mixed with many fine and medium gravels and stones; non stick; non plastic; violent effervescence with HCl few $CaCO_3$ concretions; no roots; clear boundary .
C_2cac_s	10-30	Very pale brown (10 YR 8/4 dry and moist); gravelly sand, stones; violent effervescence with HCl; some $CaCO_3$ concretions, many gypsum crystals, many coarse gravels no roots; clear boundary.

C_{3ca}	30-40	Yellow (10 YR 7/6 , dry), brownish yellow (10 YR 6/6, moist), single grains mixed with fine and medium gravels; violent effervescence with HCl many $CaCO_3$ concretions; no roots; clear boundary.
C_{4Ca}	40-60	Very pale brown (10 YR 8/4, dry and moist); gravelly mixed with sand; violent effervescence with HCl; some $CaCO_3$ concretions; some gypsum crystals; no roots; clear boundary.
C_{5ca}	60-90	Yellow (10 YR 7/6, dry), brownish yellow (10YR6/6, moist), sandy mixed with fine gravels; violent effervescence with HCl; many $CaCO_3$ concretions; no roots.

The selected profiles for the study of calcic horizon are located in two geographic units. Profiles no. 3,4 and 5 from Fayoum Governarate, as well as profiles no. 6 and 7 in the Western Desert. These profiles are orginiated from lacustrine deposits (profiles no. 3 and 4) and calcareous sediments (profiles no. 5, 6 and 7. However, profile no. 7). (North of Wadi El Natrun) is considered as an eolian deposits.

The calcic horizon in these profiles differs in many aspects. From the field description, it is clear that profile no. 7 is virgin soils with scarce natural vegetation while profiles no. 3, 4,5 and 6 are cultivated with some field crops as wheat and barley. Most of these profiles are deep but water table appears at 110 and 120 cm in profiles no 3 and 4 (near Qarun lake) and associated with imperfect drainage due to relatively heavy texture. Regarding soil colour of the calcic horizon, it differs from dark brown in the lacustrine deposits to pale brown or yellowish brown in the calcareous sediments (profiles 5,6 and 7).

The blocky structure distinguishes the clayey soils in profiles no 3 and 4 while loose, single grains or fine granular in profiles no. 5,6 and 7 .

Morphological observations (photos no 1- 5) and the analytical data in Table (1) reveal that the depth of calcic horizon differs from one profile to another. Near lake Qarun in Fayoum and north of Wadi El Natrun calcic horizon occurs on the upper part of the solum from 0-70 cm .and 0-40 cm respectively, figure 2 in calcareous sedcic horizon (Keys to Soil Taxonomy, 1992)

Regarding the form of carbonates in the calcic horizon, it is obviously clear that fine grains and powdery matrix are prevailing in profiles no 3&4. However large and small concretions are abundant in other profiles . In this respect several investigations have described the micromorphological features of calcium carbonates in thin sections***(Labib & Sys,1970; Labib& Hamdi, 1972 Labib et al, 1981; and (Abdel Rahman, 1981).***

The calcium carbonate percentage in the studied calcic horizons vary from 16.50 to 40.85(profiles no. 5 and 6). The low contents of carbonates are associated with lacustrine conditions where enrichment of fine textured soils with saline water from the lakes is the occurring calcareous sediments originated from disintegration of limestone of the Western desert contained high ratio of carbonates(Table 1 and Figure 2). Pervious studies in this respect recorded that the calcic horizon in marine sediments formed mainly of calcium carbonate (about 90 %),as reported by ***Abdel kader and Gewaifel.(1975)***

Formation of calcic horizon can be associated with gypsum precipitation. Data of profiles no 3,4 and 7 indicate the presence of gypsum (1.26-7.98 %)and this content does not satisfy the requirement of gypsum horizon. These accumulations of calcium sulphate appear in the profile as small

Table (1) Some chemical characteristics and grain size distribution of the soils with calcic horizon.

prof. No.	Location	Depth (cm)	Hor.	Ca CO_3 %	Gypsum %	O.M %	T.S.S %	pH 1:2.5 soil water	Grain size distribution				Texture class
									sand %		silt %	clay %	
									C.S	F.S			
3	1 km from lake Qarun Senoris, Fayoum	0-30	Ap_{ca}	17.58	2.56	2.10	0.93	8.40	18.76	15.20	9.50	56.54	C.
		30-70	$Ap/_{c1ca}$	19.00	-	1.74	0.54	8.10	14.17	13.45	9.00	63.38	C.
		70-110	C_{2ca}	7.60	-	1.48	0.41	7.99	14.04	13.44	17.50	54.97	C.
4	1 km from lake Qarun Ez Shamata Fayoum	0-35	Ap_{ca}	18.53	1.26	2.18	0.59	8.12	0.89	7.19	2.62	89.30	C.
		35-80	$Ap/_{c1ca}$	20.90	1.57	1.83	0.20	8.10	0.60	3.54	58.12	37.74	Si.C
		80-120	C_{2ca}	19.95	2.20	1.88	0.31	7.94	0.67	6.98	21.82	70.53	C
5	El.Fahmiya Tamiya Fayoum	0-35	Ap_{ca}	16.50	-	2.05	0.02	8.15	41.41	23.49	2.48	32.62	S.C
		35-70	C_{1ca}	40.85	-	1.02	0.01	8.10	63.40	16.80	4.40	15.40	S.L
		70-110	II C_{ca}	38.00	-	1.04	0.03	8.20	39.82	22.49	3.57	34.12	S.C
6	176 km Cairo-Alex. North of Thrir Province	0-20	Ap_{ca}	39.90	-	1.74	0.04	7.97	26.48	24.29	38.73	10.50	L.
		20-60	$Ap/_{c1ca}$	40.85	-	0.95	0.03	7.99	24.21	29.64	39.05	7.10	S.L
		60-120	C_{1ca}	39.90	-	0.83	0.02	7.81	23.42	28.87	44.46	2.75	S.L
7	114 km Cairo-Alex. desert road (the left side) Notrth of Wadi El Natrun	0-10	C_{1ca}	17.85	2.61	0.87	0.06	7.85	70.67	23.33	3.25	2.75	S
		10-30	C_{2cacs}	18.05	7.98	0.73	0.11	7.86	69.72	16.83	3.78	9.67	L.S
		30-40	C_{3ca}	14.25	3.29	0.60	0.06	7.84	69.26	16.12	5.85	8.77	L.S
		40-60	C_{4ca}	9.03	3.38	0.64	0.08	7.87	71.68	13.49	6.43	8.40	L.S
		60-90	C_{5ca}	10.45	2.45	0.43	0.04	7.80	75.65	15.08	5.65	3.62	S

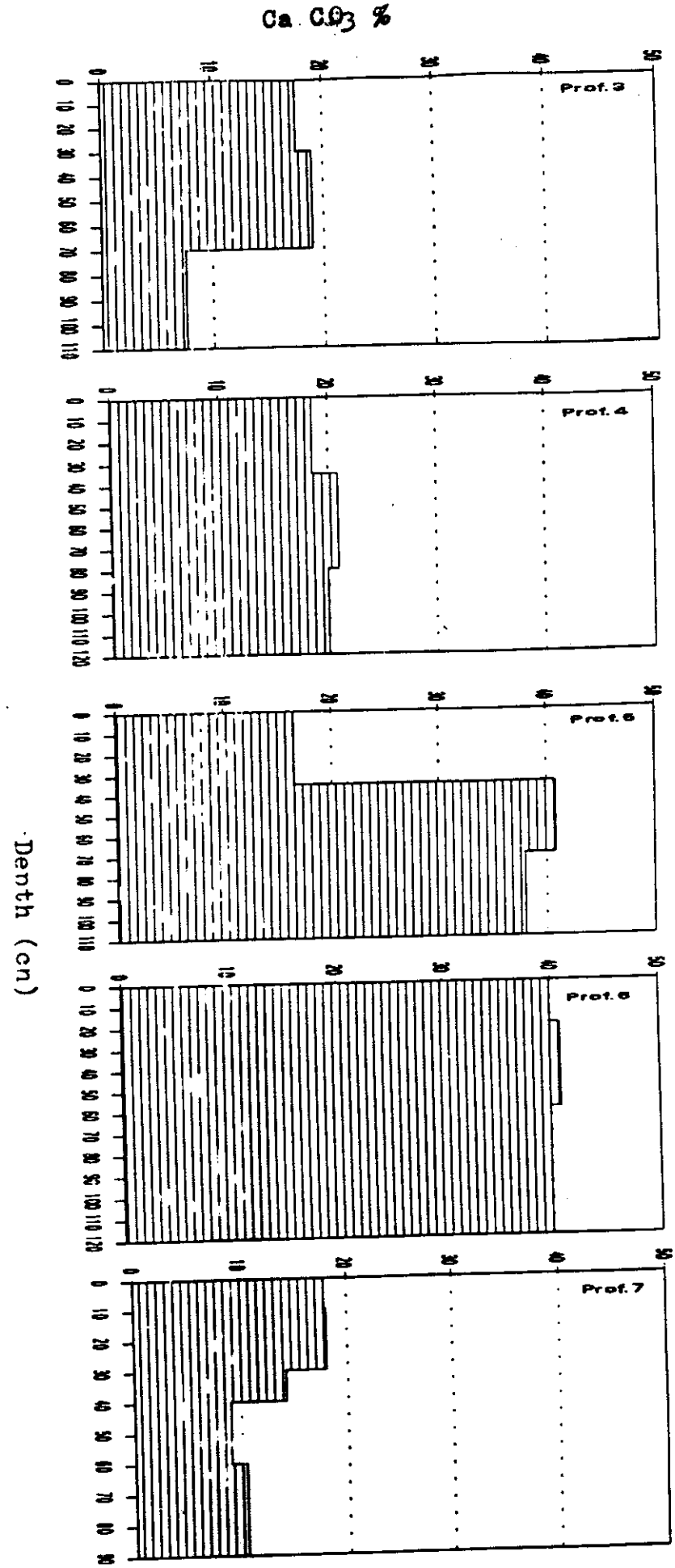

Figure 2 : Distribution of calcium carbonate in the calcareous profiles. (Calcic horizon)

or large bright white single crystals or thin sheets. The reaction between sodium sulphates in the saline lake water and the active calcium carbonate from the sediments lead to precipitation of calcium sulphate.

Data of organic matter in Table (1) are relatively low(0.43 to 2.18 %) in these calcareous soils due to arid conditions and high temperature which lead to excessive oxidation of organic residues.

Surface, leyers particularly Ap horizons of the cultivated soils have relative higher content of organic matter because of the accumulation of some roots (wheat, barley or natural vegetation).

The studied profiles which represent the calcic horizon in some Egyptian soils have low content of soluble salts (0.9 to 11.34 mmhos/cm).However profile no.3 near lake Qarun is characterized by white surface crust which has 22.40 mmhos/cm.. decreases with depth to 10.60 mmhos/cm (Table 2). The high salinity of the surface layer of this profile is combined with increase in alkalinity since ESP reached 37.0 and pH is 8.4 (Table 2).

In general, pH values of the calcic horizon tend to alkaline side and range between 7.81 to 8.40.

Magnesium substitution of calcite has been discussed by ***Jahn and Stahr (1994)***.There is an evident of Mg^{++} substitution in the calcic horizon of the studied profiles. The concentration of soluble Mg^{++} in soil water extract ranges between 1.45 to 3.77 meq/100g while soluble Ca^{++} ranges between 1.13 to 6.65 meq./100g (Table 2) However, Mg substitation of calcite can be confirmed by chemical extraction as well as by a shift of the Al (112)by X-ray examination. The dominant soluble salts in these calcareous soils is sodium chloride. Relatively low concentrations of calcium chloride, magnesium chloride, sodium sulphate and sodium carbonate are included in the soil-water paste extracts (Table 2).

Table (2) Soluble and exchangeable salts of the soils with calcic horzion

prof. No.	location	Depth cm	SP %	E.C mmhos/cm	SOLUBLE SALTS								C.E.C meq/100 g soil	EX.Na meq/100 g soil	EX.K meq/100 g soil	E.S.P
					Cations				Anions							
					meq/100g. soil											
					Ca	Mg	Na	K	CO3	HCO3	Cl	SO4				
3	1 Km from lake Qarun senoris Fayoum	0 - 30	65	22.40	2.98	3.77	48.28	0.37	-	0.72	39.10	15.88	37.98	14.05	0.85	37.00
		30 - 70	75	11.34	2.83	2.62	22.60	0.18	-	0.68	18.25	9.30	38.49	7.51	0.82	19.50
		70 -110	60	10.60	4.33	1.91	21.70	0.14	-	0.93	25.90	1.25	39.35	6.69	0.46	17.50
4	1 km from lake Qarun, Ez, Shamsta Senoris Fayoum	0 -35	93	10.00	1.58	3.54	16.09	0.09	-	0.74	11.63	8.93	49.26	6.40	0.94	13.00
		35 - 80	64	5.00	1.13	2.17	7.71	0.08	-	0.47	1.11	9.51	34.52	2.76	0.85	8.00
		80- 120	85	5.70	1.28	2.55	8.76	0.09	-	0.60	6.38	5.70	44.32	3.77	0.77	8.50
5	El Fahmiya Tamiya Fayoum	0-35	34	1.05	2.70	2.38	5.10	0.08	-	3.74	1.70	4.82	23.82	0.83	0.56	3.50
		35-70	26	0.40	0.10	0.52	1.56	0.05	-	1.04	0.52	0.67	18.81	0.56	0.15	3.00
		70-110	33	1.40	3.00	1.56	9.36	0.02	-	3.90	1.56	8.48	25.60	2.18	0.0	8.50
6	176 Km Cairo Alex. north of Tahrir prorince	0-20	41	1.7	3.65	2.18	6.36	0.1	-	0.27	10.60	1.42	18.96	0.95	0.65	5.00
		20-60	36	1.2	6.65	2.85	6.65	0.2	-	1.23	14.0	1.12	13.86	0.49	0.48	3.50
		60-120	32	0.9	3.45	1.45	0.39	0.1	-	0.34	9.80	0.25	11.12	0.56	0.46	5.00
7	114 km Cairo Alex. desert Road (The left side) North of Wadi El Natrun	0-10	25	3.90	2.13	1.42	6.45	0.05	-	0.18	8.75	1.12	10.46	0.63	0.48	6.00
		10-30	28	6.4	3.78	2.11	9.55	0.08	-	0.17	12.48	2.87	13.28	1.06	0.15	8.00
		30-40	28	3.2	2.94	1.62	3.25	0.03	-	0.17	6.32	1.35	14.19	0.28	0.15	2.00
		40-60	29	4.4	3.57	2.38	4.76	0.03	-	0.15	8.57	2.02	14.80	0.44	0.15	3.00
		60-90	26	2.4	2.59	1.50	2.36	0.02	-	0.10	0.46	0.91	8.34	0.08	0.23	1.00

The texture of the calcic horizon in the soils under investigation showed a wide range from clayey to gravelly sand. The lacustrine deposits (profiles no.3 nd 4) are clayey and clay percent ranges between 37.74 to 89.30. The data in Table (2) and illustration in Figure (3) indicated that profiles 5, 6 and 7(originated from calcareous sediments) have coarse texture (mostly sandy loam and loamy sand). Coarse sand and gravels are forming most of the grains in profile no 7(coarse sand ranges between 43.67 to 75.65%). The high contents of carbonate are found in various size grains(mostly silt and sand fractions). Previous data by ***Hassanieen. (1992)*** showed that carbonates are found in the fractions of silt except for wind blown sand in which lime was dominated in the sand fraction.

Many of soil characteristics and behavior are greatly influenced by soil texture, structure, consistancy, porosity, water capacity aeration and consequently some chemical properties which influence plant growth. The rate of water saturation fluctuates between 25 % (profile no.7) to 93 % (profiles no.4). These figures are obtained from disturbed ground soil samples(< 2mm),but lower values can be obtained for natural undisturbed samples in which there are many gravels.

According to the morphological description in the field and the analytical data ,these profiles with calcic horizon can be classified according to the Keys to Soil ***Taxonomy. (1992)*** as follows: profiles no 3,4,5 and 6 contain organic carbon > 0.64% .and sand /non- carbonate clay ratio between 1 and 13. Also the mean annual soil temperatures are lower than 22° and a difference of 5C° or more between mean summer and mean winter soil temperaturen in the studied regions. Therefore these profiles which located at El Fayoum Governorate and North of Tahrir can be included in the subgroup of xerollic Calciorthids.

profile no .7 at north of Wadi El Natrun (virgin uncultivated area)has lower content of organic carbon (<0.64) and the sand /non-carbonate clay ratio is <13. Accordingly this profile can be considered Typic Calciorthids.

4.1.2. Soils with gypsic horizon:

Profile description of profiles no. 1.2 and 10 with gypsic horizon is mentioned in the followings:

Profile No.(1)

Location : 41 Km Kattamia Suez road.

Parent material : Calcareous deposits.

Topography : Wavey

Erosion : Few-moderate.

Surface maisture : Dry.

Vegetation : Some natural plants.

Irrigation : None.

Drainage : Freely drained.

Water table : Deeper than 150 cm.

Remarks : There are few small gravels and some shells on the surface (photo 6)

Horizon	Depth (cm.)	Description
C_{1cs}	0-30	Yellow (10YR 7/8, dry), brownish yellow (10YR 6/8, moist); loamy ; weak fine subangular blocky structure; non sticky,non plastic; strong effervescence with HCl; soft $CaCO_3$ and gypsum concretions; no roots; diffuse boundary.
C_{2cacs}	30-50	Yellow (10YR 7/6, dry), brownish yellow (10YR 6/6, moist), silty loam; subangular bloky structure, non sticky; non plastic ; violent effervescence with HCl; many $CaCO_3$ concretions and gypsum in needle form; no root; diffuse boundary.

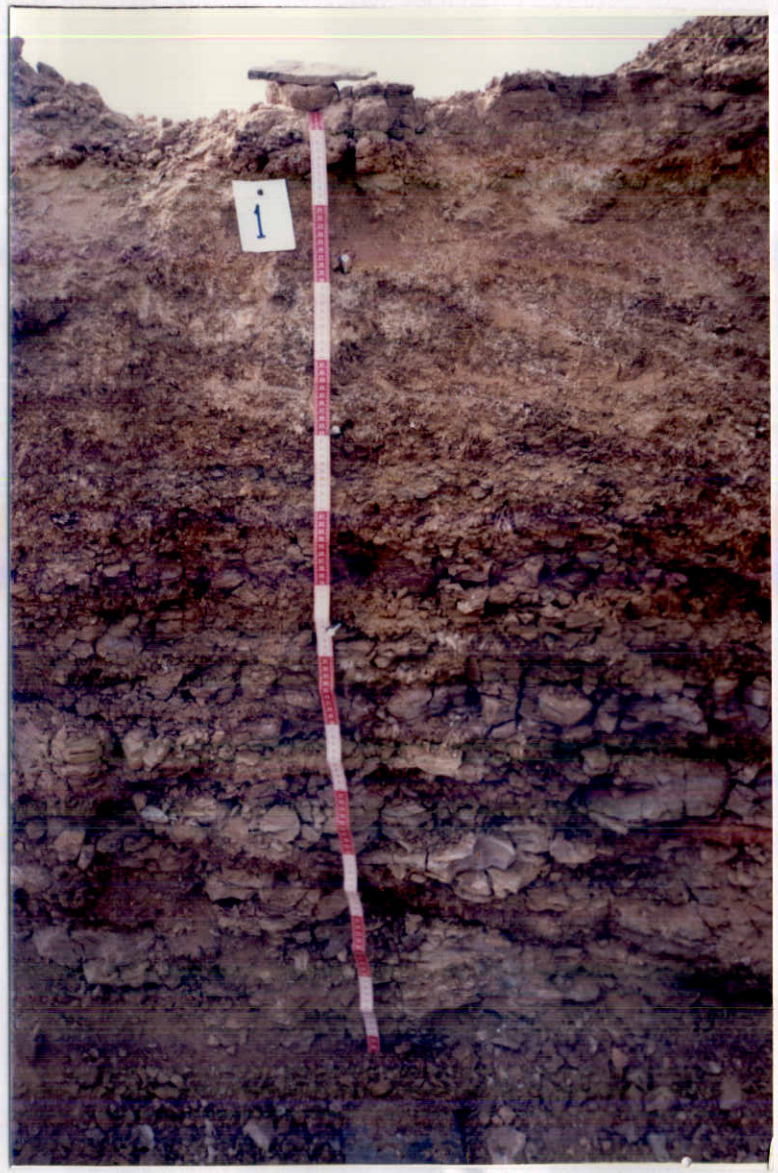

Photo 6:profile no.1 at Kattamia.

Photo 7: profile no.2 at Kattamia.

C_{3cs}	50-70	Brownish yellow (10YR 6/6, dry), Yellowish brown 5/8, moist); loamy; large granular; nonsticky; non plastic, violent effervescence with HCl; many $CaCO_3$ concretions; there are gypsic layer (5cm.) extending horizontally but not continuous, no roots diffuse boundary.
C_{cacs}	70-150	Brownish yellow (10YR 6/8, dry and moist); sandy clay (shale); strong compact platy structure with angular cracks, sticky, plastic; violent effervescence with HCl; there are layer of lime (2cm); moderate hard gypsum formation in needles form; no roots.

Profile No.(2)

Location : 47 Km Kattamia -suez road.

Parent material : Calcareous deposits.

Topography : Wavey.

Erosion : Few - moderate

Surface moisture : Dry.

Irrigation : None.

Drainage : Freely drained.

Water table : > 150 cm.

Remarks : There are few little gravels and some shells on the surface, (photo 7).

Horizon	Depth (cm.)	Description
C_{1ca}	0-30	Yellow (10YR 8/6, dry),yellow (10YR 7/6, moist), loam; loose; mixed with little and medium gravels; non sticky, non plastic; violent effervescence with HCl; some concretions of $CaCO_3$; some shells; few gypsum accumulations; no roots; diffuse boundary

C_{2cs}	30-70	Yellow (10YR 6, dry); brownish yellow (10YR 6/8, moist); silty loam; weak subangular blocky structure; non sticky; non plastic; violent effervescence with HCl; very few $CaCO_3$; many gypsum crystals, no roots; diffuse boundary.
C_{2cs}	70-110	Brownish yellow (10YR 6/8, dry and moist); sandy loam; moderate fine, weak subangular blocky structure, non sticky, non plastic; violent effervescence with HCl; many gypsum in powder form; crystals; no roots; diffusc boundary.
C_{Cacs}	110-130	Yellow (10YR 7/8, dry) , brownish yellow (10 YR 6/8, moist) ; silty clay (shale); strong compact platy structure with angular cracks; sticky; plastic violent effervescence with HCl ; some gypsum crystals; no roots.

Profile No. (10)

Location	: 150 m from El Manzala lake Eskndariya village; North El-Salam canal, Sirw, Damietta Govern - orate.
Parent material	: Lacustrine deposits.
Topography	: Nearly flat, with some depressions.
Erosion	: Few.
Surface moisture	: Dry.
Vegetation	: Cultivated with wheat.
Irrigation	: Drainage water from El- Salam canal.
Drainage	: Imperfectly.
Water table	: at 80 cm. from the surface.

Horizon	Depth (cm.)	Description
A_p/C_1	0-60	Grayish yellow brown (10 YR 4/2, dry); dark brown 3/3, moist); clay; massive; very sticky; very plastic; slight effervescence with HCl, some gypsum in form of concretions; plates and crystals; few fine roots; diffuse boundary.
C_2	60-90	Grayish yellow brown (10YR 4/2, moist); silty loam; granular; sticky, very plastic; moderate effervescence with HCl; many gypsum crystals; no roots.

Previous studies on the gypsifereous soils indicated that gypsum precipitates in scattered in local areas near some lakes (EL Manzala and Qarun), Nile terraces (North Tahrir province), combined with calcareous sediments (as in kattamia) and other locations a corrding to ***El Taweel (1982).***

Three profiles were selected for the study of gypsic horizon from two locations :Kattamia (profiles no 1 and 2) and El Manzala (profile no 10).

Field observations indicated that the soils with gypsic horizon at Kattamia have deep solums , freely drained, virgin with few natural scattered vegetations (photo. 6 and 7). Texture and structure variations in these soils refered to the occurance of two sedimentation cycles where the upper parts of the solum are silty loam or loam and the deeper horizons C_2 are silty clay loam with platy compact structure. Soil dry colour in these two profiles ranges between yellow (10 YR 7/8) to brownish yellow (10 YR 6/18). The presence of shells, or fragments of shells, particularly on the surface layers indicates the old lacustrine origin of these sediments and explains the high carbonate content, (Table 3). Profile no 10 near El Manzala lake is relatively shallow and water table is at 80 cm due to imperfect drainage.

Table (3) Some chemical characteristics and grain size distribution of the soils with gypsic horizon.

prof No.	Location	Depth (cm)	Hor.	$CaCO_3$ %	Gypsum %	O.M %	T.S.S %	pH 1:2.5	Grain size distribution				Texture Class
									Sand %		Silt %	Clay %	
									C.S	F.S			
1	41km.El	0-30	C_{1cs}	6.18	6.55	0.96	0.11	7.85	13.5	54.50	20.20	12.15	S.L
	Kattamia	30-50	C_{2cacs}	12.35	6.20	0.75	0.20	7.78	20.32	28.13	42.30	9.25	L.
	Suez	50-75	C_{3cs}	9.50	5.12	0.87	0.34	7.72	33.45	10.50	45.25	10.80	L.
	road	75-150	II C_{cacs}	12.20	6.73	0.93	0.66	7.98	42.56	7.55	11.72	38.17	S.C.
2	47Km.EL	0-30	C_{1ca}	23.21	3.56	0.58	0.16	7.97	12.45	15.63	51.72	20.20	Si.L
	Kattamia	30-70	C_{2cs}	9.50	4.92	0.87	0.34	7.92	27.30	21.34	33.01	18.35	L.
	Suez	70-110	C_{2cs}	9.98	5.09	0.67	0.56	7.96	35.40	18.69	30.16	15.75	S.L
	road	110-130	II C_{cacs}	14.25	5.17	0.93	0.72	7.91	8.75	7.95	49.10	34.20	Si.C.L
10	150 m	0-60	Ap/C_1	1.77	2.47	1.45	0.74	8.22	5.22	12.55	39.00	43.23	Si.C.
	from Manzala lake	60-90	C_2	4.66	3.56	1.60	0.30	8.10	22.80	5.20	55.60	16.40	L.

Sampled area was cultivated with wheat; therefore a plough horizon Ap with dark brown moist colour was distinguished, with considerable content of organic matter (1.66 %). This profile differs in carbonate content from the previous two profiles at Kattamia where slight to moderate effervescence with HCl addition to the soil was observed in the field which is confirmed by laboratary analysis ($CaCO_3$ contents are 1.77 and 4.66%).

Data in Table (3) and Figure (4) indicated that gypsum content ranges between 5.12 to 7.63 allover profile no 1 and from 3.56 to 5.17 % in profile no. 2. These amounts of gypsum satisfy the requirement of typical gypsic horizon according to the definition of ***Keys to Soil Taxonomy (1992)***. Gypsum was identified in the field as single white crystals of, needles or powdery forms. In this respect ***Labib and Hamdi (1972)*** described the gypsum forms in the North Tahrir as :

1- Intercalary small and large lens shape crystals.

2- Grystal chambers, large lens shape or granularted in different sizes.

3- Abundant gypsum crystals, granular, irrigular shape in some cases cemented and interconnected.

4- Complex formations of gypsum and calcite.

Also ***El Taweel (1982)*** examined several gypsiferous profiles and illustrated the forms of gypsum in the field as well as in thin sections .

The gypsic horizon in these soils is associated with relatively high carbonate content (6.18 to 12.35% in profile no. 1 and 9.50 to 23.21 % in profile no.2). The reaction between soluble sodium sulfate in soil solution and calcium carbonate leads to the precipitaion of calcium sulphate.

$$CaCO_3 + Na_2SO_4 \rightarrow CaSO_4 + Na_2CO_3$$

Values in Table (4) which illustrated in Figures (4 and 5) showed that these two profiles are moderately to highly saline (EC from 4.0 to 21.00 mmhos/cm). Figure (4) clarifies the change in salt content with depth.

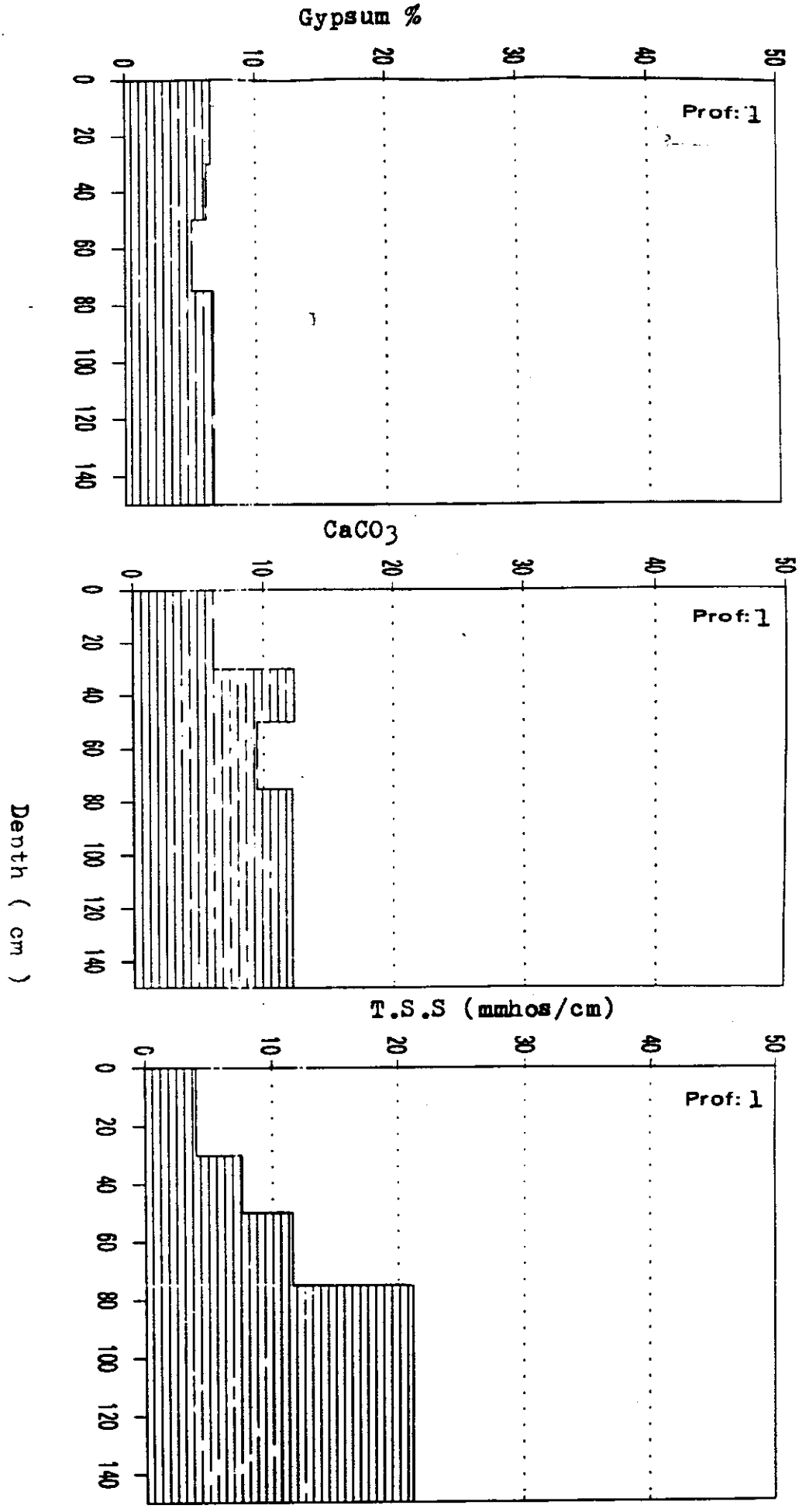

Figure 4: Distribution of gypsum, $CaCO_3$ and soluble salts in profile No. 1

Table (4) Soluble and exchangeable salts of the soils with gypsic horizon.

prof No.	Location	Depth cm.	SP %	E.C	SOLUBLE SALTS								C.E.C	Ex.Na	Ex.K	E.S.P
					Cations meq./100 g.				Anions							
					Ca^{++}	Mg^{++}	Na^{++}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$				
1	41 km. El	0-30	42	4.00	2.73	2.10	4.84	0.14	-	0.46	4.20	5.15	20.56	0.72	0.55	3.5
	Kattamia	30-50	42	7.60	3.65	2.39	12.71	0.17	-	0.48	10.20	8.25	23.14	2.31	0.43	10.0
	desert	50-75	46	11.60	4.37	3.04	18.97	0.18	-	0.57	18.75	7.24	21.83	2.84	0.19	13.0
	road	75-150	49	21.20	14.70	3.03	35.03	0.25	-	0.82	26.70	25.49	27.17	4.48	0.18	16.50
2	47 km	0-30	29	8.80	3.20	2.80	11.80	0.20	-	1.8	10.70	5.5	22.18	2.00	0.26	9.00
	El	30-70	42	12.80	3.50	4.28	20.80	0.12	-	0.24	14.10	14.36	27.42	3.98	0.51	14.50
	Kattamia	70-110	50	17.60	5.80	4.62	30.84	0.16	-	0.26	23.20	17.96	22.50	4.28	0.43	19.00
		110-130	53	21.20	4.70	3.82	40.00	0.25	-	0.28	35.19	13.30	28.33	2.93	0.43	28.00
10	Manzala	0-60	78	15.00	2.25	11.76	54.65	1.28	-	0.89	48.92	20.13	43.48	12.39	0.87	28.50
	Lake	60-90	46	10.30	1.73	7.34	29.14	1.20	-	0.79	32.35	6.27	24.64	4.80	1.50	19.50

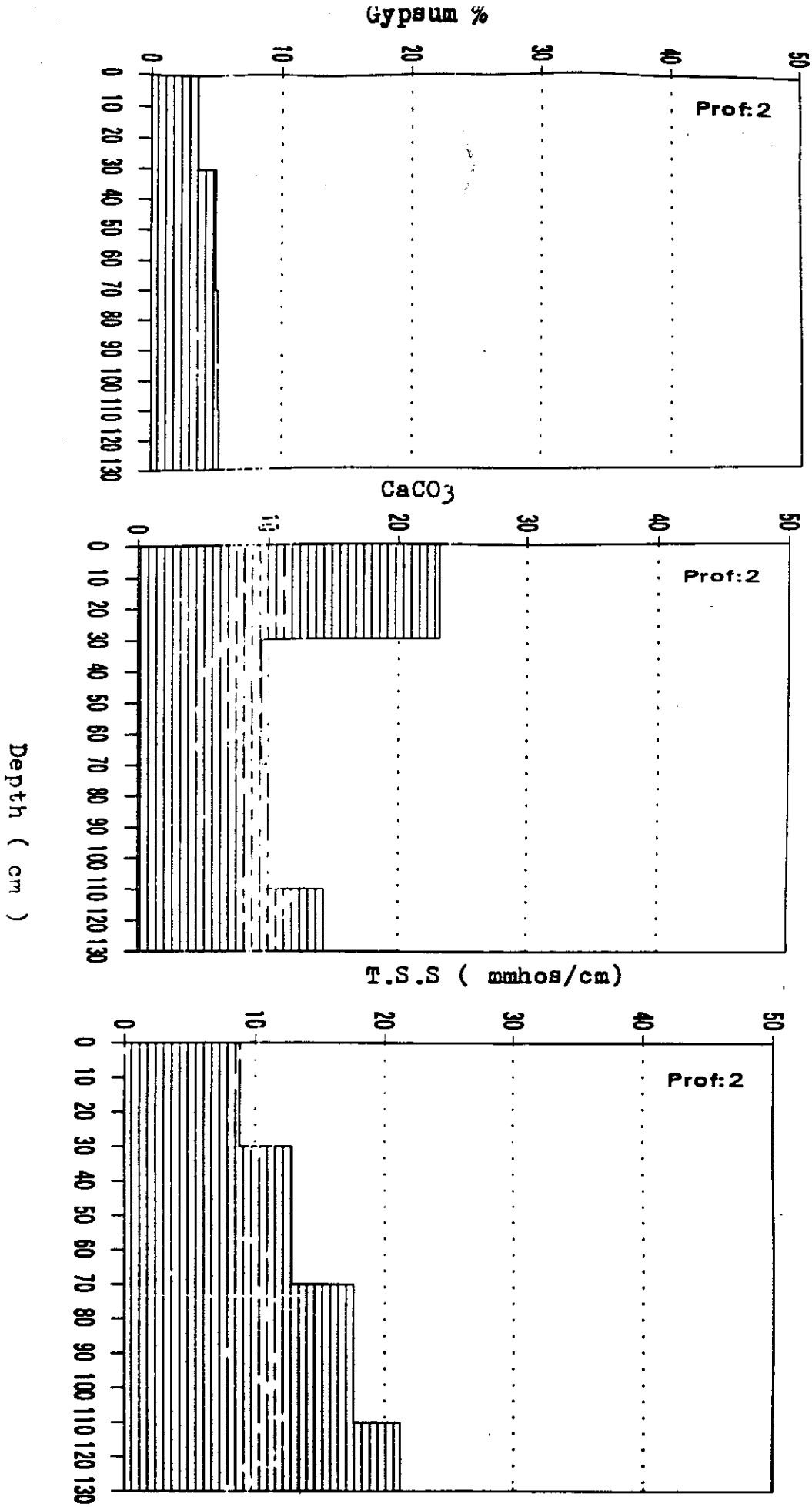

Figure 5: Distribution of gypsum, $CaCO_3$ and soluble salts in profile No. 2

The concentration of cations can be arranged in the following descending order: $Na^+ > Ca^{++} > Mg^{++} > K^{++}$. While the dominant anions are $Cl^- > SO_4^{--} > HCO_3$.

This indicates the solubility of low proportion of gypsum in this soil paste extract (solubility rate of gypsum is 0.2%). The high salinity in the deep layers of profiles no 1 and 2 (II C) coincide with enhanced values of exchangeable sodium percentage (> 15). However pH values were ranged between 7.72 and 7.97.

In respect to profile no. 10 at El Manzala, it is evident that gypsic horizon still in it developing stage. The gypsum contents as recorded in table3 are 2.47 and 3.56 % i.e < 5% which is the minimum requirement of gypsic horizon. However, this shallow profile with high water table at 90 cm may have higher content of gypsum at lower horizons. Results in Table (4) and Figure (6), this profile is highly saline (EC 10.30 and 15.00 mmhos /cm), and the dominant salts are NaCl and $MgSO_4$ besides low cocentration of $CaCl_2$, KCl and Na_2So_4. due to low content of $CaCo_3$ and $CaSo_4$ in this soil, Na+ occupies high proportion of the exchangeable sites of the fine particles (ESP 19.5 and 28.5) combined with relatively higher values of measured pH (8.10 and 8.22).

Sampled profiles at El Kattamia and EL Manzala can be classified according to the Keys to ***Soil Taxonomy (1992)*** as follows : profile no. has a gypsic horizon in which the product of its gypsum percentage multiplied by its thickness in centimeters, above a depth of 150 cm from the soil surface is less than 3,000 (Table 3). Therefore this profile is included in the subgroup of Cambic Gypsiorthids.

Profile no 2 and data in Table (3) indicated that the presence of surface calcic horizon (0-30 cm) with $CaCO_3$ percentage of 23.21 above the gypsic horizon. These charactcristics are typical for the subgroup of Calcic Gypsiorthids.

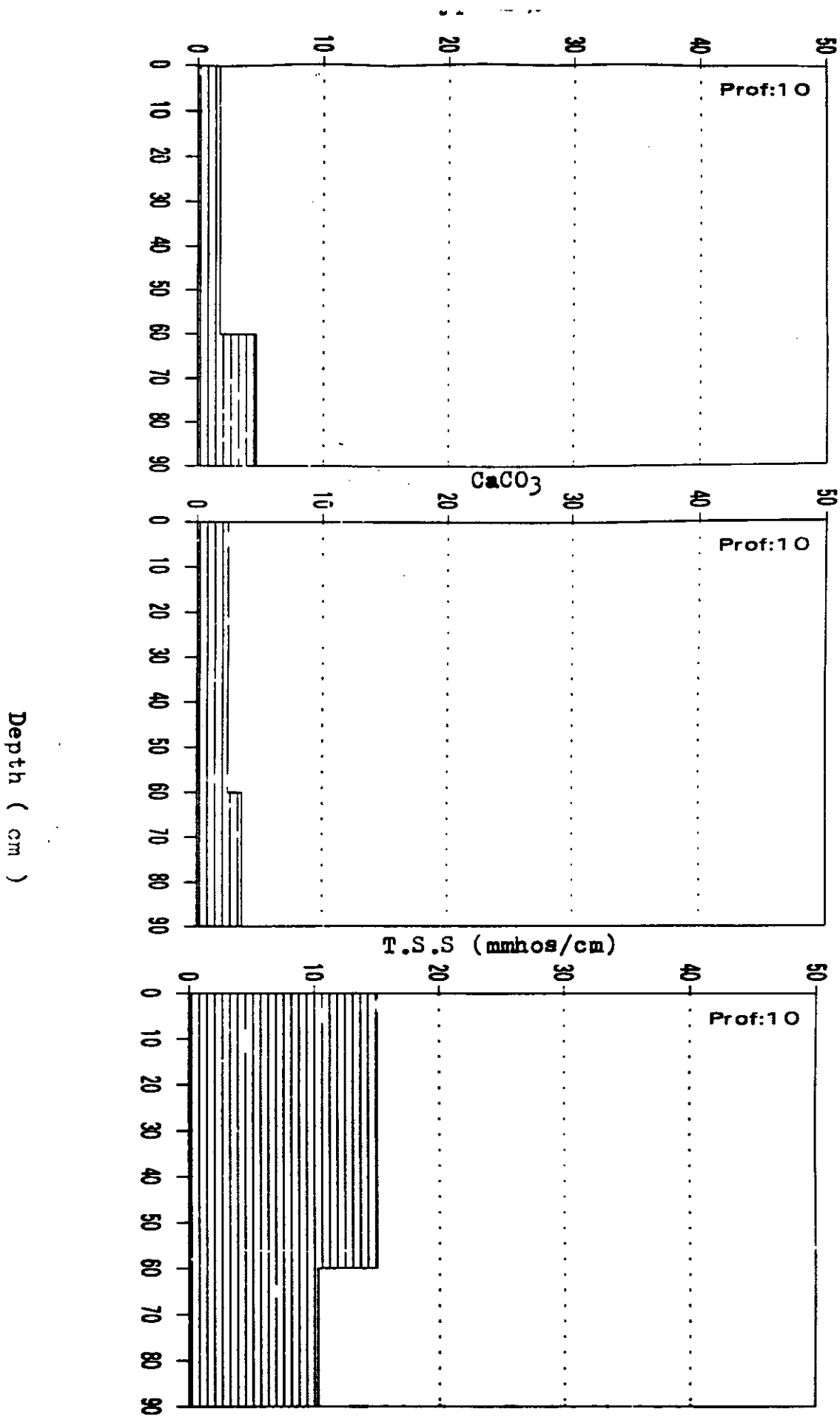

Figure 6: Distribution of gypsum, $CaCO_3$ and soluble salts in profile No. 10

Profile No. 10 near lake EL Manzala, its morphological description referes to the aquic conditions in this area. Soil colour in Ap horizon is greyish yellow brown (10 YR 4/2 dry) and organic matter is 1.60 % while gypsum content is less than 5% in the whole solum, therefore this profile has no gypsic horizon at this stage. According to these characteristics, profile no.10 can be included in the order of Entisols, suborder of Aquents, great group of Fluvaquents and subgroup of Mollic Fluvaquents.

4.1.3. Soils with salic horizon :

The profile description of the saline soils are as follows :

Profle No : 8

Location : 200m. west of El Manzala lake Ez- Hafez El - sirw Damietta Governorate.

Parent material : Lacustrine deposits.

Topography : Nearly level.

Surface moisture : Moist.

Vegetation : Cultivated with wheat after clover.

Irrigation : From drainage water (EL - Sirw drain) .

Drainage : Very poorly drained.

Ground water : 90 cm from the surface.

Remarks : The land cultivated for 6 years.
There is a drainage canal north of the site (about 80 m)
There are tall weeds (around the lake), photo 8.

Horizon	Depth (cm)	Description
Ap_{sa}	0-30	Brownish black (10YR2/2, moist); clay; moderate subangular blocky structure; very sticky, very plastic; slight effervescence with HCl; some gypsum aggregations, blue and brown mottles; some broken shells; moderate roots; diffuse boundary.

Photo 8: profile no.8 at El-Sirw

Dammietta Governorate.

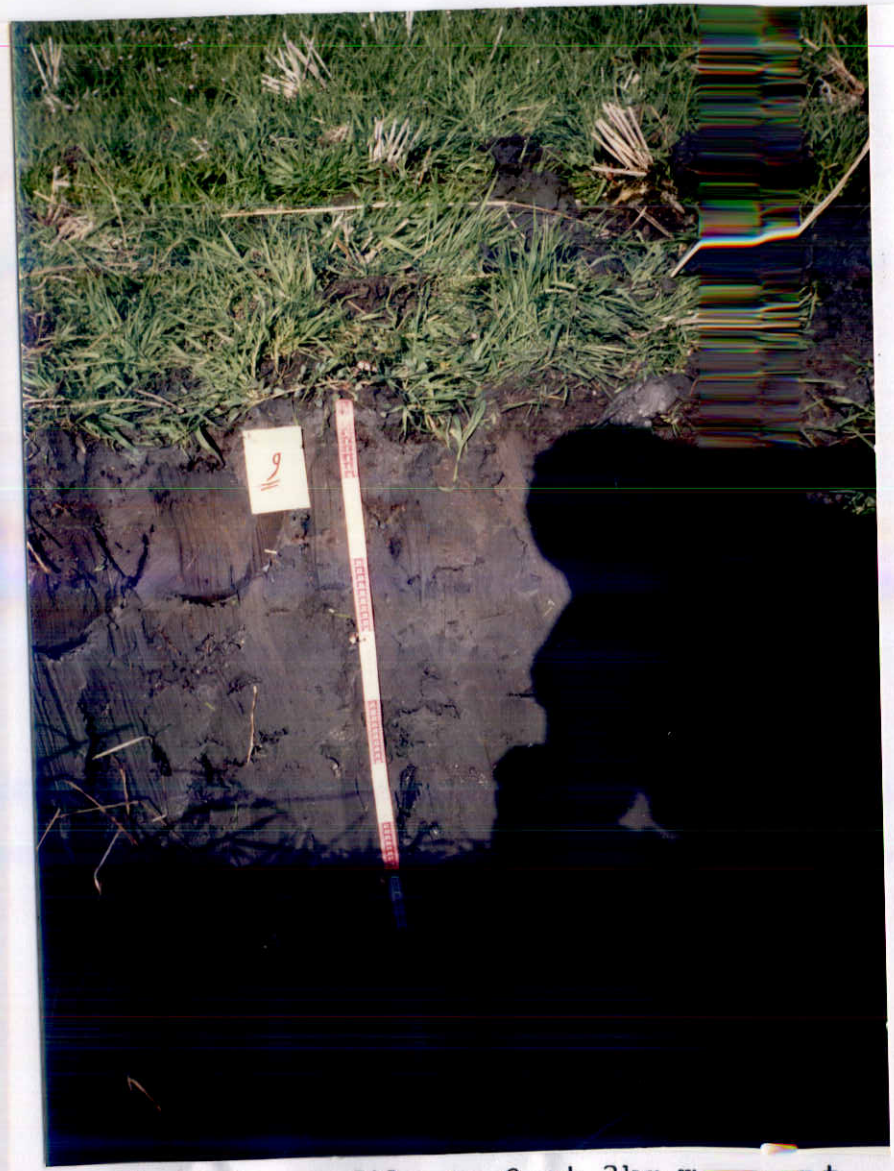

Photo 9: profile no.9 at 3km west

of El-Manzala.

Ap/C_{1sa}	**30-60**	Black (10YR 2/1 moist); clay; large blocky with slickensides; very sticky, very plastic; slight effervescence with HCl; few $CaCO_3$ concretions,, some gypsum crystals, some broken shells; common blue mottles; few fine roots; diffuse boundary.
C2sa	**60-90**	Dark olive grey (5 GY, 3/1, moist) ; clay, subangular blocky with slickensides; very sticky very plastic; slight effervescence with HCl; many blue mottles; no roots

Profile No : 9

Location : 3 km west of El Manzala lake, El-Sirw, Damietta Governorate .

Parent material : Lacustrine deposits.

Topography : Nearly level.

Surface moisture : Moist.

Surface salts : Some white precipitation of salts.

Vegetation : Cultivated with wheat.

Irrigation : From drainage water (El-sirw drain).

Drainage :Very poorly drained.

Ground water : 90 cm from the surface.

Remarks : The land was covered with many weeds.
The land was cultivated for 8 years.
When the blocks of the soil are broken they gives the colour (dark greenish grey 3/1, 7.5 3/1, GY,) photo 9.

Horizon	Depth(cm)	Description
Ap_{sa}	0-30	Black (10 YR 2/1 moist); clay; subangular blocky structure; very sticky; very plastic; slight effervescence with HCl; few blue mottles, many fine fresh roots; diffuse boundary.
$Ap_{sa/c1}$	30-70	Brownish black (10YR 3/2; moist); clay; subangular blocky with slickensides; very sticky; very plastic; slight effervescence with HCl; some broken shells; common blue mottles; some decayed roots; diffuse boundary.
C_2	70-90	Brownish black (10YR 3/2, moist); clay; large angular blocky with slickensides; very sticky; very plastic; violent effervescence with HCl; many broken shells than above layer, no roots.

Two selected profiles which represent the salic horizon are located near EL Manzala lake. They are recent lacustrine deposits characterized by high water table at 90cm from the surface and poor drainage conditions. The sampled area is recently cultivated since 6-8 years with wheat , clover and other field crops. Natural vegetation and weeds are abundant in the surrounding areas, however such soils are usually used for rice production with a surface irrigation system. Drainage water from EL Sirw drain is applied for irrigation in the sites of profiles No. 8 and 9.

The field description indicated that the colour of these profiles is mostly black or brownish black; however dark olive grey colour is observed in the deep horizon of profile no. 8 (close to the lake). According to ***Soil Colour***

Charts (1970), the value is 3 or less and chroma is mostly 2. Mottles and gley characteristics are associated with the wetness producing bluish or brownish patches of different sizes (see photos no 8 and 9).

These soils have heavy clay texture and clay percentage ranges between 56.34 and 87.75% . From the figures of grain size distribution, Table (5), it is observed that clay content increased in profile No. 9 from 56.34% on the surface to 87.57% at 70 - 90cm, while profile No.8 is mostly homogeneous in texture.

Accumulation of lime (9.70%) is found only at a depth of 70 - 90cm of profile no 9 due to the presence of some burried shells as recorded in the field observations. The other layers of the profiles have low content of carbonate (1.01 to 3.46%) in the form of small white concretions.

Depending on the texture of these soils and mode of formation, the observed structure is fine to coarse subangular blocky with slickensides. The high plasticity and stickiness of these soils lead to compactness and low permeability and consequently imperfect drainage. The high saturation capacity of water (60 - 86%) enhance the wetness conditions in such soils.

Precipitation of gypsum appears on the surface horizons of profile No 8 (3.02 and 3.57% table 5) as scattered crystals or clusters.

The salic horizon in these soils is located at different depths of the solum. Profile No 8 is saline with its typical salic horizon at 60 - 90 cm (T.S.S is 2.05%), while in profile No 9 the salic horizon is at the surface and has 2.06% T.S.S) Figure(7). The electrical conductivity of the saturation extract ranges between 14.20 and 40.20 mmhos/cm, (Table 6). The measured cations and anions reveal that the type of salts can be arranged in decreasing order of abundance as follows :

NaCl > $MgCl_2$ > $MgSO_4$ > $CaCl_2$> KCl. Low concentrations of Na HCO_3 and $CaSO_4$ are present in some horizons, (Figures 8 and 9).

Table (5) Some chemical characteristics and grain size distribution of soils with salic horizon.

prof. No.	Location	Depth (cm)	Hor.	$CaCO_3$ %	Gypsum %	O.M %	TSS %	PH 1:2.5	grain size distribution				Fexture class
									Sand %		Silt%	Clay%	
									C.S %	F.S %			
8	200 m west of Manzala lake, Damietta Governorate	0-30	Ap_{sa}	1.34	3.02	3.16	1.18	8.20	1.35	1.85	12.10	84.70	C
		30-60	Ap/c_{1sa}	1.10	3.57	3.25	0.94	8.21	2.10	1.38	14.62	81.90	C
		60-90	C_{2sa}	1.01	-	3.28	2.05	8.35	1.65	2.45	13.32	82.58	C
9	3km west Manzala Lake, Demietta	0-30	Ap_{sa}	1.34	-	3.53	2.06	8.45	0.58	20.30	22.78	56.34	C
		30-70	Ap_{sa}/cl	3.46	-	3.22	0.79	8.51	0.17	5.64	25.65	68.54	C
		70-90	C_2	9.70	-	2.58	0.78	8.38	1.14	3.78	7.33	87.75	C

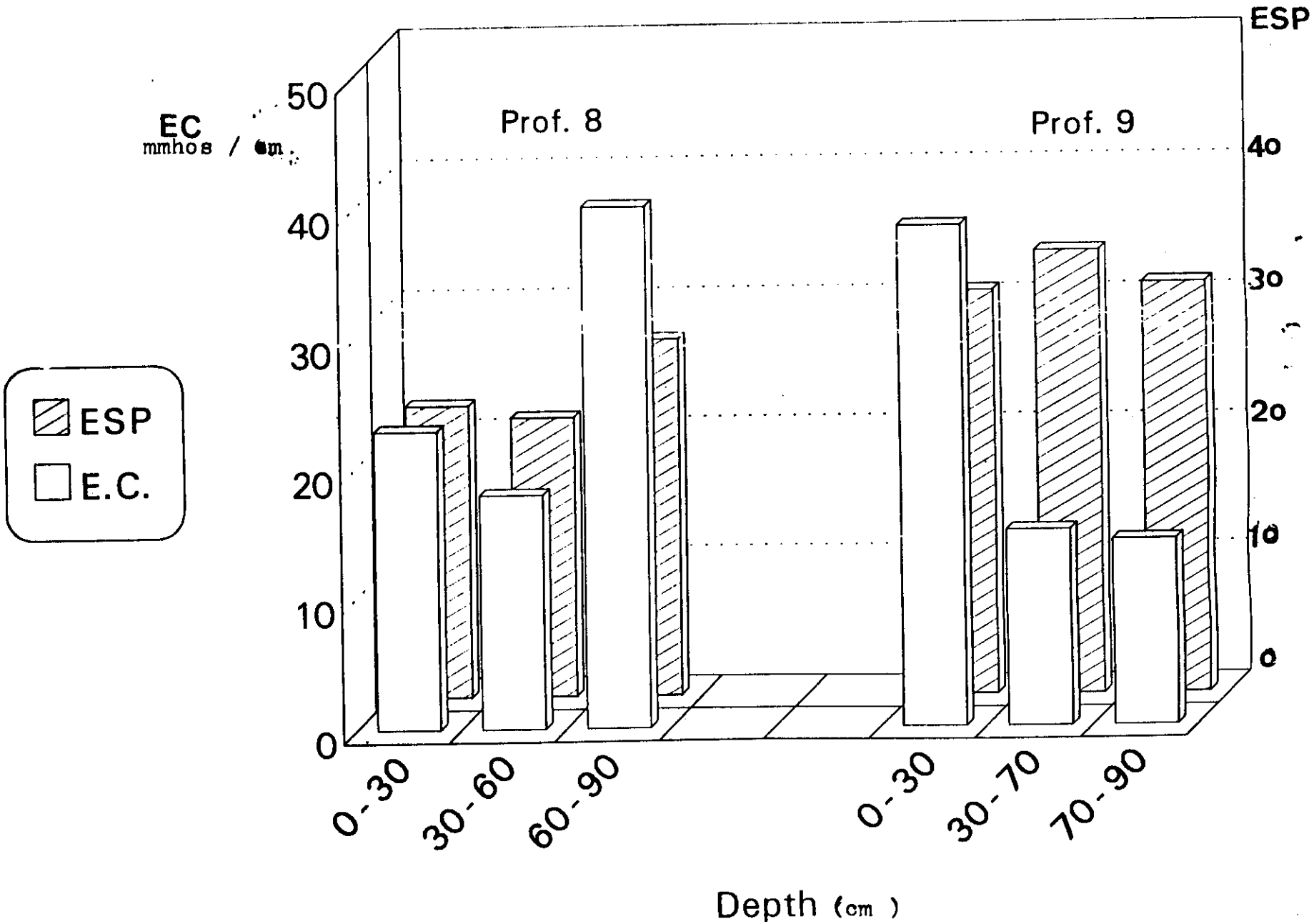

Figure 7: Salt content(EC) and ESP in the various depths of the saline profiles

Table (6) Soluble and exchangeable salts of the soils with salic horizon.

prof. No.	location	Depth (cm)	SP %	E . C mmhos/cm	soluble salts (meq/100 g. soil)								CEC meq/100 g. soil	Ex.Na meq/100 g. soil	Ex.K meq/100 g. soil	ESP
					Cations				Anions							
					Ca	Mg	Na	K	CO_3	HCO_3	Cl_4	SO_4				
8	200 m west of Manzala lake Demietta Governorete	0 - 30	80	23.00	3.03	11.80	43.34	1.12	-	1.10	45.88	12.31	47.83	10.76	1.36	22.50
		30 - 60	82	18.00	2.42	8.67	34.69	1.13	-	1.12	35.50	10.29	36.23	7.79	1.35	21.50
		60 - 90	80	40.20	2.10	4.42	48.20	1.30	-	0.67	46.25	9.10	38.50	10.59	1.11	27.50
9	3 Km west Manzala lake Demietta	0 - 30	60	38.50	3.85	6.89	52.80	1.00	-	0.86	54.50	8.47	39.13	12.13	1.28	31.00
		30 - 70	74	15.30	3.05	7.12	54.29	1.22	-	1.10	53.64	10.94	33.33	11.33	1.53	34.00
		70 - 90	86	14.20	2.68	6.91	49.30	1.00	-	0.54	46.89	12.46	46.38	14.61	1.57	31.50

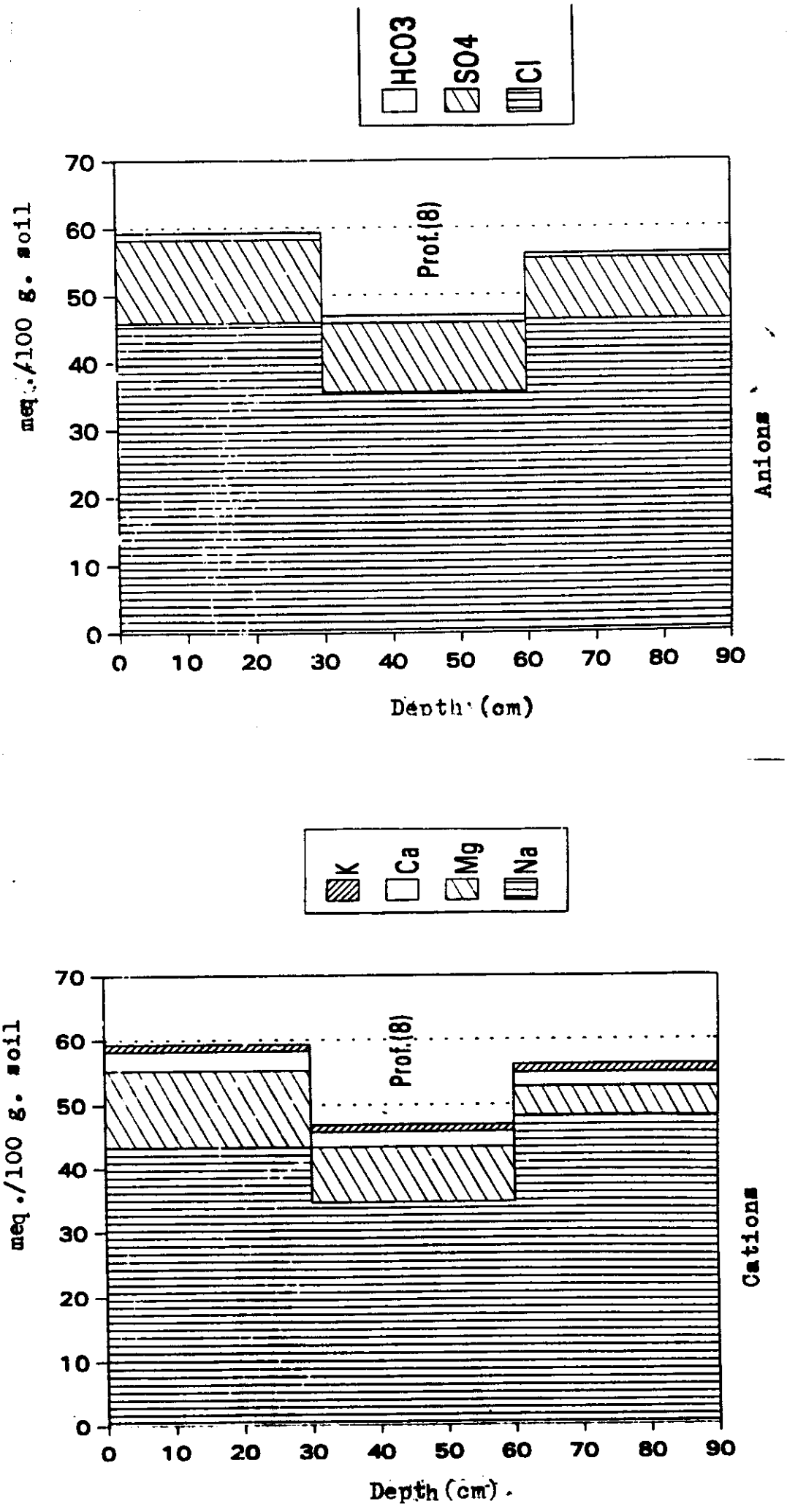

Figure 8: Distribution of cations and anions in profile No. 8 (Salic horizon)

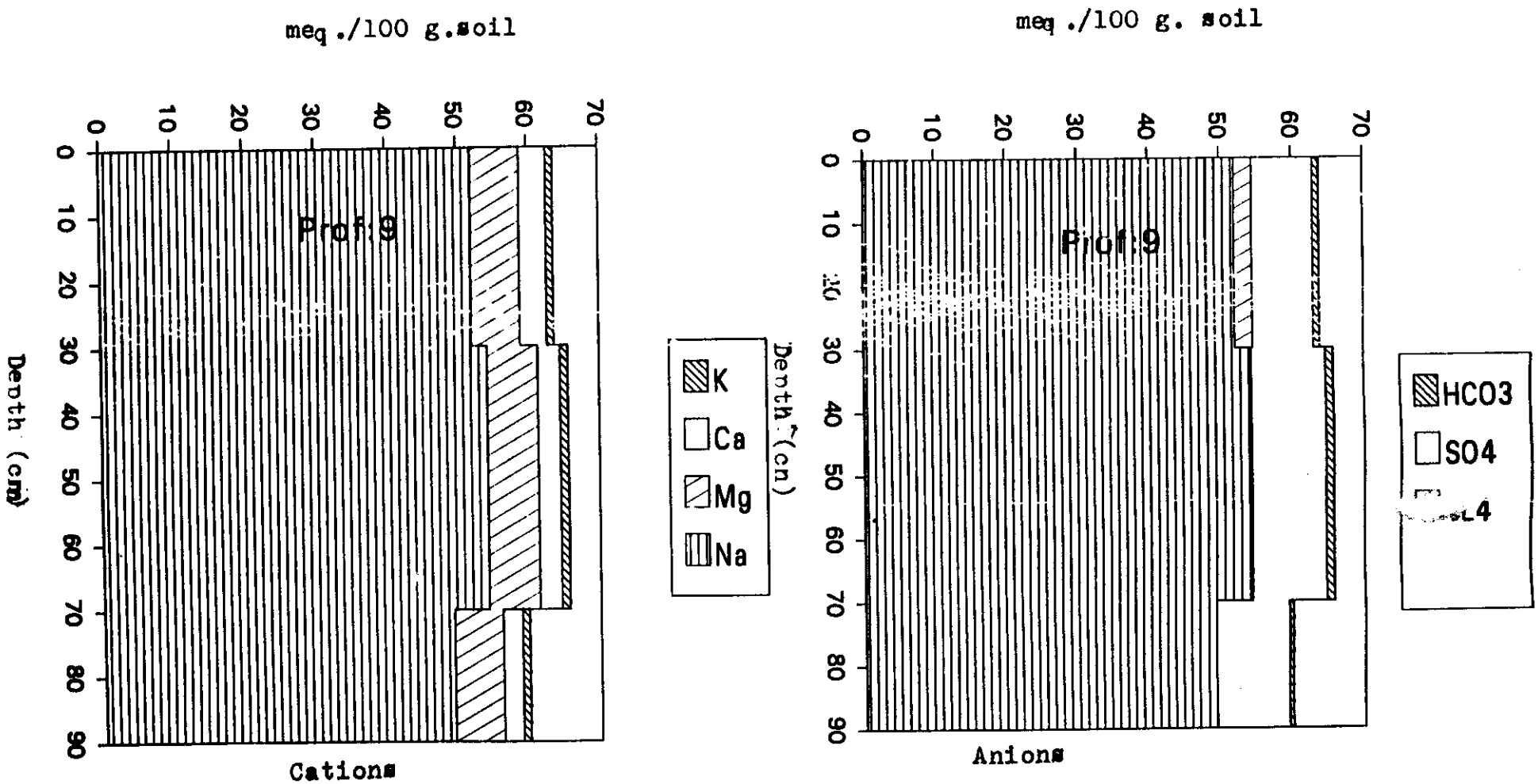

Figure 9: Distribution of cations and anions in profile No. 9 (salic horizon)

From the figures of cations and anions concentrations and exchangeable ations in Table (6), these soils are moderately alkaline. Exchangeable sodium percentage fluctuatcs between 21.5 and 34.00 and pH values range between 8.20 and 8.51. According to these properties, these solis are considered saline-sodic soils. according to ***Rahim (1993).***

The salic horizon in these soils is distinguished by relatively high content of organic matter (2.58-3.53%). This is due to the cultivation of wheat after ploughing clover into the soil. Also the high salt content inhibits the microbial activity and consequently the plant roots remain undecomposed (Ghabour, 1988).

These sampled two profiles where soluble salts are more than 2% at a depth of 60-90 cm in profile No. 8 and at depth of 0-30 cm in profile No. 9 satisfy the requirement of a typic salic horizon according to the ***Keys to Soil Taxonomy (1992).*** The wetness of this area is associated with a high ground water (at 90 cm). Also the organic carbon content is more than 0.6% to a depth of more than 40 cm. According to these characteristics these two profiles can be classified as Aquollic Salorthids. ***Rasheed et al,(1990)***

4.1.4 Normal soil without diagnostic horizons :

The profile description of profile no.11 which have no diagnostic horizons is presented as follows.

Profile No. (11)

Location : NRC farm, El - Qanater, Shalakan Qalubiya Governorate

Parent material :Nile alluvial.

Topography : Nearly level.

Erosion : None.

Surface moisture : Dry

Vegetation : Cultivated with sunflower.

Drainage : Well drained.

Water table : Deeper than 150cm.

Remarks : There is tile drainage system in this area .

Horizon	Depth (cm)	Description
Ap	0-15	Dark grayish brown (10YR 4/2 dry), very dark grayish brown (10YR 3/2 moist); clay; subangular blocky structure; sticky; plastic; slight effervescence with HCl; many fine and medium fresh roots; diffuse boundary.
Ap/C_1	15-50	Dark brown (10YR 3/2 dry); dark grayish brown (10YR 4/2 moist); clay; subangular blocky structure; very sticky; very plastic slight effevescence with HCl; many fine roots; diffuse boundary.

C_2	50-75	Dark brown (10YR 3/3 dry); dark grayish brown (10YR 4/2 moist); clay; subangulor blocky structure; very sticky; very plastic; slight effervescence whith HCl; no roots, diffuse boundary.
C_3	75-100	As above.

One selected profile was chosen to represent the most abundant type in the Nile Delta and Valley. This profile No.11 is located in the Shalakan Farm, El Qanater, South of the Delta. This profile is deep, mostly homogeneous, well drained (with a tile drainage system) and old cultivated with field crops. The soil is dark brown to dark grayish brown and the texture is clay all over the solum (clay content ranges between 49.50 to 59.00%) table 7. Angular blocky structure is dominant in such soils due to the high clay content, they are very sticky and very plastic. There is no obvious cracks on the surface due to continuous ploughing and irrigation of these soils.

The soils of these areas are free of salinity (EC ranges from 1.64 to 4.88 mhos /cm) as it is clear from (Table 8). Exchangeable sodium percentages (ESP) are very low (1.0 to 3.0) and pH fluctuates between 7.5 and 7.8. There is low content of $CaCO_3$ (< 3.0%) in the various layers of the profile. Organic matter content is relatively low (0.2 to 1.3%)

The diagnostic horizons are missing in such recent undeveloped profiles. The characteristics of the plough layer do not satisfy the requirements of mollic, anthropic or plagen epipedons which may occur in such environmental conditions.

Table (7) Some chemical characteristics and grain size distribution of the normal soil without diagnostic horizons.

prof No.	Location	Depth (cm)	Hor.	$CaCO_3$ %	Gypsum %	O.M %	T.S.S %	pH	grain size distribution				texture class
									sand %		Silt %	Clay %	
									C.S	F.S			
11	Qanater	0-15	Ap	2.8	-	1.3	0.11	7.5	2.40	10.60	37.50	49.50	C.
		15-50	Ap/c_1	2.4	-	0.3	0.06	7.6	2.00	1.00	38.00	59.00	C.
		50-70	c_2	2.9	-	0.2	0.11	7.7	2.00	4.00	36.00	58.00	C.
		75-100	c_3	1.4	-	0.9	0.19	7.8	1.40	1.60	40.00	57.00	C.

Table (8) Soluble and exchangeable salts of the soils without diagnostic horizons.

prof No.	Location	Depth	SP %	E.C mmoh/cm	Cations (meq/100 g. soil)				Anions (meq/100 g. soil)				CEC meq/100 g.soil	ExNa meq/100 g.soil	Ex.K meq/100 g.soil	ESP
		(cm)			Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4				
		0-15	54	3.32	3.50	2.50	2.70	1.60	-	4.90	4.00	1.40	34.62	0.35	1.20	1.00
11	Qanater	15-50	58	1.64	3.50	3.50	2.60	0.70	-	3.90	4.50	1.90	35.13	0.35	0.80	1.00
		50-75	58	2.92	2.50	2.50	1.80	0.60	-	3.50	3.00	0.90	36.30	0.36	0.44	1.00
		75-100	60	4.88	2.50	1.50	3.60	0.40	-	3.10	3.50	1.40	44.21	1.33	0.44	3.00

According to the morphological description of this profile and the analytical data in Tables (7 and 8), this soil is belonging to the order of Vertisols. Depending on the climatic condition. (mean annual soil temperature is more than 8 °C) and absence of cracks due to continuous irrigation. The suborder is Torrerts including this profile. At the subgroup level this profile can be classified as Typic Haplotorrerts according to ***Keys to Soil Taxonomy (1992).***

4.2.The nutritional status of the diagnostic horizons :

The main factor controlling the mineral constituents of plant material is the specific genetically fixed nutrient uptake potential for the different mineral nutrients.

Plant needs a certain level of each nutrient in its tissues, and if this is not supplied the plant will die. This critical level is different for each of the plant nutrients. Macronutrients are usually present in much concentration than the micronutrients.

The mineral content of plants is also very much dependent on its age. Young plant tissues have high contents of N,K and P, whereas older and more mature plant parts are of higher contents of Ca, Mn, Fe and B.

Many investigations were concerned by the levels of macr-onutrients. in the various types of soils in Egypt. However the nutritional status of the diagnostic horizons have been tested through the determination of total nitrogen, available phosphorus and exchangeable potassium in the collected samples of this study.

Data in Table (9) reveal that inorganic nitrogen in the 5 profiles, with calcic horizon. ranges between 24.5 and 58.8 ppm. However, the surface layer (A_p) of profile no. 5 (0-35 cm) at Tamiya in Fayoum has a high or adequate content of inorganic nitrogen (83.3 ppm), which coiencides with organic matter content (2.05 %) as shown in Table (1). Field observations of this

site indicated that it was cultivated with barley and most probably fertilized with some chemicals.

The evaluation of the macranutrient status in the soils has been reported by ***Authority of Land Reclamation in Egypt (1989)*** and presented in Table (10).

Table(9). The macronutrient status of the studied diagnostic horizons

1- Soils with calcic horizon

Profile No	Location	Depth (cm)	inorganic N ppm	Av. P ppm	Exch. K meq./ 100g soil
3	Lake Qarun Fayoum	0 - 30	39.2	5.26	0.85
		30 - 70	58.8	1.62	0.82
		70 - 110	34.3	1.62	0.46
4	Lake Qarun Fayoum	0 - 35	49.00	1.62	0.94
		35 - 80	39.2	1.82	0.85
		80 - 120	29.4	2.63	0.77
5	Tamiya Fayoum	0 - 35	33.3	9.72	0.56
		35 - 70	34.3	2.02	0.15
		70 - 110	39.2	1.41	0.68
6	North of Tahrir Province	0 - 20	34.3	1.62	0.65
		20 - 60	39.2	1.41	0.48
		60 - 120	24.5	1.62	0.46
7	North of Wadi El Natrun	0 - 10	29.4	1.82	0.48
		10 - 30	34.3	1.21	0.15
		30 - 40	24.5	2.83	0.15
		40 - 60	39.2	1.21	0.15
		60 - 90	29.4	1.62	0.23

Table (9) cont.

2. Soils with gypsic horizon

Profile No	Location	Depth (cm)	inorganic N. ppm	Av. P ppm	Exch.K meq./ 100g soil
1	Kattamia	0.30	24.5	2.03	0.55
		30.50	19.5	1.40	0.43
		50.75	29.4	1.48	0.19
		75.150	24.3	1.21	0.18
2	Kattamia	0 - 30	29.4	1.41	0.26
		30 - 70	34.3	1.21	0.51
		70 -110	24.5	1.21	0.43
		110-130	29.4	1.41	0.43
10	Manzala Lake	0 - 60	63.7	3.44	0.87
		60 - 90	73.5	1.21	1.50

3. Soils with salic horizon

Profile No	Location	Depth (cm)	*inorganic.* N ppm	Av. P ppm	Exch. K meq./ 100g soil
8	Manzala Lake	0 - 30	63.7	3.24	1.36
		30 - 60	88.2	6.08	1.53
		60 - 90	93.1	5.47	1.11
9	Manzala Lake	0 - 30	93.1	6.07	1.28
		30 - 70	93.1	5.07	1.53
		70 - 90	88.2	5.47	1.57

4 - Normal clayey soils without diagnostic horizan .

profile No	location	depth (cm).	inorganic N ppm	Av.p ppm	Exch. k meq/ 100g soil
11	Qanater	0-15	63.70	3.24	1.20
		15-50	63.70	3.24	0.80
		50-75	68.60	3.44	0.44
		75-100	68.60	3.44	0.44

Table (10) The levels of macronutrients in soil and their evaluation

Nutrient	V.Poor	Poor	medium	adequate
	concentration in ppm			
N	< 20	20 - 40	40 - 80	> 80
P	< 4	4 - 8	8 - 12	> 12
K	< 200	200 - 300	300 - 400	> 400

With respect to the available phosphors, all the studied calcareous profiles have very low content < 4 ppm higher value were recrorded for the surface layers of profiles No. 3 and 5.

The exchangeable potassium ranges between 0.15 and 0.94 meq. 100g . soil, which is considered in the normal level of the calcareous soils.

Nitrogen in the soils with gypsic horizon has been determined to assess the fertility level of these soils. Data in Table (9) show that the nitrogen in the virgin sites (profile No. 1 and 2) at El Kattamia is relatively low (19.5 to 34.3 ppm) while the cultivated area with wheat (profile No. 10 near Manzala lake) has high content of total nitrogen (63.7 and 73.5 ppm).

Available phosphrus in these gypsicfereous profiles fluctuates between 1.2 and 3.44 ppm. These obtained date in Table (9) indicate that available phosphorus is very low in the soils with gypsic horizon. Also the values of exchangeable potassium indicated that these soils are very poor in potassium content and they require adequate fertilization with compound NPK..

It is clear from the determined nitrogen in Table (9) that the soils with salic horizon near El Manzala lake are very rich in nitrogen content (63.7 to

4.3. The effect of diagnostic horizons on sorghum and sunflower growth :

The objective of any research in the field of agronomy and particularly in soil science is to increase or promote yield production .Both basic or academic study and applied research are directed towards this object. Therefore, biological experiments have been carried out to test the effect of the previously studied diagnostic horizons on the growth behaviour of indicator plants as sorghum (Sorghum Bicolar) and sunflower (Helianthus annuusl).

The results of these experiments will be discussed as follows :

4.3.1. Effect of diagnostic horizons on the growth of sorghum

1- Germination .

It is clear from photo (10) that no germination occurred for sorghum seeds in gypsic horizon (profile. No.1) calcic horizon with high salinity (profile. No. 3) and salic horizon (profile No. 8).

Photo (10) Effect of the diagnostic horizon on the growth of sorghum after 6 weeks from germination in 1994 season.

Both salic horizon subjected to leaching (profile No. 9) and calcic horizon with low salinity (profile. No.6) gave marked germination which was nearly similar to the control (profile No. 11).

It is obvious that the rate of seedlings growth was higher in saline soil subjected to leaching compared with calcic horizon with low salinity and control.

The failiar of germination in gypsic, calcic or salic horizons is attributed to the high salinity of such soils.

In the second season in spite of using the surface layers of the mentioned horizons for growing sorghum seedling, the seeds failed to germinate also in gypsic or salic horizon. but germination occurred in calcic with high salinity horizon in addition to clayey and calcic horizon with low salinity .

The highest germination ratio (96%) was in clayey soil followed by calcic horizon with low salinity (86 %), then calcic horizon with high salinity (photos No. 11 ,12)

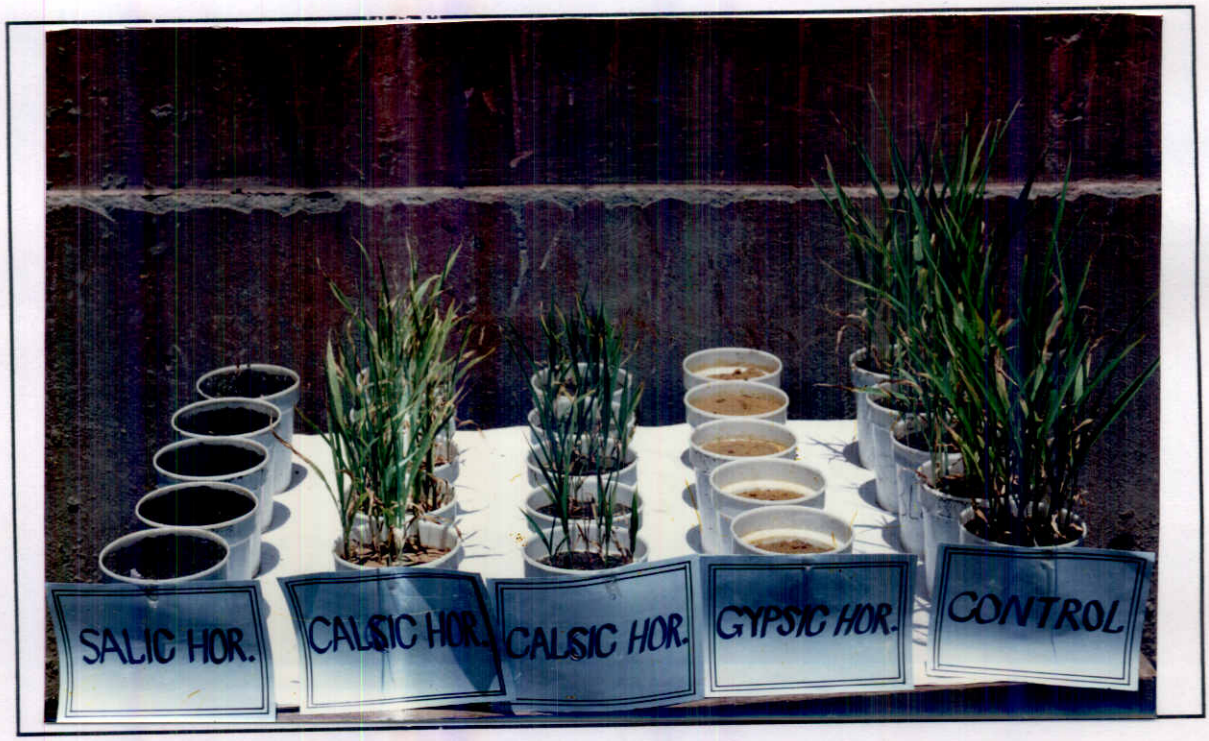

Photo (11) Effect of the diagnostic horizons on the growth of sorghum, after 4 weeks from germination in 1995 season.

photo (12) Effect of the diagnostic horizons on the growth of sorghum after 6 weeks from germination in 1995 season.

2- Stem length:

Stem length of sorghum grown in soils of different diagnostic horizons is shown in Tables (11,12 & 13)

Table (11): Effect of the diagnostic horizons on the growth of sorghum after 6 weeks in 1994 season.

Treatment	Stem length cm	Root length cm	Number of leaves	Fresh shoot weight gm.	Dry shoot weight gm.	Fresh root weight gm.	Dry root weight gm.
Clayey soil (control) S_1 (profile no.11)	27.26	5.87	4.00	3.82	1.10	2.64	1.41
Calcic with low salinity S_4 (profile no 6)	20.99	2.49	3.00	1.72	0.63	0.55	0.34
salic with after leeaching S_6	34.85	4.73	3.75	5.96	2.06	3.97	1.77

Table (12) : Effect of the diagnostic horizons on the growth of sorghum after 4 weeks in 1995 season.

Treatment	Stem length cm	Root length cm	Number of leaves	Fresh shoot weight gm.	Dry shoot weight gm.	Fresh root weight gm.	Dry root weight gm.
clayey soil (control) S_1 (profile no. 11)	30 48	7.84	4.00	0.74	0.17	0.26	0.07
Calcic with high salinity S_3 (profile no. 3)	12.28	4.04	4.00	0.21	0.10	0.08	0.05
Calcic with low salinity S_4 (profile no. 6)	17.40	5.48	3.40	0.28	0.06	0.11	0.02
L.S.D at 0.05 level	2.53	2.10	0.16	0.04	0.07	0.02	N.S

Table (13): Effect of the diagnostic horizons on the growth of sorghum after 6 weeks in 1995 season.

Treatment	Stem length cm	Root Length cm	Number of Leaves	Fresh shoot weight gm.	Dry shoot weight gm.	Fresh root weight gm.	Dry root weight gm.
Clayey soil (control) S_1 (profile no. 11)	41.02	9.60	5.00	2.33	0.50	0.31	0.05
Calcic with high salinity S_3 (profile no. 3)	15.60	4.22	3.00	0.50	0.13	0.25	0.07
Calcic with low salinity S_4 (profile no. 6)	26.23	4.72	3.00	0.59	0.15	0.26	0.07
L.S.D at 0.05 level	3.40	1.64	0.36	0.13	0.15	0.04	N.S

It is clear that various horizons significantly affected stem length of sorghum. The tallest plants (34.85 cm) were obtained from those grown in salic horizon after leaching (profile. No. 9) followed by those grown in clayey soil (profile. No.11 as a control). The shortest plants were observed in highly calcareous soil (profile.No.6) in the first season (1994).

When plants were grown in surface layers of the soils in the second season, 1995, clayey soil surpassed the soils with calcic horizon in producing plants with high length. The height of plants for the three mentioned soils were 30.48, 17.40 and 12.28 cm, respectively after 4 weeks from planting being 41.02, 26.23 and 15.60 cm after 6 weeks from planting as shown in Tables (12 and 13).

It is obviously clear that sorghum seedlings could grow well in the saline soil subjected to leaching (profile No. 9) as compared with highly calcareous soil (profile No. 6) which gave the weakest growth whereas seedlings could not survive in soil of calcic horizon with salinity (profile No. 3) and these seedlings could grow in the surface layer of the latest soil as well as the highly calcareous soil.

It could be concluded that saline soil after leaching was better than clayey or highly calcareous soil concerning plant height in sorghum and that sorghum seedlings could grow with weak growth in the surface layer of calcic horizon with salinity.

3. Root length :

Sorghum root length of different diagnostic horizons is recorded in Tables (11, 12 and 13). Results indicate that root length was significantly affected by various soil diagnostic horizons .

The highest value (5.87 cm) was obtained from plants grown in salic horizon after leaching (profile no.9) followed by that grown in clayey soil (profile no. 11) which was higher than that grown in highly calcareous soil (2.49 cm, profile no.6).

In the second season the root of seedling grown in clayey soil was longer than that grown in highly calcareous soil which gave the lowest value

(4.04cm) after four weeks of planting. Simliar trend was obtained after six weeks from planting.

It is obviously clear that growing sorghum in saline soils, after leaching, produced plants with roots longer than that grown in clayey soils and that the shortest ones were in plants grown in highly calcareous soils.

4. Number of leaves :

Number of leaves per plant in different diagnostic horizons are shown in Tables (11, 12 and 13). Results indicate that various profiles significantly affected the number of leaves per plant. The highest number of leaves (4) was given by plants grown in clayey soil as a control (profile No. 11), followed by that grown in saline soil after leaching (3.75, profile No. 9) then that grown in highly calcareous soil (3.0, profile . No. 6).

In the second season, sorghum plants grown in both clayey and calcareous soil producedsimilar number of leaves per plant (4) which was higher than that grown in calcareous soil with salinity (3.4) after 4 weeks from planting. Whereas at 6 weeks age the clayey soil produced seedlings with more leaves than both of the calcareous soil and soil of calcic horizon with high salinty. The number of leaves per plant was 5, 3, and 3 for the three mentioned soils, respectively.

It could be concluded that seedlings of sorghum plants grown in clayey soil the highest number of leaves followed by that grown in saline subjescted to leaching soil and the lowest number of leaves was obtained by seedlings grown in highly calcareous soil with high salinity.

5- Fresh weight of shoot :

The effect of different soil horizons on fresh weight of sorghum shoots is peresented in Tables (11,12 and 13).

Results reveal that fresh weight of shoots was significantly higher in plants grown in saline soil after leaching (profile No. 9) than that grown in calcareous soil with low salinity (profile No. 6). The difference in fresh weight between profile No . 9 and control was significant . The fresh weight of shoots was 5.96 , 1.72 and 3.82 gm for profile 9&6 and 11, respectively .

It is noticed that fresh weight of shoot in plants grown in salic horizon after leaching (profile No.9) was higher than that grown in clayey soil (profile No.11). The lowest value was observed in plants grown in highly calcareous soil (profile No.6) . In the second season the highest fresh weight of shoot (2.33 gm) was proeduced by plants grown in clayey soil (control) followed by those grown in the other two profiles and the lowest weight was grown in profile . No 3.

It could be concluded that growing sorghum in saline soil after leaching as well as clayey soil produced higher fresh shoot weight than that grown in highly calcareous or calcic soil with high salinity . This was true after 4 and 6 weeks from planting .

6. Dry weight of shoot :

Results shown in Tables (11,12 and 13) indicated that the dry weight of shoots followed the same trend of fresh weight previously discussed .

The highest dry shoot weight (2.06 gm.) was obtained by plants grown in profile No. 9, followed by those grown in clayey soil (1.10 gm., profile No. 11). Whereas plants grown in profile No. 6 gave the lowest value (0.63gm) in the first season .

In the second season , growing sorghum in clayey soil produced the highest dry weight of shoots (0.17 gm) compared with grown in highly calcareous soil (0.06 gm). Similar result was obtained after 6 weeks from planting.

7. Fresh weight of root :

Data recorded in Table (11) revealed that fresh weight of roots in plants grown in saline soil after leaching (profile No. 9) surpassed that of plants grown in clayey soil (control) or calcareous soils with low salinity (profile No. 6). The fresh weights of roots for the three mentioned profiles ware 3.97, 2.64 and 0.55 gm, respectively.

In the second season Tables (12 & 13) fresh weight of sorghum plants grown in clayey soil was higher than that grown in calcareous soil with low salinity (profile No. 6) or highly calcareous soil (with high salinity profile No. 3).The respective fresh root weight of the three mentioned horizons were 0.26 , 0.11 and 0.08 gm after 4 weeks being 0.31, 0.26 and 0.25 gm at 6 weeks after planting.

It could be concluded that growing sorghum seedlings in saline soils which subjected to leaching produced the highest weight of fresh roots followed by that grown in clayey soil. Whereas calcareous soil with high salinity gave the lowest value. The reduction in roots weight in plants grown in calcareous soil may be due to the inhibitory effect of $CaCO_3$ content and high salinity of such soil on root and shoot growth.

This result coincides with that of ***EL-Agrodi et al (1991) and Evlagon et al (1992)*** who reported that the presence of salinity in soil reduces the fresh weight of maize seedling roots.

8- Dry weight of roots:

Similar to fresh root weight the dry weight of sorghum seedling, roots ware significantly affected by different horizons.

Plants grown in saline soil after leaching (profile No. 9) produced more roots than that grown in clayey soil (profile No. 11 " control) or calcareous soil with low salinity (profile No. 6). The dry roots weight of seedlings grown in the three mentioned horizons were 1.77, 1.41, 0.34, gm, respectively Table(11).

In the second season, dry weight of roots in seedlings grown in clayey soil surpassed that grown in calcareous or highly calcareous soil, with either low or high salinity. The respective weights produced from clayey soil, calcic with high salinty, ahd calcic with low salinity diagnostic horizons were 0.07, 0.05 and 0.02 at (Table 12), four weeks age, being 0.05 , 0.07 and 0.07 at the six weeks age, (Table 13).

Generally, it is obviously clear from the obtained results that sorghum seedlings could grow in highly calcareous soil with low salinity (profile No. 6) as well as the saline soil which was subjected to leaching processes (profile No. 9), whereas they could not survive in the other diagnostic horizons.

Most of the measurements of seedling growth ware higher in saline soil subjected to leaching compared with clayey soil as a control. The lowest values were obtained in the highly calcareous soil with low salinity in 1994 season at six weeks from planting. Similar results were obtained in 1995 season where calyey soil was better than the calcareous soil at the two stages of growth.

4.3.2. The effect of diagnostic horizons on the growth of sunflower

1- Germination

The grown plants in photo (13) showed that no germination occurred in soil with gypsic horizon (profile No. 1) or salic horizon (profile No. 8.)

photo (13) Effect of the diagnostic horizons on the growth of sunflower after 6 weeks from germination in 1994 season.

On the other hand remarked germination occurred in the other three studied calcic horizons with high content of $CaCO_3$ and low salinity (profile no.6) and salic horizon after leaching (profile no. 9) as well as the control (clayey soil). Calcic horizon with high $CaCO_3$ and salinity content gave the lowest germination.

It is clear that the rate of seedling density was higher in the saline soil subjected to leaching compared with the control and calcic horizon with low

salinity (profile No. 6). The lowest density was obtained from seeds grown in calcic horizon with high salinity (profile No. 3).

In the second season similar results were obtained where the highest germination percent age (60 %) was recorded in clayey soil followed by that grown in calcic horizon with low salinity and calcic horizon with high salinity which gave the lowest percentage of germination (44 %) as shown in photos 14 and 15.

Photo (14) Effect of the diagnostic horizons on the growth of sunflower after 4 weeks from germination in 1995 season .

Table (15) : Effect of the diagnostic horizons on the growth of sunflower after 4 weeks in 1995 season.

Treatment	Stem Length cm	Root Length cm	Number of Leaves	Fresh shoot weight gm.	Dry shoot weight gm.	Fresh root weight gm.	Dry root weight gm.
Clayey soil (coutrol) S_1 (profile no. 11)	9.26	6.79	6.00	0.82	0.16	0.53	0.11
Calcic with high salinity S_3 (profile no. 3)	6.60	3.81	5.40	0.63	0.11	0.25	0.04
Calcic with low salinity S_4 (profile no. 6)	7.54	4.94	5.00	0.66	0.13	0.38	0.06
L.S.D at 0.05 level	2.46	2.06	0.40	0.07	0.15	0.03	N.S

Table (16): Effect of the diagnostic horizon on the growth of sunflower after 6 weeks in 1995 season.

Treatment	Stem Length cm	Root Length cm	Number of Leaves	Fresh shoot weight gm.	Dry shoot weight gm.	Fresh root weight gm.	Dry root weight gm.
Clayey soil (control) S_1 (profile no. 11)	23.42	7.80	8.60	4.61	0.92	1.18	0.24
Calcic with high salinity S_3 (profile no. 3)	9.28	5.25	4.80	1.07	0.34	042	0.07
Calcic with low salinity S_4 (profile no. 6)	11.28	5.43	6.00	1.53	0.30	0.52	0.08
L.S.D at 0.05 level	1.90	2.15	0.94	0.45	0.31	0.08	N.S

Stem length was 5.85, 6.71,8.20 and 8.99 cm for calcic with high salinity (profile No. 3), calcic (profile No.6), saline soil after leaching (profile No. 9) and clayey soil (profile No. 11), respectively.

It is obviously clear that the stem length of sunflower seedlings grown in different profiles was lower than that in clayey soil (control).

Growing sunflower in saline soil subjected to leaching (profile No. 9) gave the tallest seedling followed by that grown in calcic profile (No.6) and the lowest value was obtained from calcic soil with high salinity (profile No. 3).

The decrease in seedling stem length grown in calcic with high salinity may be due to the inhibitory effect of salinity as well as the high content of $CaCO_3$ in such soil on meristimatic activity in plants.

Growing sunflower seedlings in the surface layer of studied profiles indicated that the tallest seedlings (9.26 cm) was obtained from plants grown in clayey soil followed by that grown in calcic soil with low salinity (7.54 cm)., The shortest seedling were in calcic with high salinity (6.60 cm) at 4 weeks age (Table 15). At six weeks age; seedlings lengths were 23.42, 11.28 and 9.28 cm for the three respective mentioned horizons (Table 16).

It could be concluded that growing sunflower seedlings in saline soil after leaching as well as clayey soil gave the tallest seedlings, whereas the shortest ones were in calcareous saline soil.

3- Root Length:-

The effect of different profiles on root length is shown in Tables (14,15 and 16).

The respective root length was 3.96, 4.75, 6.88 and 7.16 cm for calcic with high salinity (profile No.3), calcic with low salinity (profile No.6), salic soil after leaching (profile No. 9) and control (profile. No. 11) .

Results of root length indicated that plants grown in clayey soil and saline soil subjected to leaching surpassed that grown in calcic soil with low salinity length. The shortest roots were observed in plants grown in calcic soil with high salinity.

The reduction in growth of such roots may be due to the inhibitory effect of high soil content of $CaCO_3$ and salinity .

Similar trend was recorded in the second season at 4 and 6 weeks age (Tables 15 and 16). The longest roots were produced by plants grown in clayey soil followed by calcic soil with low salinity which was taller than with calcic soil with high salinity.

4- Number of leaves :-

Results shown in Tables (14,15 and 16) indicated that the greatest number of leaves(8) was given by plants grown in clayey soil (profile No . 11) compared to the other profiles (profile No.9, 6 and 3) which produced 6.00 , 6.00 and 5.75 leaves, respectively in the first season .

In the second season, similar results were obtained where the number of leaves per plant were 6.00, 5.40 and 5.00 for clayey calcic with high salinity soil and calcic with low salinity soil, respectively (Table 15) being 8.60 4.80 and 6.00 for the three mentioned soils respectively (Table 16) .

It could be concluded that $CaCO_3$ and salinity adversely affected the meristimic activity which contributed to the reduction in plant leave production.

5-Fresh wieght of shoots :-

There were significant differences in fresh shoot weight of the different horizons (Tables 14,15 and 16)with significant difference between clayey soil (control) and salic soil after leaching. The fresh shoot weight of plants grown in calcic soil with high salinity soil (profile No. 3), calcic soil with low salinity (profile No. 6) , salic soil after leaching (profile No. 9)and clayey soil as a control were 2.93,3.02,6.88 and 5.82 gm respectively without significant difference between profile No.3 and 6.

Plants grown in sali soil subjected to leaching ware similar to that grown in clayey soil regarding fresh shoot weight. They surpassed that grown in calcic soil with high or low salinity which produced lower fresh weight . The decrease in fresh weight in such soil may be due to salinity which inhibit the dry matter formation and accumulation in plant organs .

Similar results were obtained in the second season where the highest fresh weight was in seedling grown in clayey soil (0.82 and 4.61gm) followed by that grown in calcic with low salinity soil (0.66 and 1.53gm) . The lowest values (0.63 and 1.07gm) were for seedling growing in calcic soil with high salinity at four and six weeks age respectively .

6- Dry weight of shoot :-

Dry weight of shoot in different horizons was similar to the fresh weight where saline soil subjected to leaching (profile No.9) and clayey soil (control) were superior than both of calcic soil with high salinity (profile No.3) and calcic soil with low salinity (profile No.6) .

It could be concluded that growing sunflower plants in clayey soil or salic soil subjected to leaching produced higher dry matter content compared with calcic horizons with high or low salinity .

In the second season , the dry shoot weights were o.16 ,0.11, 0.13gm and 0.92, 0.34, 0.30gm at 4 and 6 weeks age respectively after planting for the three previously respective mentioned horizons .

It is clear that the seedlings growth reduced when sunflower seeds were sown in both salic and calcic horizons compared to the clayey soil . This

reduction may be due the inhibitory effect of salinity on dry matter production and accumulation .

EL- Agrodi et al (1991) came to the same conclusion he found that soil salinity adversely affected dry matter content of maize plants .

7- Fresh weight of roots :-

Fresh root weight of sunflower grown in different diagnostic horizons is shown in Tables (14,15 and 16). Results indicated that fresh weight of root in plants grown in salic horizon after leaching (profile No. 9) was higher than that grown in clayey soil (profile No . 11) The fresh root weight was 1.89 , 1.66, 1.15 and 1.53 gm for profiles No 9,6,3 and 11, respectively .

In the second season the highest fresh weight of roots was in seedlings grown in clayey soil followed by that in calcic soil with low salinity . The lowest weight was in plants grown in calcic with high salinity soil (Tables 15 and 16). This was true at 4 and 6 weeks age .

It could be concluded that growing sunflower in saline soils after leaching as well as clayey soils produced higher fresh root weight than that grown in highly calcareous soils with low salinity as well as the highly calcareous soil with high salinity .

8- Dry weight of roots :-

Data of the effect of different diagnostic horizons on the dry root weight of sunflower seedling are presented in Tables (14, 15 and 16) .

Results presented in Table (14) revealed that dry weight of roots in plants grown in salic soil after leaching (profile No. 9) was higher than that

grown in the other profiles . The lowest dry weight was produced by plants grown in calcic soil with high salinity .

In the second season, the dry root weights were O.11, 0.06 and 0.04 gm for clayey, calcic and calcic with high salinity soil, respectively at 4 weeks age and 0.24 ,0.08 and 0.07gm at six weeks age (Tables 15 and 16).

It could be concluded that the root dry weight in saline soil subjected to leaching surpassed that grown in clayey soil, highly calcareous soil and that calcareous soil with high salinity caused a remark able decrease in root dry weight. Similar conclussion was reported by. ***EL. Agrodi (1991)*** .