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Ecological and Phytochemical Studies on Some Species of Genus *Amaranthus* in the Nile Delta, Egypt

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ABSTRACT

The present study deals with some features of ecology and phytochemistry of three *Amaranthus* species, namely: *Amaranthus graecizans, A. lividus* and *A. viridis* which are naturally growing in the Nile Delta region of Egypt. The composition of weed vegetation in the present investigation is classified by cluster analysis into four groups: group A is codominated by *Amaranthus graecizans* and *Portulaca oleracea,* group B is codominated by *Amaranthus lividus* and *Cynodon dactylon,* group C is codominated by *Alternanthera sessilis* and *Echinochloa crus-galli* and group D is codominated by *Aster squamatus, Conyza bonariensis* and *Paspalum disticum*. The ordination of the sampled stands applied by Detrended Correspondence Analysis (DCA) indicated that, the recognized vegetation groups are markedly distinguishable and having a clear pattern of segregation on the ordination plane. The application of the Canonical Correspondence Analysis (CCA) showed that, soil texture, porosity, water-holding capacity, bicarbonate, sodium, soil reaction (pH), organic matter and electrical conductivity are the most effective soil variables which correlate with the distribution and abundance of weed vegetation in the study area. The seed germination under different levels of salinity, light, temperature and humidity is studied for the three investigated species. Phytochemically, the mean values of moisture, ash, total nitrogen, protein, total lipids, soluble sugars, glucose, sucrose, polysaccharides and total carbohydrates were determined. The elementary analysis together with qualitative and quantitative analyses of 16 amino acids were also carried out in the investigated plant species.

Keywords: Autecology, phytochemistry, *Amaranthus,* vegetation analysis, seed germination.

INTRODUCTION

Attention should be paid to increase our knowledge of the best conditions for propagation of economic plants. In this connection, the importance of studying plants in their natural habitats, the effect of each habitat factor upon growth establishment and distribution must be emphasized.

Many investigators studied the main active constituents of several species belonging to family *Amaranthaceae*. Nodeide *et al.* (1996) reported that, the green leaves of *Amaranthus viridis* was rich in water, energy, fats, proteins, minerals, amino acids and carotenoid. In some species of the genus *Amaranthus,* sixteen phenolic acid were identified by Sokolowska (1996). An economical use of *Amaranthus paniculatus,* starch is given by Teli *et al.* (1996), it can be used as a textile printing thickener. Two comarins and three flavonoids were isolated from *Amaranthus paniculatus* by Bratoeff *et al.* (1997). Singh and Whitehead (1996) mentioned that, *Amaranthus* species are commonly utilized as vegetable and consumed in Africa, China, India and Italy.

Jale *et al.* (1999) mentioned that, grain amaranth was used as a partial substitute for barley in diets fermented in an artificial rum. Syamdaya and Naidu (1999) studied the nutritive value of amaranth to sheep. One can expect the prime importance of the individuals belonging to this family as a source of substances that can be used for several industrial, medicinal and fodder purposes.

The present study have (1) description of weed communities that associate with the studied plant species in their natural habitats, (2) determination of the factors controlling the distribution and abundance of the identified weed communities, (3) determination of the seed germination behaviour of the studied plant species under different environmental factors, and (4) detection of the main active constituents in the studied plant species.

MATERIALS AND METHODS

The study area

The species under study of genus *Amaranthus* were sampled from ten selected localities (sites) in three Governorates of the Nile Delta region, namely: Kafr El-Sheikh, El-Dakahlyia and Damietta in which the selected *Amaranthus* species are flourishing and naturally growing (Fig. 1). Generally, the Nile Delta is a triangular and covers an area of about 22000 km^2 that comprises about 63% of the Egyptian fertile land (Abu Al-Izz, 1971). Soils of the Nile Delta are mostly heavy in texture and compact at the surface. The humus status of the soils is fairly well (El-Gabaly *et al.,* 1969). According to the map of the world distribution of the arid region (UNESCO, 1977), in the Nile Delta, summer is warm with an average temperature ranging between 20 to 30^oC, while winter is mild with an average temperature ranges between 10 to 20^oC. Most of the rain (70% or more) occurs during winter.

Forty stands (5 m^2 each) have been selected for sampling vegetation in different habitat types supporting *Amaranthus graecizans, A. lividus* and *A. viridis*. The total number of sampled stands was 40: 7 on canal banks, 7 in orchards and 26 in cultivated lands. The density and plant cover of each species had been

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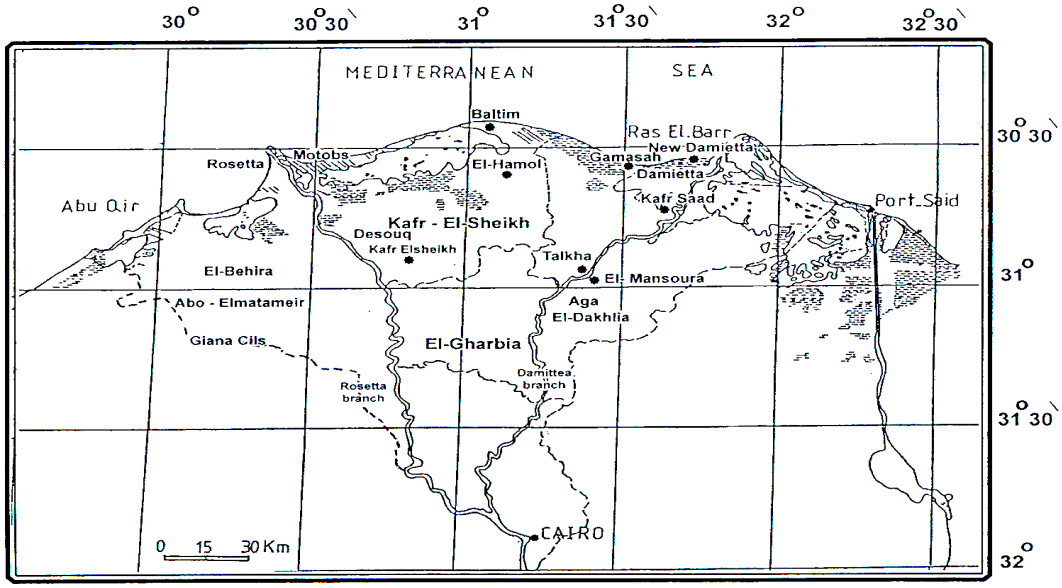

Figure (1): Map of the Nile Delta region showing different sampled localities (sites) as indicated by (•) in the study area.

estimated in each stand. The plant cover was estimated by using line-intercept method (Canfield, 1941). Relative values of density and cover were calculated for each species and summed up to give an estimate of its importance value (IV) in each stand. Nomenclature and identification of the species was according to Tackholm (1974) and Boulos (1999-2005).

From each stand, one soil sample was collected (from profile 0-25 cm) for physical and chemical analyses. Soil texture was determined by the hydrometer method, while the water-holding capacity was estimated using the Hilgard-Pan Box method of Piper (1947). Oxidizable organic carbon was estimated using the Walkely and Black rapid titration method (Black, 1965). The percentage of calcium carbonate was estimated by titration against 1N HCl whereas, estimation of soluble carbonate and bicarbonate were carried out by titration against 0.1N HCl (Allen *et al.*, 1974). Soil pH was estimated using pH meter. The electrical conductivity (EC: mmhos/cm) was measured using conductivity meter. Determination of Na^+, K^+ and Ca^{++} in soils solutions were carried out using flame photometer (Allen *et al.,* 1974). Chlorides were estimated by titration against N/35.5 silver nitrate, while sulphates were estimated gravimetrically using 5% barium chloride.

Cluster analysis was used for classification (Orloci, 1969), while the ordination techniques applied were the Detrended Correspondence Analysis (DCA) and Canonical Correspondence Analysis (CCA) using CANOCO (ter Braak, 1986 & 1988). The statistical treatments applied were according to Snedecor and Cochran (1968) and Anonymous (1993).

Germination experiments were conducted to find out the effect of salinity levels, light and dark, temperature and water spray (humidity) on the rate of seed germination of the three different *Amaranthus* species. For the first three experiments, germination was tested in equal sized Petri-dishes (13 diameter) containing double layered filter paper moistened with distilled water or with different test solution. For each treatment, one hundred seeds were sown in each dish and two replicates Petri dishes were used. In case of water spray experiment, in equal sized pots (14 cm height and 14 cm diameter) were filled with clean sand. One hundred seeds were sown at 0.5 cm depth.

Concerning the phytochemical analysis, the studied species were cleaned, rinsed, left to dry in air at room temperature, separated into roots, stems and leaves, ground to fine powder (mesh. No. 40) and kept in stopper vessels. The mean values of moisture, ash, water-soluble ash, acid- insoluble ash, and total lipid content were estimated according to A.O.A.C. (1970) methodology. Soluble sugars, glucose, sucrose, polysaccharides and total nitrogen content were estimated according to Naguib (1963 & 1964). The protein content was determined colorimetrically as described by Lowry *et al.* (1951). The preliminary phytochemical screening was carried out following the methods described by Egyptian Pharmacopoeia (1953), Fieser and Fieser (1959) and Wall *et al.* (1964). Hundred grams powder of each plant was subjected to extraction with successive solvents using A.O.A.C. (1970) methodology. The macro and micro-elements were determined by atomic absorption spectrophotometer using the methods described by Allen *et al.* (1974). The identification and quantitative determination of amino acids in the plant were carried out using amino acid analyzer (Model, LC 3000) as described by Moore and Stein (1958).

RESULTS

A. Vegetation Analysis

(1) Classification of stands

The dendrogram obtained from cluster analysis based on the importance values of 65 species recorded in 40 sampled stands in the study area indicated the distinction of four vegetation groups (Fig. 2 & Table 1). Group A comprises 12 stands codominated by *Amaranthus graecizans* (IV = 37.70) and *Portulaca oleracea* (IV = 29.42). Important species included *Sonchus oleraceus* (IV = 13.99), *Cyperus rotundus* (IV = 13.98) and *Dactyloctenium aegyptium* (IV = 11.72). Group B includes 17 stands codominated by *Amaranthus lividus* (IV = 34.42) and *Cynodon dactylon* (IV = 26.29). Important species were numerous such as: *Sorghum vigratum* (IV = 18.51), *Cyperus rotundus* (IV = 14.42), *Ammi majus* (IV = 14.31), *Convolvulus arvensis* (IV = 13.87) and *Bidens pilosa* (IV = 10.25). Group C includes 9 stands codominated by *Alternanthera sessilis* (IV = 36.53) and *Echinchloa crus-galli* (IV = 27.15). The important species were *Eclipta alba* (IV = 18.29) and *Phyla nodiflora* (IV = 10.25), Group D consists of 2 stands codominated by *Aster squamatus* (IV = 40.18), *Conyza bonariensis* (IV = 27.67) and *Paspalum distichum* (IV = 31.04). Important species comprised *Bassia indica* (IV = 26.65), *Phragmites australis* (IV = 25.94), *Pluchea dioscoridis* (IV = 15.50) and *Alternanthera sessilis* (IV = 13.75).

(2) Ordination of stands

The ordination of the sampled stands which obtained by Detrended Correspondence Analysis (Fig. 3) indicated that the vegetation groups yielded by cluster analysis are markedly distinguishable and have a clear pattern of segregation on the first and second axes of the ordination plane. Group A codominated by *Amaranthus graecizans* and *Portulaca oleracea* was separated at the central part of the DCA diagram. Group B codominated by *Amaranthus lividus* and *Cynodon dactylon* was segregated at the left side of the ordination diagram. On the other hand, group C codominated by *Alternanthera sessilis* and *Echinochloa crus-galli* was segregated at the right side of the DCA diagram. It is clear that, groups B and C are separately segregated at both sides of group A, where these three groups (A, B & C) are distinctly located on the positive and negative sides of

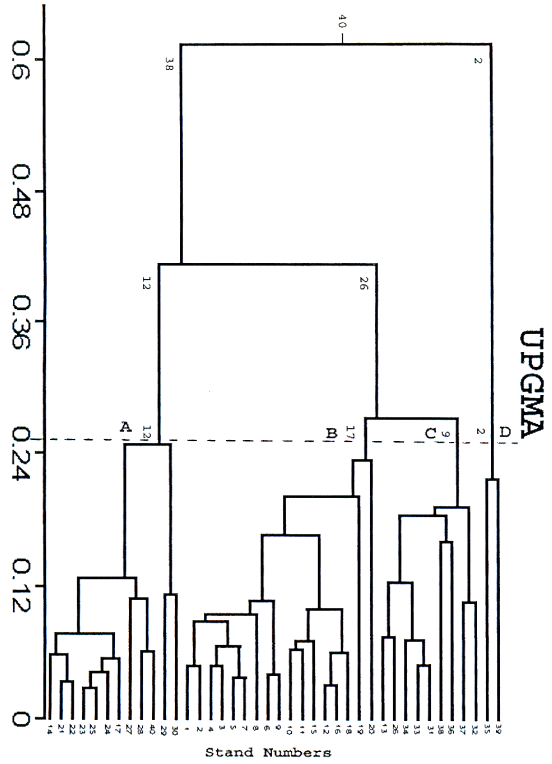

Figure (2): The dendrogram resulting from cluster analysis of 40 sampled stands representing habitat types of some *Amaranthus* species. The dashed line denotes the level at which the dendrogram yields four distinct vegetation group.

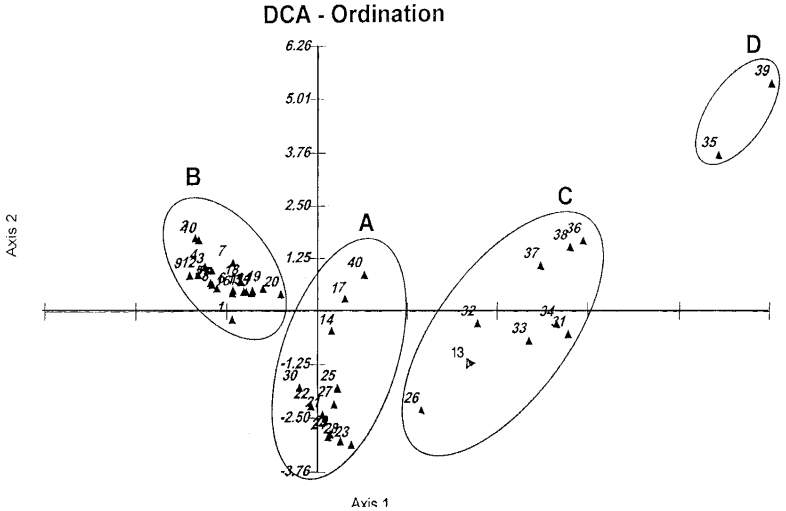

Figure (3): Detrended Correspondence Analysis (DCA) ordination of the 40 sampled standes with four cluster groups.

Table (1): Mean value and coefficient of variation of the importance value of species in the vegetation groups resulting from cluster analysis of the sampled stands.

Species	Vegetation group			
	A	B	C	D
Alternanthera sessilis (L.) DC.	5.37(3.47)	-	36.53(0.97)	13.75(0.27)
Amaranthus graecizans L.	37.70(1.04)	-	2.92(2.83)	-
Amaranthus lividus L.	3.94(2.09)	34.42(1.34)	0.37(1.86)	-
Amaranthus viridis L.	4.22(2.54)	4.96(1.40)	1.66(2.59)	-
Ammi majus L.	1.94(3.47)	14.31(1.43)	2.44(2.83)	-
Anagallis arvensis L.	1.91(2.49)	-	-	-
*Aster squamatu*s (Spreng.)Hieron.	-	-	-	40.18(0.65)
Bassia indica (Wight)Scott	-	0.15(4.13)	-	26.65(0.38)
Beta vulgaris L. subsp. *maritima*	-	-	2.19(2.61)	-
Bidens pilosa L.	9.30(2.35)	11.58(1.66)	2.13(2.83)	-
Brachiaria eruciformis (Sm.) Griseb.	-	-	2.44(1.87)	-
Cakile maritima Scop. subsp. *maritima*	0.13(3.54)	-	-	-
Calendula arvensis L.	-	1.48(4.14)	-	-
Cenchrus biflorus Roxb .	1.71(2.37)	-	-	-
Chenopodium album L.	2.10(2.64)	7.57(1.65)	-	-
Chenopodium glaucum L.	-	-	3.76(2.83)	-
Chenopodium murale L.	4.79(1.66)	7.17(1.72)	1.73(2.82)	-
Cichorium endivia L. subsp. *pumilum*	-	0.69 (2.83)	-	-
Convolvulus arvensis L.	4.76(1. 95)	13. 87(2.01)	-	-
Conyza aegyptiaca (L.)Dryand.	-	-	0.85(2.12)	-
Conyza bonariensis (L.) Cronquist	0.51(3.47)	-	-	37.67(0.34)
Cynodon dactylon (L.) Pers.	7.62(2.51)	26.29(1.12)	4.96(1.48)	-
*Cyperus alopecuroide*s Rottb .	-	-	4.33(1.62)	-
Cyperus difformis L.	1.98(2.38)	-	2.59(2.82)	-
*Cyperus laevigatu*s L.	0.31(3.42)	-	-	-
Cyperus rotundus L.	13.98(1.32)	14.42(1.22)	2.69(2.83)	-
Dactyloctenium aegyptium (L.) Willd.	11.72(2.46)	-	-	-
Digitaria sanguinalis (L.) Scop.	6.46(3.10)	-	-	-
Dinebra retroflexa (Vahl) Panz.	-	-	0.84(1.88)	-
Echinochloa colona (L.) Link.	-	1.53(2.94)	3.79(1.42)	-
Echinochloa crus – galli(L.) Beauv.	3.46(1.42)	-	27.15(0.96)	-
Echinochloa stagnina (Retz.) Beauv.	-	-	6.88(2.83)	-
Eclipta alba (L.) Hassk.	-	-	18.29(1.56)	-
Eleusine indica (L.) Gaertn.	4.12(3.46)	-	8.22(2.83)	-
Euphorbia peplus L.	2.79(2.67)	8.98(1.85)	1.91(2.82)	-
Euphorbia prostrata Aiton	0.73(2.03)	-	-	-
Gnaphalium luteo– album L.	1.08(1.82)	-	0.49(2.84)	-
Inula crithmoides L.	-	-	2.71(2.82)	-
Lotus glaber Mill.	-	5.91(3.13)	-	-
Malva parviflora L.	0.87(3.01)	3.08(2.30)	3.69(2.83)	-
Medicago intertexta (L.) Mill.	0.91(3.47)	-	-	-
Medicago polymorpha L.	1.36(2.07)	-	-	-
Melilotus indicus (L.) All.	5.02(1.54)	0.28(4.11)	-	-
Mesembryanthemum crystallinum L.	-	-	5.10(2.83)	-
Oxalis corniculata L.	-	2.88(1.91)	-	-
Paspalum distichum L.	-	-	8.58(1.46)	31.04(0.140)
Phragmites australis(Cav.)Trin. ex Steud.	-	-	-	25.94(0.27)
Phyla nodiflora (L.) Greene	-	-	10.25(1.28)	-
Plantago major L.	3.59(2.35)	0.52(4.15)	0.26(2.81)	-
Pluchea dioscoridis (L.)DC.	0.69(3.46)	-	4.68(1.52)	15.50(1.00)
Polygonum plebeium R.Br.	-	0.50(3.18)	-	-
Polypogon monspeliensis (L.) Desf.	4.22(1.60)	1.98(1.72)	-	-
Polypogon viridis (Gouan) Brestr.	0.10(3.60)	-	-	-
Portulaca oleracea L.	29.42(1.12)	2.36(3.69)	4.59(2.52)	-
Pseuderucaria teretifolia (Desf.) Schulz	0.06(3.50)	-	-	-
Rumex dentatus L.	3.85(2.04)	5.83(1.37)	7.20(1.23)	-
Scirpus maritimus L.	-	-	7.42(2.02)	-
Senecio vulgaris L.	-	-	0.28(2.79)	-
Setaria verticellata (L.) Beauv.	-	3.46(1.60)	0.17(2.83)	-
Solanum nigrum L.	0.20(3.40)	5.59(3.11)	1.02(2.82)	-
Sonchus oleraceus L.	13.99(1.84)	0.38(2.92)	-	-
Sorghum virgatum (Hack.) Stapf	-	18.51(1.71)	3.39(2.83)	-
Spergularia marina (L.) Griseb.	-	0.13(4.00)	-	-
Urtica urens L.	3.41(3.47)	1.31(4.11)	1.53(2.83)	-
Xanthium strumarium L.	-	-	-	0.91(1.00)

the first and second axes of DCA diagram. However, group D codominated by *Aster squamatus, Conyza bonariensis* and *Paspalum distichum* was separated at the upper most right positive side of DCA diagram.

B. Vegetation – Soil Relationships

(1) Soil analysis

The soil variables of the four vegetation groups are presented in Table (2). It has been found that, most of the soil characteristics show little variations between the different groups of the sampled stands. The soil texture in all groups is mainly formed of coarse fraction (sand) and partly of fine fractions (silt and clay). The mean values of water-holding capacity and soil porosity are obviously comparable in all groups. The mean values of calcium carbonate content are higher in groups C (10.89%) and B (7.88%) than in groups A (5.32%) and D (3.75%), while those of organic carbon content are higher in groups A (0.33%), B (0.29%) and D (0.26%) than in group C (0.14%). The pH values indicated that, the soil reaction is neutral or slightly alkaline, and it ranges between 7.38 in group A and 7.80 in group D. The electrical conductivity (EC), chloride and sulphate attain higher mean values in groups C and D than in groups B and A. The soluble bicarbonate was detected in traces. The concentration of extractable cations: Na^+, K^+ and Ca^{++} attain their highest mean values in group D (1465.00, 494.25 and 111.70 ppm, respectively).

(2) The correlation between vegetation and soil variables

The relationship between vegetation and edaphic variables was indicated on the ordination diagram produced by Canonical Correspondence Analysis (CCA-biplot) (Fig. 4). It is obvious that the values of clay, bicarbonate, soil porosity, sodium cation, sand fraction, water-holding capacity, organic matter, soil reaction (pH) and electrical conductivity were the most effective soil variables which showed a distinct significant correlations with the first and second axes of the CCA biplot diagram.

C. Seed Germination

The seed germination capacity of *Amaranthus* species was investigated under different levels of salinity, light/dark, temperature and water spray (Table 3). The effect of different salinity levels on the seed germination of the three studied *Amaranthus* species showed that the rate of germination reached its highest values of 97% with distilled water treatment. When the low salinity levels of 0.02, 0.03 and 0.04M NaCl solution were used, the percentages of germination attained 92%, 77% and 57% for *A. graecizans,* 86%, 80% and 57% for *A. lividus* and 94%, 80% and 68% for *A. viridis*, respectively. But at salinity levels of 0.1, 0.2, 0.3, 0.4 and 0.5M NaCl solutions, the percentages of germination decreased gradually and attained the minimum rate of germination at 0.5M NaCl solution 9% for *A. graecizans* and 5% for both *A. lividus* and *A. viridis*. The results obtained from the effect of light and darkness on seed germination of the studied species showed that the highest values of germination attained 90%, 98% and 70% under continuous light for *A. graecizans, A. lividus* and *A. viridis*, respectively. The minimum number of germinated seeds were 65% for *A. graecizans* and 58% for both *A. lividus* and *A. viridis*. The seeds of the investigated plant species had the capacity of germination between 20-40^{o}C for both *A. lividus* and *A. viridis*, and 25-40^{o}C for *A. graecizans*. It is evident that, the optimum temperature for the seed germination of *A. graecizans, A. lividus* and *A. viridus* were 35^{o}C (49%), 40^{o}C (98%) and 30^{o}C (78%), respectively. It is also obvious that, the decreased amount of water spray had badly affected the rate of seed germination of the three plant species. In case of *A.*

Table (2): Mean value (±SE) of the different soil variables in the sampled stands representing the four vegetation groups obtained by cluster analysis in the habitat types of *Amaramthus* species.

Soil character	Vegetation group			
	A	B	C	D
Sand (%)	98.25±0.37	97.23±0.42	97.11±0.73	95.00±0.00
Silt (%)	1.67±0.37	2.59±0.37	1.78±0.38	3.00±0.71
Clay (%)	0.08±0.09	0.18±0.08	1.11±0.40	2.00±0.71
Moisture content (%)	11.52±3.11	15.63±3.38	16.10 ±3.42	1.25±0.23
W.H.C. (%)	48.36±3.80	48.51±1.86	55.40 ±2.38	48.21±8.12
Porosity (%)	53.43±1.83	52.05±1.28	57.58 ±1.19	61.37±4.25
CaCO3 (%)	5.32±1.91	7.88±1.89	10.89±2.09	3.75±0.71
Organic carbon (%)	0.33±0.05	0.29±0.04	0.14 ±0.02	0.26±0.04
pH	7.38±0.15	7.34±0.13	7.43 ±0.11	7.80±0.05
EC (mmhos/ cm)	0.45±0.06	0.62±0.06	2.95±2.37	0.79±0.09
Cl^- (%)	0.03±0.00	0.03±0.00	0.35 ±0.29	0.13±0.01
SO_4^- (%)	0.10±0.01	0.14±0.03	0.17±0.08	0.15±0.00
HCO_3^- (%)	0.06±0.01	0.08±0.00	0.05±0.00	0.06±0.00
Na^+ (ppm	212.58±36.34	493.12±95.64	453.90±199.75	1465.00±223.40
K^+ (ppm	24.09±5.71	19.55±1.72	284.83±94.94	494.25±305.50
Ca^{++} (ppm	89.67±27.01	150.37±12.26	71.59±23.86	111.70±5.82

W.H.C.: Water-holding capacity, EC: Electrical conductivity.

Table (3): Number of germinated seed of *Amaranthus* species under different levels of temperature, water spray (humidity), salinity and light / dark.

Day	Species	Temperature (C°)								Water spray (mm)						
		5	10	15	20	25	30	35	40	5	10	15	20	25	30	saturated
3		0	0	0	0	9	10	13	11	0	0	0	0	1	1	1
6		0	0	0	0	19	23	25	24	0	1	1	6	10	11	12
9		0	0	0	0	30	33	38	36	0	7	9	13	20	21	23
12	***Amaranths graecizans***	0	0	0	0	30	40	46	41	0	10	12	20	37	43	56
15		0	0	0	0	30	41	49	47	0	20	27	29	38	45	65
18		0	0	0	0	30	41	49	47	0	33	47	49	53	56	75
21		0	0	0	0	30	41	49	47	0	34	48	50	55	56	75
3		0	0	0	0	0	4	8	17	0	0	0	0	0	4	10
6		0	0	0	0	0	12	16	26	0	0	0	0	6	14	20
9		0	0	0	8	16	18	46	58	0	0	0	13	26	35	39
12	***Amaranthus lividus***	0	0	0	15	28	50	80	90	0	0	6	17	44	55	66
15		0	0	0	20	50	80	82	98	0	0	13	19	51	76	80
18		0	0	0	20	50	80	82	98	0	0	23	26	62	78	90
21		0	0	0	20	50	80	82	98	0	0	23	46	72	79	90
3		0	0	0	0	0	18	10	1	0	0	0	3	18	20	28
6		0	0	0	5	8	25	14	6	0	0	0	17	33	40	47
9		0	0	0	9	14	52	32	16	0	0	10	35	56	60	62
12	***Amaranthus viridis***	0	0	0	19	23	72	58	28	0	0	18	39	77	80	83
15		0	0	0	31	32	78	72	30	0	0	24	45	82	89	92
18		0	0	0	31	32	78	72	30	0	0	38	51	86	91	95
21		0	0	0	31	32	78	72	30	0	0	46	63	87	91	96

Day	Species	Salinity level (NaCl M)									Light /Dark		
		Dist H_2O	0.02	0.03	0.04	0.1	0.2	0.3	0.4	0.5	L	D	L/D
3		31	28	26	20	18	17	3	0	0	0	0	0
6		53	40	30	26	23	19	9	0	0	16	0	4
9		69	50	36	30	26	22	10	0	0	44	36	38
12	***Amaranths graecizans***	74	69	39	37	34	28	13	6	0	66	58	62
15		91	83	50	40	37	29	20	11	2	72	62	68
18		100	91	63	55	37	33	25	12	6	78	65	69
21		100	92	77	57	37	34	27	12	9	90	65	70
24		100	92	77	57	37	34	27	12	9	90	65	70
3		0	0	0	0	0	0	0	0	0	8	3	5
6		16	12	6	0	0	0	0	0	0	11	7	8
9		68	56	42	29	12	2	0	0	0	14	9	13
12	***Amaranthus lividus***	89	60	49	36	25	4	1	0	0	26	12	16
15		93	78	57	43	32	11	8	4	0	52	22	28
18		96	86	80	57	42	20	11	10	5	78	31	32
21		96	86	80	57	42	20	11	10	5	95	52	58
24		96	86	80	57	42	20	11	10	5	98	58	74
3		0	0	0	0	0	0	0	0	0	10	4	6
6		34	32	29	26	20	0	0	0	0	42	26	38
9		46	42	34	31	25	0	0	0	0	52	44	46
12	***Amaranthus viridis***	72	64	62	44	40	8	0	0	0	66	52	58
15		82	80	78	52	43	16	6	2	0	72	58	62
18		91	85	80	56	44	20	18	9	4	72	58	64
21		94	94	80	58	46	21	18	10	4	72	58	64
24		96	94	80	68	46	21	18	11	5	72	58	64

graecizans, seed germination was started at 10mm water spray and being 34%. At 5 and 10mm water spray, both *A. lividus* and *A. viridis* seeds were failed to germinate and started at 15mm water spray, and being 23% and 46% respectively. At the highest level of applied water spray (saturation), the germination percentages reached 75%, 90% and 96% for the seeds of *A. graecizans, A. lividus* and *A. viridis* respectively.

D. Phytochemical Analysis

(1) Determination of chemical constituents

The data analysis showed that *A. lividus* contained a relatively high percentage of moisture content (mean=9.51%), ash content (mean=20.67%), water-soluble ash (mean=11.17%), total protein (mean=214.8 mg/100g dry wt.) and total lipid (mean=13.73%). *A. graecizans* contained a relatively high percentage acid insoluble ash (mean=2.45%), and total carbohydrates (mean=196.5 mg/g dry wt.). The highest mean value of total nitrogen content (271.14 mg/100g dry wt.) was recorded in *A. viridis* (Table 4).

(2) Preliminary phytochemical screening

The preliminary phytochemical screening showed a presence of alkaloids, carbohydrates, flavonoids, sterols and tannins in all organs of the studied species. Saponins was detected only in the leaves of both *A.*

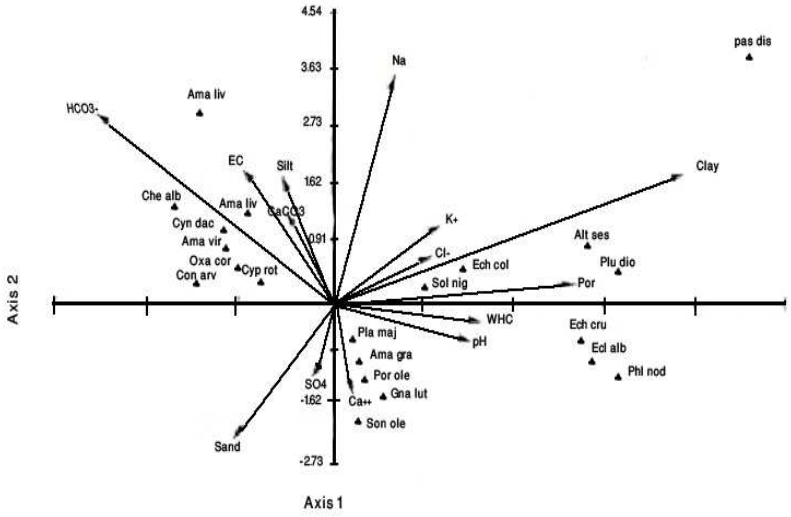

Figure (4): Canonical Correspondence Analysis (CCA) ordination diagram with soil variables represented by arrows. The indicator and preferential species are abbreviated to the first three letters of each of the genus and species.

Table (4): Mean value of chemical constituents in different organs of *Amaranthus* species.

Constant		*Amaranthus graecizans*				*Amaranthus lividus*				*Amaranthus viridis*			
		leaves	**stems**	**roots**	**mean**	**leaves**	**stems**	**roots**	**mean**	**leaves**	**stems**	**roots**	**mean**
Moisture content (%)		6.37	10.18	7.36	7.97	8.7	8.11	11.73	9.51	9.29	8.1	8.7	8.7
Ash content (%)		24.2	17.3	9.9	17.13	21.5	27.5	13	20.67	15.5	14.5	15.5	15.17
Water- soluble ash (%)		5	15.75	9.05	9.93	9.5	15.5	8.5	11.17	0.5	7	10	5.83
Acid- insoulble ash (%)		7.15	0.015	0.05	2.45	2	0.5	0.5	1	3.5	1.5	0.5	1.83
Total nitrogen (mg/100mg dry wt.)		359.7	136.3	128.5	208.2	239	144.1	115.9	242	438.4	217.4	158.5	271.14
Total protein (mg/100mg dry wt.)		232	173.3	204.6	203.3	246.6	208.3	189.6	214.8	277.6	158.3	254	144.8
Total lipid (%)		11.69	17.54	10.05	13.09	14.26	13.92	13	13.73	11.76	18.81	1.09	10.55
Carbohydrates (mg/g dry wt.)	Total soluble sugar	43.95	62.64	71.2	59.25	18.56	36.96	70.64	42.05	20.16	14.96	12.16	15.76
	Glucose	0.9	1.93	0.18	1	0.31	0.89	0.97	0.72	0.2	0.26	0.18	0.21
	Sucrose	2.06	4.06	1.94	2.69	8.26	2.44	2.18	4.29	1.31	1.15	1.04	1.17
	Polysaccharides	139.2	121.3	128.2	29.56	135.7	142.4	114.8	131	148.1	136.2	143.7	142.65
	Total carbohydrates	186	190	211.6	196.5	162.8	182.7	188.5	178	163.8	158.6	157.9	160.09

lividus and *A. viridis* as well as in the stems of *A. viridis.* Sulphates were recorded in all organs of the studied species except in the leaves of *A. graecizans*. Chlorides were recorded in all investigated plant organs except in the leaves and roots of *A. graecizans* (Table 5).

(3) Extraction with successive solvents

The weight and colour of the residues obtained from the extraction with successive selective organic solvents of the studied plant species were shown in Table (6). The results indicated that, the leaves of *A. lividus* attained a relatively high percentage of total extractives, and being 96.45g%, while the lowest one (15.25g%) was recorded in the roots of *A. graecizans*.

(4) Elementary analysis

It is clear that, the highest values of potassium ion concentration (112.6 mg/100g dry wt.), iron (198.5mg/100g dry wt.), copper (1.17mg/100g dry wt.) and cadmium (0.19 mg/100g dry wt.) were recorded in *A. graecizans.* The sodium ion concentration (276.74mg/100g dry wt.), calcium (93.14mg/100g dry wt.), magnesium (3.34mg/100g dry wt.), manganese (0.45 mg/100g dry wt.) and zinc (2.03 mg/100g dry wt.) were recorded in *A. lividus* (Table 7).

(5) Amino acids investigation

The data obtained from the amino acids investigation were presented in Table (8). Fifteen amino acids were detected in each of the studied species, namely: aspartic, threonine, serine, glutamic, proline, glycine, alanine, valine, leucine, isoleucine, phenylalanine, tyrosine, histidine, lysine and arganine, in addition to cystine which was detected only in *A. graecizans* (Fig. 5).

DISCUSSION

Amaranthus is a cosmopolitan genus comprises almost 65 species, distributed in the tropical, subtropical and warm regions of the world (Boulos, 1999). In the present study, the selected species, namely: *Amaranthus graecizans, A. lividus* and *A. viridis* have high medicinal and nutritive values (El-Morsy, 2001). The habitat types supporting the growth of these selected species are

Table (5): A preliminary phytochemical screening of active constituents of the different organs of *Amaranthus* species

Test	*Amaranthus graecizans*			*Amaranthus lividus*			*Amaranthus viridis*		
	leaves	**stems**	**roots**	**leaves**	**stems**	**roots**	**leaves**	**stems**	**roots**
Alkaloids	+ ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Glycosides and/or carbohydrates	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Flavonoids	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Sterols	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Tannins	+ve	+ve	-ve	+ve	+ve	+ve	+ve	+ve	-ve
Saponins	-ve	-ve	-ve	+ve	-ve	-ve	+ve	+ve	-ve
Sulphates	-ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Chlorides	-ve	+ve	-ve	+ve	+ve	+ve	+ve	+ve	+ve

+ve : present ,-ve : absent

Table (6): Extraction of the different fractions of *Amaranthus* species with successive organic solvents.

Solvent used	*Amaranthus graecizans*			*Amaranthus lividus*			*Amaranthus viridis*		
	Leaves g% remark	**Stems g% remark**	**roots g% remark**	**Leaves g% remark**	**stems g% remark**	**roots g% remark**	**Leaves g% remark**	**stems g% remark**	**roots g% remark**
Petroleum ether	0.90 yellow	2.45 yellow	1.20 yellow	29 dark green	31.55 yellow	46.90 yellow	29.6 dark green	34.06 green	0.16 yellow
Ether	4.35 green	4.95 yellow	2.50 yellow	39.7 green	15.6 orange	1.60 yellow	0.77 brown	2.90 yellow	4.50 yellow
Chloroform	1.30 green	0.70 yelow	2.05 yellow	1.25 brown	3.30 yellow	1.65 yellow	0.50 green	0.73 brown	11.53 yellow
Acetone	7.55 green	2.90 yellow	1.10 yellow	9.50 black	1.65 yellow	0.90 yellow	11.73 green	26.83 yellow	20.03 green
Alcohol	26.55 brown	4.65 brown	1.15 yellow	7.90 yellow	2.90 yellow	17.85 yellow	4.47 green	1.90 yellow	1.53 yellow
Water	3.15 brown	5.55 brown	7.25 yellow	9.1 yellow	38.65 yellow	16.20 yellow	4.00 brown	10.27 yellow	6.20 yellow
Total	43.8	21.2	15.25	96.45	93.65	85.1	51.07	76.69	43.95

Table (7): Mean value of cation concentrations (mg/100g dry wt) in the air-dried powder in the different organs of *Amaranthus* species.

Species	Organ	mg/100g dry wt								
		K	**Na**	**Ca**	**Mg**	**Mn**	**Fe**	**Zn**	**Cu**	**Cd**
A graecizans	leaves	110.54	84.57	88.11	4.86	0.45	247.8	1.22	0.91	0.19
	stems	112.8	131.19	47.75	2.43	0.38	55.1	1.19	1.09	0.14
	roots	114.47	264.72	89.69	1.26	0.47	292.6	1.4	1.51	0.23
	mean	112.6	160.16	75.18	2.85	0.43	198.5	1.27	1.17	0.19
A lividus	leaves	107.42	157.85	103.81	0.63	0.5	199.9	1.58	0.71	0
	stems	108.02	327.05	87.59	1.46	0.44	129.6	2.03	0.92	0.05
	roots	106.75	345.32	88.01	1.94	0.4	231.7	2.48	1.27	0.04
	mean	107.4	276.74	93.14	3.34	0.45	187.07	2.03	0.97	0.03
A viridis	leaves	111.35	63.57	96.03	2.43	0.52	138.7	1.06	0.94	0.07
	stems	103.23	71.24	80.21	0.49	0.34	82.7	0.96	0.98	0.08
	roots	106.29	142.46	71.67	0.97	0.43	70.8	2.32	1.13	0.12
	mean	106.96	92.42	82.64	1.3	0.43	97.4	1.47	1.02	0.09

Table (8): Mean value of amino acid concentrations (µg / mg) in *Amaranthus* species.

Amino cid	Species			Mean
	A graecizans	*A lividus*	*A viridis*	
Aspartic acid	51.659	37.272	35.957	41.629
Threonine	17.422	11.512	7.391	12.108
Serine	21.529	19.142	13.738	18.136
Glutamic	104.254	50.562	50.562	68.459
Proline	124.179	73.733	69.339	89.084
Glycine	16.442	13.959	14.871	15.091
Alanine	21.445	14.257	15.898	17.200
Valine	26.079	9.246	14.325	16.550
Leucine	12.859	5.969	10.209	9.679
Isoleucine	25.391	15.779	21.318	20.829
Phenylalanine	4.162	3.617	1.209	2.996
Tyrosine	15.373	9.728	10.64	11.914
Histidine	8.822	7.314	8.164	8.100
Lysine	18.869	10.285	16.025	15.060
Arginine	17.457	7.581	10.184	11.741
Cystine	0.012	0	0	0.004

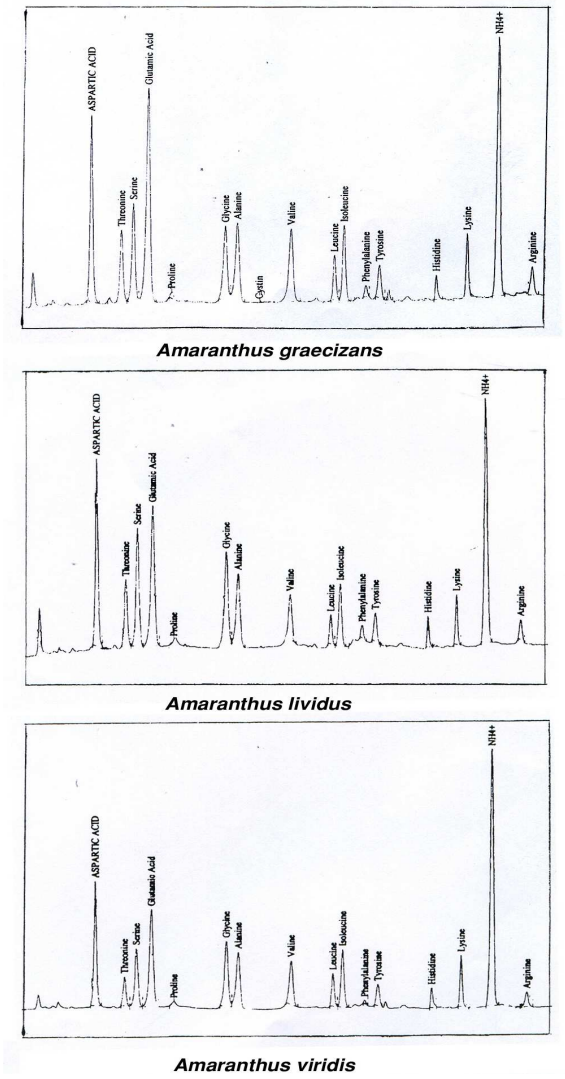

Figure (5): Amino acids contents of *Amaranthus* species.

mainly ruderal including orchards, cultivated lands and canal banks which predominate the agricultural areas of the Nile Delta region of Egypt.

The weed vegetation in the present study is classified by cluster analysis into four groups, each group comprises a number of stands which are similar in terms of codominant species. Group A is codominated by *Amaranthus graecizans* and *Portulaca oleracea,* group B is codominated by *Amaranthus lividus* and *Cynodon dactylon,* group C is codominated by *Alternanthera sessilis* and *Echinochloa crus-galli* and group D is codominated by *Aster squamatus, Conyza bonariensis* and *Paspalum distichum*. These groups may be related to alliance of *Digitarietalia sanguinalis* described by Zohary (1973). The associations of weed vegetation recognized in the present study may be similar to those described by El-Fahar (1989), El-Ashri (1996), El-Halawany *et al.* (2002), Mashaly and Awad (2003), Mashaly (2003) and Omar (2006). The ordination of the sampled stands by DCA indicated that, group A (*Amaranthus graecizans* and *Portulaca oleracea*) and group C (*Alternanthera sessilis* and *Echinochloa crus-galli*) are more closely related to each other than group B (*Amaranthus lividus* and *Cynodon dactylon*) and group D (*Aster squamatus, Conyza bonariensis* and *Paspalum distichum*). This may be due to the distinct similarities of the floristic composition in these vegetation groups. The application of CCA indicated that, the values of fine fraction (clay), bicarbonate, soil porosity, sodium cation, coarse fraction (sand), water-holding capacity, organic carbon, soil reaction (pH) and soil salinity (EC) are the most effective soil variables controlling the distribution and richness of the weed vegetation in the study area. These findings are in accordance with those of El-Halawany *et al.* (2002), Mashaly (2003) and Omar (2006).

With regard to seed germination of the studied plant species, it is denoted that, *Amaranthus graecizans* is more salt tolerant than the other two species, while *A. viridis* is more sensitive to salinity than *A. lividus*. The seed germination showed distinct sensitivity to continuous darkness, while in continuous light, the seeds attained their highest values of germination. These observations may give an indication that, these species are long-day plants. The studied plants had the capacity to germinate between wide range of temperature. This may explain why these species prefer to flourish at early and mid-summer. The percentage of seed germination of the studied species increased with rise of water spray or humidity level.

Phytochemical investigation of the selected plant species, revealed that, the presence of tannins, alkaloids, glycosides and/or carbohydrates, flavonoids and sterols in all plant organs of the studied species. Saponins were detected only in the leaves of *A.lividus* and leaves and stems of *A.viridis*. The elementary analysis together with qualitative and quantitative analyses of 16 amino acids were also carried out in the investigated plants. The phytochemical results in the present study, seemed to be comparable with those obtained by Raja *et al.* (1997), El-Morsy (2001) and Omar (2006). Consequently, the selected plant species appeared a promising weeds as a renewable natural resources and raw materials for different uses in industrial, food, forage and pharmaceutical purposes.

REFERENCES

ABU AL-IZZ, M.S. 1971. Land forms of Egypt. The American University in Cairo Press. Dar Al- Maaref, Cairo, Egypt.

ALLEN, S.E., H.M. GRIMSHAW, J.A. PARKINSON, C. QUARMBY, AND J.D. ROBERTS. 1974. Chemical analysis of ecological materials. Black Well Scientific Publications. Osney, Oxford, London.

ANONYMOUS. 1993. SPSS Program, for Windows. Base System User's Guide Release 5.0.2 Marija. J., Norsis INC.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

1970. Official methods of analysis. 9th ed. A.O.A.C. Washington, D.C.,USA.

BLACK, C.A. 1965. Methods of soil analysis. American Socity Agronomy 771- 1572.

BOULOS, L. 1999-2005. Flora of Egypt. Al Hadara Publishing, Cairo, Egypt. **1-4**.

BRATOEFF, E.M., C. PEREZ-AMADOR, E. RAMIREZ, G. FLORES, AND N. VALENICA. 1997. Xanthones, flavones and coumarins from *Amaranthus paniculatus* Schinz (Amaranthaceae); Phyton (Buenos Aires) **60(112)**: 103-107.

CANFIELD, R. 1941. Application of the line interception method in sampling range vegetation. Journal Forestry **39**: 288-394.

EGYPTIAN PHARMACOPOEIA. 1953. 1st. English Ed., Cairo University Press, Cairo.

EL-ASHRI, N.N. 1996. Ecological studies on the seasonal fluctuation on the flora in El-Dakhlia Province. M.Sc.Thesis, Faculty of Science, Mansoura University, Egypt.

EL-FAHAR, R.A. 1989. A phytosociological study on weed vegetation in the Nile Delta region. M.Sc. Thesis, Faculty of Science, Tanta University, Tanta.

EL-GABALY, M.M, I.M. GEWAIFEL, M.N. HASSAN, AND B.G. ROZANOV. 1969. Soil map and land resources of the United Arab Republic. Research Bulletin, Alexandria University **22**: 1-14.

EL-HALAWANY, E.F., I.A. MASHALY, AND G. OMAR. 2002. On the ecology of weed communities of the principal crops in Damietta area, Egypt. Bulletin Faculty of Science, Assiut University **31(2-D)**: 159–174.

EL-MORSY, E.R. 2001. Ecological studies on the weed flora of the orchards in the Nile Delta and their nutritive potentialities. M.Sc. Thesis, Faculty of Science, Mansoura University, Egypt.

FIESER, L.F., AND M. FIESER. 1959. Sterols Reihld Publishing NewYork.

JALE, D., M. BARAN, AND P. SIROKA. 1999. Use of grain amaranth (*Amaranthus hypochondriacus*) for feed and its effect on rumen fermentation in vitro. Czech-Journal of Animal Science **44(4)**: 163-167.

LOWRY, O.H., N.J. ROSEBROUGH, A.L. FARR, AND R. RANDALL. 1951. Protein measurement with the folin phenol reagent. Jounal Biological Chemistry **193**: 265-275.

MASHALY, I.A. 2003. Phytosociological study on the weed flora of croplands in Kafr El-Sheikh Governorate, Egypt. El-Minia Science Bulletin **14(2)**: 127-153.

MASHALY, I.A., AND E.R. AWAD. 2003. Ecological perspectives on the weed flora of orchards in the Nile Delta, Egypt. Journal of Environmental Sciences, Mansoura University **25**: 1-37.

MOORE, S., AND H.W. STEIN. 1958. Chromatography of amino acids on sulfanated polystyrene resins, Annals Chemistry **30**: 1185.

NAGUIB, M.I. 1963. Colorimetric estimation of plant polysaccharides. Zucker **16**: 15-23.

NAGUIB, M.I. 1964. Effect of sevin on the carbohydrates and nitrogen metabolism during the germination of cotton seeds. Indian Jourrnal Experimental Biololgy **2**: 149-155.

NODEIDE, M.B., A. HATLOY, M. FOLLING, E.O. LIED, AND A. SHAUG. 1996. Nutrient composition and nutritional importance of green leaves and wild. Food Resources in an Agricultural District. Koutiala, in Southern Mali. International Journal of Food Sciences and Nutrition **47(6)**: 455- 468.

OMAR, G. 2006. Plant life of the different habitats in the north Nile Delta of Egypt: ecology and fodder potentialities. Ph.D. Thesis,Faculty of Science, Mansoura University, Egypt.

ORLOCI, L. 1969. Information analysis of structure in biological collection. Nature **223**:484.

PIPER,C.S. 1947. Soil and plant analysis. Interscience Publishers, Inc. New York.

RAJA, T.K., O.C. OTHMAN, AND T.E. BAHEMUKA. 1997. Levels of crude proteins and some inorganic elements in selected green vegetables of Dar es Salaam. Journal of Food Science and Technology Mysore **34(5)**: 419-422.

SINGH, B.P., AND W.F. WHITEHEAD. 1996. Management methods for producing vegetable amaranth. P. 511-515: J. Janick(ed.), Progress in New Crops. ASHS Press, Arlington, VA.

SNEDECOR, G.W., AND W.G. COCHRAN. 1968. Statistical methods. Sixth Edition. The Iowa State University Press. U.S.A.

SOKOLOWSKA-WOZNIAK, A. 1996. Phenolic acids in the some species from the genus *Amaranthus* L. Herba Pol. **42(4)**: 283-288.

SYAMDAYA, J., AND M.M. NAIDU. 1999. Nutritive value of amaranth in sheep. Indian Veterinary Journal **76(7)**: 666-667.

TACKHOLM, V. 1974. Students' flora of Egypt. 2nd Edition. Cairo University Press.

TELI, M.D., V. SHANBAG, P.R. KULKARNI, AND R.S. SINGHAL. 1996. *Amaranthus paniculatus* (Rajgera) starch as a thickener in the printing of textiles. Carbohydr. Polym. **31(3)**: 119-122.

TER BRAAK, C.J. 1986. Canonical correspondence analysis: A new eigenvector technique for multivariate direct gradient analysis. Ecology **67**: 1167-1179.

TER BRAAK, C.J. 1988. CANOCO–a FORTRAN Program for canonical community ordination by partial detrended correspondence analysis, principal cmpponent analysis and redundancy analysis (Version 2.1). Agric. Math. Group. Wageninigen, The Netherlands .

UNESCO. 1977. Map of the world distribution of arid regions. MAB Technical Notes.

WALL, M.E., M.M. KREIDER, C.F. KREMSON, C.R. EDDY, J.J. WILLIAMAN, D.S. CORELL, AND H.S. GENTRY. 1964. Steroidal sapogensis.VIII .Survey of plants for steroidal sapogensis and other constituents. Jourunal Pharmaceutical Socity **34**: 1-3.

ZOHARY, M. 1973. Geobotanical foundations of the Middle East. Stuttgrat, Gustav Fischer Verrlag.

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دراسات بيئية وكيمياء نباتية على بعض أنواع جنس الأمارانطون بدلتا النيل بمصر

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الملخص العربـــى

إستهدف هذا البحث دراسة الخصائص البيئية والكيمياء النباتية لثلاثة أنواع نباتية عشبية تنتمى لجنس الأمارانطون (*Amaranthus*) بدلتا نهر النيل بمصر وهذه الأنواع الثلاثة هى: شجرة السنطين (*Amaranthus graecizans*) والأمارانطون (*Amaranthus lividus*) وعرف الديك (*Amaranthus viridis*). تم إختيار 40 موقعا لدراسة العلاقة بين العوامل البيئية والتركيب النوعى للعشائر النباتية التى تنتمى إليها النباتات محل الدراسة، حيث أمكن التعرف على أربع مجموعات نباتية ذات سيادات مشتركة، وقد تم فصلها إحصائيا على النحو التالى:

1- مجموعة A وتتميز بسيادة مشتركة بين نبات شجرة السنطين ونبات الرجلة.
2- مجموعة B وتتميز بسيادة مشتركة بين نبات الأمارانطون ونبات النجيل.
3- مجموعة C وتتميز بسيادة مشتركة بين نبات لقمة الحمل ونبات الدينيبة.
4- مجموعة D وتتميز بسيادة مشتركة بين نبات الأستر ونبات عين الكتكوت ونبات المديد.

وأظهرت النتائج أن أهم عوامل التربة التى تؤثر فى توزيع وتركيب ووفرة الكساء الخضرى لتلك المجموعات النباتيه هى: نسبة الطين ومسامية التربة والسعة المائية ومستوى الملوحة ونسبة البيكربونات وتركيز الصوديوم والكربون العضوى والأس الهيدروجينى، وبدراسة تأثير درجة الملوحة على إنبات البذور فقد اتضح أن نبات شجرة السنطين هو أكثر النباتات الثلاثة تحملا للملوحة، كما أن إنبات هذه النباتات ذات حساسية تجاه الظلام المستمر ولكنها تفضل الضوء فهى أنواع نهارية، كما أن لديها مدى حرارى واسع فى الإنبات يمتد ما بين أوائل الصيف حتى قرب نهايته كما أن إنباتها يزيد بزيادة نسبة الرطوبة المتاحة.

كما تم دراسة المحتوى الأيضى وتراكم المعادن فى الأنواع النباتية محل الدراسة وشمل ذلك النسب المئويه لكل من الرطوبة والرماد الكلى والرماد الذائب والسكريات الطليقة والمعقدة والمحتوى النيتروجينى واللبيبدات والألياف، كما تم إجراء الإستخلاص المتعاقب باستخدام بعض المذيبات العضوية وتم تقدير نسب الرواسب المختلفة وخواصها الطبيعية، كما أظهرت التجارب الأولية وجود القلوانيات والسكريات والأسترويدات والتانين والصابونين والفلافونيدات ومعظم العناصر الكبيرة والصغيرة ، كما خصص جزء لدراسة المحتوى البروتينى باستخدام جهاز تحليل الأحماض الأمينية، حيث أمكن التعرف على 16 حمض أمينى كما تم تقدير تركيزاتها، لذا فقد أوضحت دراسة الكيمياء النباتية لتلك الأنواع الثلاثة بأنها تحتوى على مواد عضوية وأخرى غير عضوية تؤهلها لتكون نباتات إقتصادية غير تقليدية بمصر.