

## ESTIMATION AND DISTRIBUTION OF WEED FLORA IN STRAWBERRY (*Fragaria ananassa* DUCHESNE) FIELDS IN EGYPT.

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### ABSTRACT

Weeds are considered a problem in strawberry production areas in Egypt. This study on weed flora is carried out on two methods for strawberry production. The first is located in West Delta area and Qalubia governorate where the soils fumigated by methyl-bromide (protected cultivation) and the second is in Qalubia, Sharkia and Ismailia governorates where the soils were not fumigated (normal cultivation). The study was conducted during winter seasons from 2000/2001 to 2003/2004. Weeds were estimated randomly on one square meter as random and replicated ten times in every fields. Six parameters were used for evaluated weed species, namely the relative density, general density, general frequency, percentage of infested fields, cumulative number and abundance. The results appeared that, total of 112 species were recorded, belonging to 78 genera and 31 families. Species *Artemisia vulgaris*, *Galinsoga parviflora*, *Oxalis latifolia* and *Urochloa panicoides* were recorded as new species introduced to Egyptian flora. While, species *Chenopodium murale*, *Conyza bonariensis*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Melilotus indicus*, *Nothoscordum inodorum*, *Oxalis comiculata*, *Poa annua*, *Polypogon monspeliensis*, *Portulaca oleraceae*, *Sonchus oleraceus*, *Stellaria media*, *Trianthema portulacastrum* and *Trifolium resupinatum* were evaluated as the most troublesome weeds. In addition, the effect of methyl-bromide on legume seeds germination were less than other species.

### INTRODUCTION

Strawberry is an important export and cash vegetable crop in Egypt. Cultivated area about 2000 hectares. It is cultivated by two dominant methods, Protection cultivated (fresh) and normal cultivation (frigo). The dominant pests in the strawberry were; nematodes, mites, insects and weeds. Nematodes were controlled by methyl bromide or crop rotations, while mites and insects were controlled by chemical compounds and biocontrol methods. Weeds were controlled essentially by mechanical methods; rarely by herbicides.

Distribution and types of strawberry weeds are not clear. The cultivation of strawberry season in Egypt starts from August or September to May or June. The summer weeds were growing at the beginning and ending of season, and winter weeds were growing at winter months, while many perennial weeds were growing during the whole season.

Atkinson *et al.* (1983) in UK, surveyed the weeds of strawberry and reported that the most spreadable weed species were; *Convolvulus arvensis*, *Agropyron repens*, *Cyndon dactylon*, *Paspalum dilatatum* and *Sorghum halepense*, while in Ireland, MacGiolla *et al.* (1989) reported that, the dominant weeds were *Epilobium montanum*, *Senecio vulgaris* and *Viola arvensis*. Nonnecke *et al.* (1993) and Quarles (1999) in USA found in strawberry fields the following weeds; *Rumex crispus*, *Chenopodium album*, *Amaranthus retroflexus*, *Portulaca oleracea*, *Solanum nigrum*, *Plantago*

*lanceolata*, *Agrostis palustris*, *Digitaria sanguinalis*, *Setaria pumila* and *S. viridis*.

Abd El-Raouf *et al.* (1993) identified the most dominant winter weeds in Egypt; *Anagallis arvensis*, *Avena fatua*, *A. sativa*, *Beta vulgaris*, *Capsella bursa-pastoris*, *Chenopodium murale*, *Coronopus squamatus*, *Phalaris paradoxa*, *Polypogon monspeliensis*, *Rumex dentatus* and *Sonchus oleraceus*. While, Abousteit *et al.* (1993) in Egypt, observed the major summer weeds; *Amaranthus hybridus*, *A. viridis*, *Brachiaria reptans*, *Corchorus olitorius*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Dinebra retroflexa*, *Echinochloa colona*, *Leptochloa panicea*, *Portulaca oleraceae* and *Trianthema portulacastrum*. The new weeds records by Daie and El-Khanagry (2004) included some dangerous weeds and may caused problems in the future, these weeds are; *Urochloa panicoides*, *Trianthema portulacastrum*, *Cenchrus echinatus*, *Acrachne racemosa*, *Digitaria ciliaris*, *Commelina benghalensis*, *Leptochloa panicea*, *Eragrostis pilosa* and *Tribulus terrestris*. Culpepper *et al.* (2004) reported that, *Commelina benghalensis* was the first weed species observed in United States in 1928 and distributed as most troublesome cotton weed's in many states.

The sensitivity of weeds to methyl-bromide was very differed among species. Zhang *et al.* (1997) and Unruh *et al.* (2002) found that, methyl bromide provided 100 % control of *Cyperus rotundus*, *C. esculentus*, *Lolium multiflorum* than *Portulaca oleracea*, *Abutilon theophrasti* and *Brassica kaber*, while, lesser effect on *mollugo verticillata*. The effect of fumigation in controlling weeds depended on the moisture and temperature of the soil. Amer *et al.* (1998) reported that *Vicia faba* seeds were fumigated with 50 and 100 g/m<sup>2</sup> methyl bromide for 4 h, 1, 2, 3 and 4 days, the seed germination decreased with increased the rates and time of application.

Most species of genus *Amaranthus* distributed as annoyed weeds in cultivated lands especially in summer crops. Grichar (1997) showed that *Amaranthus palmeri* decreased the yield of peanut between 25-60 % compared with the yield controlled by herbicides. While, Massing and Currie (2002) studies the impact of *A. palmeri* on corn. They reported that, *A. palmeri* declined the grain yields from 11 to 74 % compared weed free yields. Moreover, Massing *et al.* (2003) found that *A. palmeri* decreased the leaf area of corn 5-15 % and 60-80 % of light was intercepted above the ground. On the other hand, Bensch *et al.* (2003) arranged descendingly the effect of different *Amaranthus* species on soybean yield as the following *A. palmeri*, *A. hybridus*, *A. retroflexus*, *A. rubis*, *A. bilitoides* and *A. viridis*. In addition, Moore *et al.* (2004) evaluated the effects of *A. palmeri* on grain of sorghum, found that grain yield decreased by 1.8 to 3.5 % by increasing one weed plant per 15 m at each row. Also, each 1 kg of *A. palmeri* dry weight reduced grain yield by 5-9 %.

## **MATERIALS AND METHODS**

Weed survey on strawberry fields was started from December to May during 2000/2001 to 2003/2004. The area of study included protected cultivation in great farms at west Delta area and Qalubia governorate. Every farm was divided into sections as fields; number of fields were 112 and 51

fields at west Delta and Qalubia, respectively. Soils of these fields were fumigated by methyl bromide at 50-70 g/m<sup>2</sup> to control the nematodes. The normal cultivation fields were 142 at Qalubia, 45 at Sharkia and 86 at Ismailia. These fields were not fumigated, but the crop rotation system used as antinematicides.

Weeds were estimated more than once at different times. Ten individual square meter were chosen randomly in each field. Weeds identification and distribution were conducted according to Täckholm (1974), Cope and Hosni (1991), El-Hadidi and Fayed (1994/65) and Boulos (1999, 2000 and 2002).

**The following equations used for evaluation the weeds associated with strawberry :**

Relative density (R.D.) % =

$$\frac{\text{Total number of individual plant of every species}}{\text{Total plants number of all species}} \times 100$$

$$\text{General density (G.D.) (plant/m}^2\text{)} = \frac{\text{Total plant number of every species}}{\text{Number of fields} \times \text{sample size of field}}$$

General frequency (G.F.) % =

$$\frac{\text{Total number of infested square meter for every species}}{\text{Number of all field} \times \text{sample size of field}} \times 100$$

$$\text{Infested field (I.F.) \%} = \frac{\text{Number of infested fields by every species}}{\text{Total number of fields}} \times 100$$

**Cumulative number :**

The results of the previous equations transferred to symbols and had numbers depend on the following scale which used by Abd El-Raouf *et al.* (1993), Abousteit *et al.* (1993) and El-Mashad (2001).

Dominant (a)	> 5 % RD > 5 plant/m <sup>2</sup> GD > 20 % GF and IF
Common (c)	> 1-5 % RD > 1-5 plant/m <sup>2</sup> GD > 10-20 % GF and IF
Rare (b)	> 0.1-1 % RD > 0.1-1 plant/m <sup>2</sup> GD > 1-10 % GF and IF
Very rare (a)	> 0.1 % RD > 0.1 plant/m <sup>2</sup> GD > 0.1 % GF and IF

Every symbol transferred again to absolute numbers as follows; d = 4, c = 3, b = 2 and a = 1, then from these numbers of very species counted the cumulative number.

**Abundance parameter :**

Cumulative number divided into four sets for defined the abundance as follows: Dominant (13-15), very common (10-12), common (7-9), and rare (4-6).

Different parameters were recorded for weeds evaluation, *i.e.* Kershaw (1975), Shaltout and El-Fahar (1991) and Hassanein *et al* (1997) used the relative density to find a relation between recorded weed species, while Abd El-Raouf *et al.* (1993) and Hassanein *et al.* (1997) used the general density to evaluate the density of every species per square meter. On the other hand, El-Mashad *et al.* (2002) and Sherif (2002) used the general frequency equation to estimate the distribution of every species. Moreover, Attalla (2002) and Daie and El-Khanagry (2004) applied the infested field equation to evaluate the distribution of every species in the different study area. Meanwhile, El-Khanagry (1993) and Colbasch (2000) used cumulative number to count different parameters in one measure. In addition, Abd El-Ghany (1981), Marshall (1988), McCulty *et al.* (1991) and Hassan and Mohamed (1992/93) used abundance parameter for arranging the species in sequence sets.

## RESULTS AND DISCUSSION

The recorded weed species in all strawberry fields appeared in Table (1). The total weeds were 112 species belong to 78 genera and 31 families. One species belongs to Conifer group; Dicots taxa were 80 species divided into 11 perennial and 69 annual weeds. Annual weeds classified to 14, 53, 2 species as summer, winter and all year plants, respectively; Monocots taxa were 31 species classified to 6 perennial and 25 annual weeds. Annual weeds classified to 8, 14 and 3 as summer, winter and all year plants; respectively. The sequence of families according and their species were; Gramineae (26), Compositae (17), Cruciferae (10), Leguminosae (8), Amaranthaceae (6), Chenopodiaceae (5), Polygonaceae (3), Caryophyllaceae (3), Euphorbiaceae (3), Malvaceae (3), Scrophulariaceae (3), Oxalidaceae (2), Umbelliferae (2), Plantaginaceae (2) & Juncaceae (2). The others 17 families included one species only.

The new record plants as weeds from Egyptian flora in the cultivated area were *Boerhavia diffusa*, *Bassia indica*, *Rorippa integrifolia*, *Cyananchem acutum*, *Misopates orontium*, *Veronica* spp., *Lactuca serriola*, *Launea nudicaulis*, *Symphoricarum squamatus*, *Juncus bufonius*, *Commelina benghalensis*, *Bromus catharticus*, *Cenchrus echinatus*, *Digitaria ciliaris*, *Eragrostis* spp. In addition, the new species introduced to Egyptian flora were *Oxalis latifolia*, *Artemisia vulgaris*, *Galinsoga parviflora*, *Nothoscordum inodorum* and *Urochloa panicoides*. Moreover, some desert plant recorded in strawberry fields, *i.e.*, *Artemisia monosperma* and *Parapholis incurva*; while *Cusuarina* sp., *Tamarix* sp. and *Juncus acutus* registered as occasionally species. The new distribution of old Egyptian flora were *Trianthema portulacastrum*, *Amaranthus blitoides*, *A. palmeri* and *Commelina benghalensis*. Moreover, *Orobanche aegyptiaca* collected as abnormal weed, it parasitized on *Ammi majus* and *Sonchus oleraceus*.

Table (1). List of families and their taxa and life types of weed flora in strawberry fields.

Families and their taxa		Life type
<b>Gymnospermae</b>		
Coniferospida		
Casuarinaceae		
	<i>Casuarina</i> sp.	P
<b>Angiospermae</b>		
Dicotyledineae		
Urticaceae		
	<i>Urtica urens</i>	W
Polygonaceae		
	<i>Emex spinosa</i>	W
	<i>Rumex crispus</i>	W
	<i>R. dentatus</i> subsp. <i>dentatus</i>	W
Nyctaginaceae		
	<i>Boerhavia diffusa</i>	P
Aizoaceae		
	<i>Trianthema portulacastrum</i>	S
Portulacaceae		
	<i>Portulaca oleracea</i>	S
Caryophyllaceae		
	<i>Silene rubella</i>	W
	<i>Spergularia</i> spp.	W
	<i>Stellaria media</i>	W
Chenopodiaceae		
	<i>Bassia indica</i>	W
	<i>Beta vulgaris</i>	W
	<i>Chenopodium album</i>	A
	<i>C. ficifolium</i>	W
	<i>C. murale</i>	A
Amaranthaceae		
	<i>Amaranthus blitoides</i>	S
	<i>A. graecizans</i>	S
	<i>A. hybridus</i>	S
	<i>A. lividus</i>	S
	<i>A. palmeri</i>	S
	<i>A. viridis</i>	S
Fumariaceae		
	<i>Fumaria</i> ssp.	W
Cruciferae		
	<i>Brassica nigra</i>	W
	<i>B. tournefortii</i>	W
	<i>Capsella bursa-pastoris</i>	W
	<i>Coronopus didymus</i>	W
	<i>C. squamatus</i>	W
	<i>Raphanus raphanistrum</i>	W
	<i>Rorippa palustris</i>	W
	<i>Sinapis allionii</i>	W
	<i>S. arvensis</i>	W
	<i>Sisymbrium irio</i>	W

Table (1). Cont.

Families and their taxa			
		<b>Leguminosae</b>	
		<i>Medicago intertexta</i> var. <i>ciliaris</i>	W
		<i>M. polymorpha</i>	W
		<i>Melilotus indicus</i>	W
		<i>M. serratifolius</i>	W
		<i>Trifolium resupinatum</i>	W
		<i>Trigonella laciniata</i>	W
		<i>Vicia monantha</i>	W
		<i>V. sativa</i>	W
		<b>Oxalidaceae</b>	
		<i>Oxalis corniculata</i>	P
		<i>O. latifolia</i>	P
		<b>Euphorbiaceae</b>	
		<i>Euphorbia heterophylla</i>	S
		<i>E. peplus</i>	W
		<i>E. prostrata</i>	S
		<b>Tiliaceae</b>	
		<i>Corchorus olitorius</i>	S
		<b>Malvaceae</b>	
		<i>Aputilon theophrasti</i>	S
		<i>Malva parviflora</i>	W
		<i>Sida alba</i>	S
		<b>Tamariaceae</b>	
		<i>Tamarix</i> sp.	P
		<b>Umbelliferae</b>	
		<i>Ammi majus</i>	W
		<i>Apium leptophyllum</i>	W
		<b>Primulaceae</b>	
		<i>Anagallis a. vensis</i>	W
		<b>Asclepiadaceae</b>	
		<i>Cynanchum acutum</i>	P
		<b>Convolvuiaceae</b>	
		<i>Convolvulus arvensis</i>	P
		<b>Labiatae</b>	
		<i>Lamium amplexicaule</i>	W
		<b>Solanaceae</b>	
		<i>Solanum nigrum</i>	W
		<b>Scrophulariaceae</b>	
		<i>Misopates orontium</i>	W
		<i>Veronica anagallis-aquatica</i>	W
		<i>V. polita</i>	W
		<b>Orobanchaceae</b>	
		<i>Orobanche aegyptiaca</i>	W
		<b>Plantaginaceae</b>	
		<i>Plantago lagopus</i>	W
		<i>P. major</i>	W

Table (1). Cont.

Families and their taxa		Life type
<b>Compositae</b>		
	<i>Artemisia monosperma</i>	P
	<i>A. vulgaris</i>	P
	<i>Bidens pilosa</i>	A
	<i>Calendula arvensis</i>	W
	<i>Cichorium endivia</i> subsp. <i>divaricatum</i>	W
	<i>Conyza bonariensis</i>	A
	<i>Galinsoga parviflora</i>	W
	<i>Lactuca serriola</i>	W
	<i>Launaea nudicaulis</i>	P
	<i>Pluchea dioscoridis</i>	P
	<i>Pseudognaphalium luteoalbum</i>	W
	<i>Reichardia tingitana</i>	W
	<i>Senecio glaucus</i> subsp. <i>coronopifolius</i>	W
	<i>Sonchus asper</i>	W
	<i>S. oleraceus</i>	W
	<i>Symphytorichum squamatus</i>	P
	<i>Urospermum picroides</i>	W
<b>Monocotyledoneae</b>		
<b>Alliaceae</b>		
	<i>Nothoscordum inodorum</i>	P
<b>Juncaceae</b>		
	<i>Juncus acutus</i>	P
	<i>J. bufonius</i>	W
<b>Commelinaceae</b>		
	<i>Commelina benghalensis</i>	P
<b>Gramineae</b>		
	<i>Avena fatua</i>	W
	<i>A. sativa</i>	W
	<i>A. sterilis</i>	W
	<i>Brachiaria reptans</i>	S
	<i>Bromus catharticus</i>	W
	<i>Cenchrus echinatus</i>	S
	<i>Dactyloctenium aegyptium</i>	S
	<i>Digitaria ciliaris</i>	S
	<i>D. sanguinalis</i>	S
	<i>Echinochloa colona</i>	S
	<i>E. crus-galli</i>	S
	<i>Eleusine indica</i>	S
	<i>Eragrostis ciliaris</i>	W
	<i>E. pilosa</i>	A
	<i>Lolium multiflorum</i>	W
	<i>L. temulentum</i>	W
	<i>Panicum repens</i>	P
	<i>Parapholis incurva</i>	W
	<i>Phalaris minor</i>	W
	<i>P. paradoxa</i>	W
	<i>Phragmites australis</i>	P
	<i>Poa annua</i>	W
	<i>Polypogon monospermiensis</i>	W
	<i>Rostraria cristata</i>	W
	<i>Setaria viridis</i>	A
	<i>Urochloa panicoides</i>	S
<b>Cyperaceae</b>		
	<i>Cyperus rotundus</i>	P

P : perennial, S : annual summer weeds, W : annual winter weeds, A : all year (given more one generation in the year).

**1- Normal cultivation:**

Table (2) shows the weed flora recorded in strawberry fields at Qalubia, Sharkia and Ismailia governorates.

**1.1- Qalubia governorate:**

Number of weeds were 70 species belongs to 53 genera and 26 families.

**1.1.1- Relative density (R.D.):** The highest percentage of families recorded by Oxalidaceae (17.139%), Graminae (16.320%), Alliaceae (10.261%), Cyperaceae (8.172%). Total percentages of these families were (51.892%). The percentages of Caryophyllaceae, Umbelliferae, Portulacaceae, Chenopodiaceae, Compositae, Aizoaceaea, Cruciferae, Scrophulariaceae, Leguminosae and Polygonaceae were between 1-5 %, the total of these families were 30.366 %. The other 12 families recorded 16.742 %. Meanwhile, the very common species were *N. inodorum*, *Oxalis corniculata*, *Cyperus rotundus* and *O. latifolia*. While, 12 species were appeared as common weeds, 26 as rare and 23 as very rare species.

**1.1.2- General density (G.D.):** *C. rotundus*, *N. inodorum* and *Oxalis* spp. were recorded as common weeds and 25 species as rare weeds and 41 species as very rare weeds. The density mean of all species was 19.682 plant/m<sup>2</sup>.

**1.1.3- General frequency (G.F.):** Species were registered as very common weeds. *N. inodorum*, *Poa annua* and *Stellaria media*, the other species distributed as common, rare and very rare weeds (8, 25 and 33 species); respectively.

**1.1.4- Infested fields (I.F.):** Results obtained indicated that the highest percentages of infestation were by *Poa annua*, *C. rotundus*, *Capsella bursa-pastoris*, *Sonchus oleraceus*, *N. inodorum* and *O. corniculata*. The other very common weeds (27 species) were less than 50 %. Meanwhile, the remainder species appeared as common, rare and very rare weeds (11, 29 and 35 species), respectively.

**1.1.5- Cumulative number (C.U.):** High cumulative number recorded by *N. inodorum*, *O. corniculata* and *O. latifolia*.

**1.1.6- Abundance (A.B.):** Six dominant species found in the strawberry fields at Qalubia, they were *C. rotundus*, *N. inodorum*, *O. corniculata*, *O. latifolia*, *P. annua* and *S. media*. On the other hand, the remainder species were divided into 21 very common, 18 common and 20 rare species.

**1.2- Sharkia governorate:**

The number of families recorded at Sharkia governorate were 24 included 45 genera and 57 species.

**1.2.1- Relative density:** The highest percentages of (RD) were for families: Graminae (22.190%), Cyperaceae (19.792%), Portulacaceae (15.583%), Amaranthaceae (7.193%) and Caryophyllaceae (5.968%). The total percentage of these families were 70.726 %. The other families which represented more than 1 % were Cruciferae, Aizoaceae, Compositae, Chenopodiaceae, Primulaceae, Scrophulariaceae and Leguminosae. The total percentage of these families were 19.584%. The total percentage of the remainder families were 9.69 %. The very common species were *Amaranthus viridis*, *C. rotundus*, *Chenopodium murale*, *P. oleracea*, *P. annua* and *S. media*.



Table (2): Estimated weed flora in normal cultivated method of strawberry field at Qalubia, Sharkia and Ismailia Governorates by relative density (%), general density (plants/m<sup>2</sup>), general frequency (%), infested field (%), cumulative number and abundance.

Species	Qalubia						Sharkia						Ismailia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Amaranthus blitoides</i>	-	-	-	-	-	-	-	-	-	-	-	-	7	1	23	332	5	R
<i>Amaranthus graecizance</i>	-	-	-	-	-	-	-	-	-	-	-	-	52	7	69	581	5	R
<i>Amaranthus hybridus</i>	465	91	183	986	7	C	-	-	-	-	-	-	3379	456	93	2209	10	V
<i>Amaranthus lividus</i>	-	-	-	-	-	-	-	-	-	-	-	-	1155	116	279	1744	10	V
<i>Amaranthus palmeri</i>	-	-	-	-	-	-	-	-	-	-	-	-	7	1	23	232	5	R
<i>Amaranthus vindus</i>	1209	238	499	2465	11	V	7193	1109	4400	8889	15	D	5206	702	1163	4070	13	D
<i>Ammi majus</i>	2862	563	1056	3169	12	V	58	9	89	889	5	R	215	29	23	230	6	R
<i>Anagallis arvensis</i>	1216	239	1697	6760	12	V	2926	451	1133	4444	12	V	7284	982	1232	5698	13	D
<i>Apium leptophyllum</i>	1767	348	598	2334	11	V	-	-	-	-	-	-	-	-	-	-	-	-
<i>Artemisia vulgaris</i>	7	3	14	141	5	R	-	-	-	-	-	-	103	13	69	465	6	R
<i>Avena fatua</i>	676	133	606	3521	10	V	404	62	356	3111	9	C	250	34	163	1395	8	C
<i>Avena sativa</i>	504	99	380	1760	8	C	72	11	111	1111	7	C	121	16	35	230	6	R
<i>Avena sterilis</i>	28	5	35	352	5	R	231	35	178	1333	8	C	103	13	23	230	6	R
<i>Bassia indica</i>	-	-	-	-	-	-	-	-	-	-	-	-	336	45	81	465	6	R
<i>Beta vulgaris</i>	497	97	35	1408	7	C	259	40	289	2000	9	C	69	9	23	230	5	R
<i>Bidens pilosa</i>	440	86	204	1388	8	C	-	-	-	-	-	-	284	38	81	694	6	R
<i>Brachiaria reptans</i>	-	-	-	-	-	-	43	7	67	667	5	R	-	-	-	-	-	-
<i>Brassica nigra</i>	422	83	155	1197	8	C	58	9	67	667	5	R	112	15	35	349	5	R
<i>Bromus catharticus</i>	1528	201	1204	6620	12	V	-	-	-	-	-	-	741	100	221	930	7	R
<i>Capsella bursa-pastoris</i>	1052	301	641	2183	11	V	4209	649	1111	4000	12	V	880	118	418	2558	10	V
<i>Casuarina sp.</i>	46	9	70	282	5	R	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cenchrus echinatus</i>	-	-	-	-	-	-	418	64	244	178	7	C	827	111	163	1064	9	C
<i>Chenopodium album</i>	2100	413	887	3591	11	V	2710	418	1444	5111	12	V	983	132	674	4302	10	V

Table (2). Contd.

Species	Qalubia						Sharkia						Ismailia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Chenopodium ficifolium</i>	-	-	-	-	-	-	-	-	-	-	-	-	3362	453	442	2558	11	V
<i>Chenopodium murale</i>	1810	356	1021	5000	12	V	6169	951	1444	4889	13	D	1379	186	477	3372	11	V
<i>Cichorium endivia</i>	25	5	35	352	5	R	173	27	89	889	6	R	69	9	35	232	5	R
<i>Commelina benghalensis</i>	139	27	120	282	7	C	404	62	133	444	7	C	336	45	93	349	6	R
<i>Convolvulus arvensis</i>	1571	309	824	3028	11	V	173	27	111	889	7	C	86	11	70	349	5	R
<i>Conyza bonariensis</i>	264	52	127	634	7	C	86	13	133	1333	7	C	1155	156	349	2442	11	V
<i>Coronopus didymus</i>	111	22	70	211	6	V	58	8	89	889	5	R	4543	612	698	2791	11	V
<i>Coronopus quamatus</i>	376	74	204	1268	8	C	245	38	222	2000	9	C	17	2	23	232	5	R
<i>Cyperus rotundus</i>	8172	1608	2289	7817	14	D	19792	3055	4578	10000	15	D	33189	4477	4860	9302	15	D
<i>Digitaria ciliaris</i>	655	129	183	775	8	C	807	124	400	2222	10	V	1140	153	302	698	9	C
<i>Digitaria sanguinalis</i>	500	98	471	986	7	C	1485	229	209	6000	11	V	940	127	1930	4767	11	V
<i>Echinochloa colona</i>	1005	198	260	775	9	C	3589	553	1200	5555	11	V	2155	291	732	3023	11	V
<i>Echinochloa crusgallis</i>	-	-	-	-	-	-	58	9	89	444	5	R	-	-	-	-	-	-
<i>Emex spinosus</i>	-	-	-	-	-	-	14	2	22	222	5	R	-	-	-	-	-	-
<i>Fragrostis pilosa</i>	-	-	-	-	-	-	-	-	-	-	-	-	1009	136	174	814	9	C
<i>Euphorbia peplus</i>	440	87	183	1268	8	C	490	75	155	1555	8	C	1259	170	267	1967	10	V
<i>Euphorbia prostrata</i>	21	4	21	211	5	R	-	-	-	-	-	-	-	-	-	-	-	-
<i>Fumaria spp.</i>	14	3	21	211	5	R	-	-	-	-	-	-	26	3	35	349	5	R
<i>Galonsoga parviflora</i>	393	77	197	915	7	C	-	-	-	-	-	-	-	-	-	-	-	-
<i>Juncus bufonis</i>	-	-	-	-	-	-	-	-	-	-	-	-	310	42	46	1165	7	C
<i>Lamium amplexicaule</i>	908	179	739	3944	10	V	778	120	511	3778	10	V	1103	148	221	1395	10	V
<i>Lolium multiflorum</i>	1485	292	514	2817	11	V	418	64	178	1333	9	C	655	88	360	2209	9	C
<i>Lolium temulentum</i>	21	4	21	211	4	R	14	2	22	222	5	R	-	-	-	-	-	-
<i>Malva parviflora</i>	25	5	35	352	5	R	43	6	66	667	5	R	146	20	93	930	6	R

Table (2). Contd.

Species	Qalubia						Sharkia						Ismailia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Medicago intertexta</i>	179	35	225	1760	8	C	187	29	11	667	6	R	301	41	186	930	7	C
<i>M. polymorpha</i>	3	*	7	70	4	R	216	33	244	2222	9	C	345	46	325	2209	9	C
<i>Melilotus indicus</i>	383	75	268	2113	9	C	231	35	244	2222	9	C	1948	263	663	4419	11	V
<i>M. serratifolius</i>	57	11	98	845	5	R	58	9	67	667	5	R	103	14	128	1279	8	C
<i>Misopates orontium</i>	-	-	-	-	-	-	331	51	200	889	7	C	-	-	-	-	-	-
<i>Nothoscordon inodorum</i>	10261	1883	3956	5704	15	D	-	-	-	-	-	-	-	-	-	-	-	-
<i>Orobanche aegyptiaca</i>	-	-	-	-	-	-	58	9	67	667	5	R	-	-	-	-	-	-
<i>Oxalis comiculata</i>	10113	1048	1204	5350	14	D	404	62	355	1333	8	C	8732	1178	1314	4767	14	D
<i>Oxalis latifolia</i>	7026	1383	1633	3451	14	D	-	-	-	-	-	-	-	-	-	-	-	-
<i>Panicum repens</i>	-	-	-	-	-	-	-	-	-	-	-	-	17	2	23	232	5	R
<i>Parapholis incurva</i>	-	-	-	-	-	-	-	-	-	-	-	-	174	23	81	814	6	R
<i>Phalaris minor</i>	1503	296	613	2958	11	V	360	55	244	1778	9	C	112	15	46	465	6	R
<i>Phalaris paradoxa</i>	1277	251	655	2394	11	V	259	40	178	1555	8	C	1008	136	325	1860	10	V
<i>Phragmites australis</i>	-	-	-	-	-	-	216	33	111	1111	8	C	-	-	-	-	-	-
<i>Plantago major</i>	339	67	190	1056	8	C	14	2	22	222	5	R	-	-	-	-	-	-
<i>Pluchea dioscoridis</i>	25	5	49	493	5	R	-	-	-	-	-	-	431	58	58	465	6	R
<i>Poa annua</i>	4816	948	3563	8451	13	D	9817	1513	1867	7111	12	V	9138	1232	2035	6744	15	D
<i>Polypogon monspeliensis</i>	2304	454	387	1549	10	V	3964	611	1533	6222	12	V	353	452	535	2791	10	V
<i>Portulaca oleracea</i>	4150	817	1437	4085	12	V	15583	2402	4933	9778	15	D	9611	1296	2384	6395	15	D
<i>Pseudognaphalium luteoalbum</i>	-	-	-	-	-	-	-	-	-	-	-	-	89	9	23	232	5	R
<i>Raphanus raphanistrum</i>	93	18	42	422	5	R	-	-	-	-	-	-	215	29	139	698	7	C
<i>Rorippa palustris</i>	7	1	14	141	5	R	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rostraria cristata</i>	-	-	-	-	-	-	29	4	44	444	5	R	-	-	-	-	-	-
<i>Rumex crispus</i>	114	22	113	775	6	R	-	-	-	-	-	-	60	8	81	581	5	R
<i>Rumex dentatus</i>	1402	276	838	5000	11	V	42	64	355	2444	8	C	224	30	174	1744	8	C
<i>Senecio glaucus</i>	7	1	14	141	5	R	-	-	-	-	-	-	52	7	70	349	5	R

Table (2). Contd.

Species	Qalubia						Sharkia						Ismailia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Setaria viridis</i>	18	3	21	211	5	R	-	-	-	-	-	-	1000	135	163	1163	10	V
<i>Silene rubella</i>	14	3	28	282	5	R	-	-	-	-	-	-	121	16	81	581	6	R
<i>Sinapis allionii</i>	21	4	42	422	5	R	29	4	44	444	5	R	-	-	-	-	-	-
<i>Sinapis arvensis</i>	3	*	7	70	4	R	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sisymbrium irio</i>	193	38	197	1268	8	C	-	-	-	-	-	-	371	50	174	1395	8	C
<i>Solanum nigrum</i>	35	7	28	282	5	R	42	7	67	667	5	R	853	115	949	2209	10	V
<i>Sonchus asper</i>	7	1	14	141	5	R	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sonchus oleraceus</i>	1234	243	1782	6408	12	V	2912	449	1289	4667	12	V	1431	193	767	4535	11	V
<i>Spergularia spp.</i>	-	-	-	-	-	-	-	-	-	-	-	-	207	28	128	930	7	C
<i>Stellaria media</i>	4698	925	2169	4084	13	D	5968	919	3022	5778	14	D	4423	596	1884	5697	12	V
<i>Symphytonichum squamatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	86	11	81	689	5	R
<i>Trianthema portulacastrum</i>	2400	472	465	1338	10	V	3748	578	289	2000	11	V	121	16	35	349	6	R
<i>Trifolium resupinatum</i>	1055	208	429	2887	11	V	274	38	155	1333	8	C	1974	266	814	4767	11	V
<i>Urochloa panicoides</i>	-	-	-	-	-	-	245	38	200	1778	8	C	-	-	-	-	-	-
<i>Urtica urens</i>	85	17	84	775	5	R	42	6	67	667	5	R	1146	155	267	1860	10	V
<i>Veronica anagallis-aquatica</i>	479	94	422	2183	9	C	807	124	778	4444	10	V	1888	255	721	4186	11	V
<i>Veronica polita</i>	1656	326	641	2676	11	V	58	9	44	444	5	R	836	113	395	2209	10	V
<i>Vicia monantha</i>	57	11	56	422	5	R	58	9	89	889	5	R	-	-	-	-	-	-
<i>Vicia sativa</i>	3	*	7	70	4	R	-	-	-	-	-	-	17	2	7	70	4	R

RD = Relative density ( $\times 10^{-3}$ ), GD = general density ( $\times 10^{-3}$ ), GF = general frequency ( $\times 10^{-2}$ ), IF = infested field ( $\times 10^{-2}$ ), CU = cumulative value, AB = abundance, D = dominate, V = very common, C = common, and R = rare.

\* Less than  $\times 10^{-3}$ .

**1.2.2- General density:** Species of *A. viridis*, *C. rotundus*, *P. annua* and *P. oleracea* appeared as common weeds. Also, 13 and 30 species were recorded as rare and very rare weeds, respectively. The density mean of fall species was 13.492 plants/m<sup>2</sup>.

**1.2.3- General frequency:** The highest very common species found were *A. viridis*, *C. cornutus*, *P. oleracea* and *S. media*. However, the other species divided to 8 common, 26 rare and 19 as very rare weeds.

**1.2.4- Infested fields:** The species which were infested more than 60% of the total studied fields were : *C. rotundus*, *P. oleracea*, *A. viridis*, *P. annua* and *Digitaria sanguinalis*. In addition, 13 species were infested less than 60 %. The common and rare weeds were 11 and 23 species, respectively.

**1.2.5- Cumulative number:** The following species *A. viridis*, *C. rotundus*, *P. oleracea* and *S. media* gave the highest (CU) than the other species.

**1.2.6- Abundance:** The dominant species were *A. viridis*, *C. rotundus*, *P. oleracea*, *S. media* and *C. murale*. The very common and rare weeds were 15, 21 and 18 species, respectively.

### **1.3- Ismailia governorate:0**

The number of weed species were 72 species belonging to 56 genera and 24 families.

**1.3.1- Relative density:** The highest total percentage of families were Cyperaceae (33.189%), Graminae (19.743%), Portulacaceae (9.611%), Amaranthaceae (9.106%), Oxalidaceae (8.732%), Primulaceae (7.287%), Cruciferae (6.138%) and Chenopodiaceae (6.129%). The other families which obtained more than 1.0 % were Caryophyllaceae, Leguminosae and Compositae. The very common weeds were *C. rotundus*, *P. oleracea*, *P. annua*, *O. corniculata*, *A. arvensis* and *A. viridis*; Other species classified to 17 common, 32 rare and 14 very rare weeds.

**1.3.2- General density:** Four species appeared as common weed, they were *C. rotundus*, *O. corniculata*, *P. annua* and *P. oleracea*. Also, 29 and 38 species were found as rare and very rare weeds. The density mean of all species was 13.492 plants/m<sup>2</sup>.

**1.3.3- General frequency:** Results obtained indicated that, the very common species were *C. rotundus*, *P. annua* and *P. oleracea*. The remainder species were classified to 5 common, 33 rare and 30 very rare weeds.

**1.3.4- Infested fields:** Data clearly showed that, the very common species which infested more than 50 % of the fields were *C. rotundus*, *P. annua*, *P. oleracea*, *A. arvensis* and *S. media*. The other very common weeds less than 50 % were 20 species. The common, rare and very rare weeds were 12, 33 and 1; respectively.

**1.3.5- Cumulative number :** The highest (CU) registered by *P. annua*, *P. oleracea* and *C. rotundus*.

**1.3.6- Abundance:** The following species appeared as dominant weeds; *A. viridis*, *A. arvensis*, *C. rotundus*, *O. corniculata*, *P. annua* and *P. oleracea*. The other species which found as very common, common and rare weeds were 33, 13 and 29; respectively.

The previous results could be summarized as follows : The important species found at Qalubia governorate only were; *O. latifolia*, *Galinsoga*

*parviflora* and *N. inodorum*. While, *Orobanche aegyptiaca* and *Misopates orontium* found only at Sharkia governorate. Meanwhile, all species of genus *Amaranthus* appeared at Ismailia governorate. In addition, *C. rotundus* (only species) found as very common or dominant weed in the three governorates. On the other hand, most important weeds in all studied fields were *A. viridis*, *A. arvensis*, *Chenopodium album*, *C. murale*, *Lammium amplexicaule*, *O. corniculata*, *P. annua*, *P. oleracea*, *S. oleraceus* and *S. media*.

## **2- Protected cultivation:**

Table (3) includes the weed flora records in strawberry fields at West Delta area and Qalubia governorate.

### **2.1- West Delta:**

Total species at West Delta were 65 belonged to 52 genera and 22 families.

**2.1.1- Relative density :** Data obtained indicate of that the highest total percentage were for the following important families; Leguminosae (36.246%), Compositae (30.801%), Graminae (17.979%), Portulacaceae (4.207%) and Chenopodiaceae (1.175%). Also, the very common species were *Conyza bonariensis*, *Melilotus indicus*, *Eragrostis pilosa* and *Trifolium resupinatum*. Other species classified to 11 common, 31 rare and 19 very rare weeds.

**2.1.2- General density:** The only two species appeared as common weeds were *C. bonariensis* and *T. resupinatum*. Other species were 11 rare and 52 very rare weeds. The total mean of plant density were 7.449 plant/m<sup>2</sup>.

**2.1.3- General frequency:** The following species recorded as dominant weeds; *C. bonariensis*, *M. indicus*, *T. resupinatum* and *E. pilosa*. The common and rare weeds were 26 and 35; respectively.

**2.1.4- Infested fields:** Fourteen species were appeared as very common weeds. The high percentage recorded by *C. bonariensis*, *T. resupinatum* and *M. indicus*. Other species appeared as common and rare weeds.

**2.1.5- Cumulative number:** Three species registered highest cumulative number. These species were : *C. bonariensis*, *T. resupinatum* and *M. indicus*.

**2.1.6- Abundance:** Dominant species were *C. bonariensis*, *M. indicus*, *T. resupinatum* and *E. pilosa*. In addition, the remainder species were found as 10 very common, 17 common and 34 rare weeds.

### **2.2- Qalubia governorate:**

Weed species in the protected cultivation of strawberry field at Qalubia governorate were 55 species belongs to 37 genera and 21 families.

**2.2.1- Relative density:** The highest percentages showed by the following families; Leguminosae (26.836%), Portulacaceae (24.080%), Compositae (17.440%) Graminae (6.780%), Chenopodiaceae (3.260%) and Cyperaceae (2.120%). The total percentages of the families were 80.516 %. The very common species were *C. bonariensis*, *M. indicus*, *P. oleracea* and *T. resupinatum*. Other species were 12 common, 27 rare and 12 very rare.

**2.2.2- General density:** The following species registered as common weeds *M. indicus*, *P. oleracea* and *T. resupinatum*. The remainder were 13 species found as rare weeds and 39 species as very rare weeds. The density mean of all species was 9.804 plant/m<sup>2</sup>.

**Table (3): Estimated weed flora in protective cultivation method of strawberry in west Delta and Qalubia Governorate by relative density (%), general density (plants/m<sup>2</sup>), general frequency (%), infested field (%), cumulative number and abundance.**

Species	West Delta						Qalubia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Amaranthus blitoides</i>	24	1	8	89	4	R	-	-	-	-	-	-
<i>Amaranthus graecizance</i>	48	3	36	357	5	R	-	-	-	-	-	-
<i>Amaranthus hybridus</i>	48	3	36	357	5	R	140	14	58	588	6	R
<i>Amaranthus lividus</i>	-	-	-	-	-	-	260	25	98	392	6	R
<i>Amaranthus palmeri</i>	168	12	36	268	6	R	-	-	-	-	-	-
<i>Amaranthus viridus</i>	431	32	250	2232	9	C	60	6	39	392	5	R
<i>Ammi majus</i>	455	34	98	625	6	R	20	2	19	96	4	R
<i>Anagallis arvensis</i>	347	10	124	1250	8	C	920	90	176	1764	8	C
<i>Aputilon theophrasti</i>	36	12	26	268	5	R	-	-	-	-	-	-
<i>Artemisia monosperma</i>	96	3	26	178	5	R	-	-	-	-	-	-
<i>Avena fatua</i>	252	18	107	625	7	C	340	33	176	80	6	R
<i>Beta vulgaris</i>	120	9	53	536	6	R	-	-	-	-	-	-
<i>Bidens pilosa</i>	156	12	116	1071	8	C	2400	235	686	2745	11	V
<i>Boerhavia diffusa</i>	347	26	152	982	7	C	-	-	-	-	-	-
<i>Brachiaria reptans</i>	-	-	-	-	-	-	40	4	19	196	5	R
<i>Brassica tournefortii</i>	383	24	152	1161	8	C	-	-	-	-	-	-
<i>Calendula arvensis</i>	24	2	18	178	5	R	-	-	-	-	-	-
<i>Capsella bursa-pastoris</i>	-	-	-	-	-	-	1340	131	117	784	9	C
<i>Cenchrus echinatus</i>	336	11	107	714	7	C	120	12	59	392	6	R
<i>Chenopodium album</i>	132	10	89	803	6	R	640	62	255	1568	8	C
<i>Chenopodium murale</i>	923	69	161	893	7	C	2620	257	490	3137	11	V
<i>Convolvulus arvensis</i>	-	-	-	-	-	-	2400	237	294	2745	11	V
<i>Conyza bonariensis</i>	26585	1980	6375	9821	15	D	9760	957	3610	7451	14	D
<i>Calendula arvensis</i>	-	-	-	-	-	-	15	1	12	122	5	R
<i>Corchorus olitorius</i>	-	-	-	-	-	-	1000	98	255	1372	8	C
<i>Coronopus didymus</i>	-	-	-	-	-	-	220	22	157	980	7	C

Table (3). Cont.

Species	West Delta						Qalubia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Coronopus squamatus</i>	-	-	-	-	-	-	560	55	294	1567	8	C
<i>Cynachum acutum</i>	336	25	45	357	6	R	80	8	39	392	5	R
<i>Cyperus rotundus</i>	24	2	18	178	5	R	2120	208	1490	3333	12	V
<i>Dactyloctenium aegyptium</i>	371	28	80	803	6	R	160	16	39	392	6	R
<i>Digitaria ciliaris</i>	1246	93	393	1874	8	C	480	47	78	784	6	R
<i>Digitaria sanguinalis</i>	3560	265	893	4018	12	V	680	67	176	1176	8	C
<i>Echinochloa colona</i>	48	4	37	357	5	R	160	16	39	392	6	R
<i>Eleusine indica</i>	-	-	-	-	-	-	40	39	137	980	6	R
<i>Emex spinosus</i>	3883	298	803	3125	11	V	-	-	-	-	-	-
<i>Fragrostis ciliarisE</i>	144	11	71	446	6	R	-	-	-	-	-	-
<i>Eragrostis pilosa</i>	8402	625	1000	3035	13	D	760	74	78	784	6	R
<i>Euphorbia heterophylla</i>	24	2	18	178	5	R	-	-	-	-	-	-
<i>Euphorbia peplus</i>	216	16	37	268	6	R	420	41	58	392	6	R
<i>Euphorbia prostrata</i>	635	47	71	446	6	R	-	-	-	-	-	-
<i>Galonsoga parviflora</i>	-	-	-	-	-	-	680	67	235	784	7	C
<i>Juncus acutus</i>	-	-	-	-	-	-	40	4	39	392	5	R
<i>Lactuca serriola</i>	24	1	18	178	5	R	-	-	-	-	-	-
<i>Launaea nudicaulis</i>	72	5	37	267	5	R	-	-	-	-	-	-
<i>Lolium temulentum</i>	36	-	26	267	5	R	-	-	-	-	-	-
<i>Maiva parviflora</i>	120	1	89	893	10	V	40	4	19	192	5	R
<i>Medicago intertexta</i>	707	527	375	2589	10	V	460	45	157	784	7	C
<i>M. polymorpha</i>	1606	120	259	1696	10	V	600	59	254	1176	8	C
<i>Melilotus indicus</i>	11195	834	2223	4643	14	D	10420	1022	108	4784	13	D
<i>M. serratifolius</i>	3464	268	150	5893	11	V	396	388	549	2353	10	V
<i>Oxalis corniculata</i>	-	-	-	-	-	-	4040	396	431	1961	10	V
<i>Phalaris minor</i>	156	10	71	714	6	R	-	-	-	-	-	-
<i>Phalaris paradoxa</i>	216	16	62	357	6	R	-	-	-	-	-	-



Table (3). Cont.

Species	West Delta						Qalubia					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Plantago lagopus</i>	24	2	18	178	5	R	-	-	-	-	-	-
<i>Pluchea dioscoridis</i>	1618	121	705	4196	11	V	1600	157	882	4313	11	V
<i>Poa annua</i>	1702	127	205	1071	10	V	960	94	176	1372	8	C
<i>Polypogon monspeliensis</i>	1246	93	446	1517	9	C	1260	123	313	1764	10	V
<i>Portulaca oleracea</i>	4207	313	607	3432	11	V	24080	2361	1863	5098	13	D
<i>Pseudognaphalium luteoalbum</i>	36	3	26	268	5	R	180	17	235	784	7	C
<i>Reichardia tingitana</i>	407	30	169	1071	8	C	-	-	-	-	-	-
<i>Rostraria cristata</i>	264	20	98	803	6	R	1720	169	353	1372	10	V
<i>Rumex dentatus</i>	-	-	-	-	-	-	20	2	19	192	5	R
<i>Senecio glaucus</i>	359	26	178	1428	8	C	80	8	58	588	5	R
<i>Setaria viridis</i>	-	-	-	-	-	-	60	6	39	392	5	R
<i>Sida alba</i>	-	-	-	-	-	-	40	4	39	392	5	R
<i>Sisymbrium irio</i>	36	3	26	268	5	R	120	12	58	588	6	R
<i>Solanum nigrum</i>	396	29	205	982	7	C	220	22	137	980	7	C
<i>Sonchus asper</i>	24	2	18	178	5	R	220	22	98	784	6	R
<i>Sonchus oleraceus</i>	911	60	491	3661	9	C	2000	200	823	4706	11	V
<i>Spergularia spp.</i>	-	-	-	-	-	-	120	12	59	392	6	R
<i>Stellaria media</i>	264	20	89	893	6	R	20	2	19	196	5	R
<i>Symphoricarum squamatus</i>	156	12	62	536	6	R	460	45	255	1960	8	C
<i>Tamarix sp.</i>	575	43	348	2232	9	C	-	-	-	-	-	-
<i>Trianthema portulacastrum</i>	1007	75	348	1249	8	C	700	7	274	1372	8	C
<i>Trifolium resupinatum</i>	17380	1295	3116	5893	15	D	14960	1496	3275	8238	15	D
<i>Trigonella laciniata</i>	48	3	18	178	5	R	-	-	-	-	-	-
<i>Urospermum picroides</i>	36	3	27	268	5	R	-	-	-	-	-	-
<i>Urtica urens</i>	96	7	18	178	5	R	-	-	-	-	-	-
<i>Veronica polita</i>	120	9	27	268	6	R	-	-	-	-	-	-
<i>Vicia monantha</i>	288	21	116	714	7	C	160	16	39	392	6	R
<i>Vicia sativa</i>	1510	112	402	2053	11	V	2640	264	470	2353	11	V

RD = Relative density ( $\times 10^{-3}$ ), GD = general density ( $\times 10^{-3}$ ), GF = general frequency ( $\times 10^{-2}$ ), IF = infested field ( $\times 10^{-2}$ ), CU = cumulative value, AB = abundance, D = dominate, V = very common, C = common, and R = rare.

**2.2.3- General frequency:** The only species appeared as very common weeds was *T. resupinatum*, while *P. oleracea* and *C. rotundus* recorded as common weeds. The remainder 29 and 23 species registered as rare and very rare weeds; respectively.

**2.2.4- Infested fields:** The following species had highest percentages of infested fields; *T. resupinatum*, *P. oleracea*, *C. bonariensis*, *S. oleraceus* and *M. indicus*. The other very common distribution species less than 40 %. Meanwhile, infested fields by common, rare and very rare weeds were 12, 29 and 2 species, respectively.

**2.2.5- Cumulative number:** *C. bonariensis*, *P. oleracea* and *M. indicus* were registered highest (CU).

**2.2.6- Abundance:** The dominant weeds were *C. bonariensis* and *T. resupinatum*. Meanwhile, 11 species were found as very common weeds, 15 as common weeds and 25 as rare weeds.

The previous results indicated that, the dominant species in West Delta farms were *C. bonariensis*, *M. indicus*, *T. resupinatum* and *E. pilosa*. These species except *E. pilosa* were found at Qalubia; also, in addition to *P. oleracea*.

### **3- Comparison between normal and protected cultivation :**

Table (4) shows the all species recorded in strawberry fields with their different parameters.

#### **3.1- Normal cultivation :**

104 species recorded in the normal cultivated fields. These species belong to 70 genera and 29 families, these families which included high number of species were : Graminae (22), Compositae (12), Cruciferae (9), Leguminosae (8), Amaranthaceae (6), Chenopodiaceae (5), Scrophulariaceae (3), Euphorbiaceae and Oxalidaceae (2). Also, 20 families each included one species only.

**3.1.1- Relative density :** The families which showed high percentage were Cyperaceae (16.139%), Graminae (11.928%), Oxalidaceae (9.663%), Portulacaceae (7.217%), Alliaceae (5.753%) and Chenopodiaceae (5.541%). The following families registered percentage between 1-5 %; Caryophyllaceae, Amaranthaceae, Cruciferae, Primulaceae, Compositae, Leguminosae, Scrophulariaceae, Umbelliferae, Aizoaceae and Polygonaceae. Meanwhile, the dominant weeds that have high percentages were *C. rotundus* (16.139%), *P. oleracea* (7.217%), *P. annua* (6.638%), *N. inodorum* (5.753%) and *O. corniculata* (5.440%). Number of species appeared as common, rare and very rare weeds were 19, 32 and 36 species; respectively.

**3.1.2- General density:** The common species were *C. rotundus*, *P. oleracea* and *P. annua*. Also, species recorded as rare and very rare weeds were 32 and 57. The general density mean of all species was 17.029 plants/m<sup>2</sup>.

**3.1.3- General frequency:** The sequence of very common weeds were *P. annua*, *P. oleracea*, *S. media* and *N. inodorum*. Other species recorded as common (7), rare (31) and very rare (40).

**3.1.4- Infested fields:** Species that infested more than 50 % from all fields studied were; *S. media*, *C. rotundus*, *A. arvensis* and *S. oleraceus*; while, 16

species recorded as dominant weeds were less than 50 %. Other species distributed as common (18), rare (41) and very rare (9).

**3.1.5- Cumulative number:** High CU obtained by *P. annua*, *P. oleracea* and *N. inodorum*.

**3.1.6- Abundance:** The high abundance species recorded by *P. annua*, *P. oleracea*, *N. inodorum*, *C. rotundus*, *O. corniculata* and *S. media*. Other species distributed as very common (24), common (25) and rare weeds (41).

**3.2- Protected cultivation :**

Total weeds were 88 species. They belong to 64 genera and 26 families. The greater number of species classified under the following families : Graminae (17), Compositae (14), Leguminosae (8), Amaranthaceae (6), Cruciferae (5), Chenopodiaceae, Malvaceae and Euphorbiaceae (3), Polygonaceae and Caryophyllaceae (2). On the other hand, 16 families each included one species.

**3.2.1- Relative density :** Families of higher percentages were : Cyperaceae (16.139%), Graminae (11.928%), Oxalidaceae (9.663%), Portulacaceae (7.217%), Alliaceae (5.753%) and Chenopodiaceae (5.541%). Ten families gave percentage ranged from 1-5 %. They were Caryophyllaceae, Amaranthaceae, Cruciferae, Primulaceae, Compositae, Leguminosae, Scrophulariaceae, Umbelliferae, Aizoaceae and Polygonaceae. Meanwhile, a very common weeds which had the highest percentages were *C. rotundus* (16.139%), *P. oleracea* (7.217%), *P. annua* (6.638%), *N. inodorum* (5.751%) and *O. corniculata*. Another species classified as common (19), rare (32) and very rare weeds (36).

**3.2.2- General density :** The species; *C. rotundus*, *P. oleracea* and *P. annua* appeared as common weed. Also, 32 and 57 species were recorded as rare and very rare weeds; respectively. The general mean of all species was 17.029 plants/m<sup>2</sup>.

**3.2.3- General frequency :** The sequence of very common weeds were *P. annua*, *P. oleracea*, *S. media* and *N. inodorum*. Other species recorded as 7 common, 31 rare and 40 species very rare weeds.

**3.2.4- Infested fields :** Species which distributed in more than 50 % of the studied fields were : *S. media*, *C. rotundus*, *P. annua*, *A. arvensis* and *S. oleraceus*; while, 16 species recorded as common weeds infested less than 50 % of all fields. Other species distributed as common (18), rare (14) and very rare (9).

**3.2.5- Cumulative number :** The species; *P. annua*, *P. oleracea*, *O. corniculata* and *S. media* gave high number of CU followed by *N. inodorum*.

**3.2.6- Abundance :** The species; *P. annua*, *P. oleraceae*, *N. inodorum*, *C. rotundus*, *O. corniculata* and *S. media* appeared high abundance. Number of species of very common, common and rare weeds were 24, 21 and 41 species; respectively.

This study showed the new species records, new phytogeographical of some old Egyptian flora, new weeds infested the cultivated lands in Egypt, and the effect of the agricultural practices on the weeds.

The new recorded species added to the Egyptian flora were *Artemisia vulgaris*, *Galinsoga parviflora*, *Oxalis latifolia* and *Urochloa panicoides*. These results depended on what Tackholm (1974), Cope and Hosni (1991), El-Hadidi and Fayed (1994-95), and El-Khanagry (1993 & 2005) had reached in this concern.

Table (4): Estimated weed flora in strawberry under different cultivated method by relative density (%), general density (plants/m<sup>2</sup>), general frequency (%), infested field (%), cumulative number and abundance.

Weed species	Normal cultivation						Protected cultivation					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Amaranthus blitoides</i>	2	3	7	73	4	R	15	1	6	61	4	R
<i>Amaranthus graecizance</i>	13	2	22	183	5	R	30	2	24	245	5	R
<i>Amaranthus hybridus</i>	1122	191	124	1208	10	V	82	6	42	429	5	R
<i>Amaranthus lividus</i>	288	49	88	549	8	C	97	8	31	122	5	R
<i>Amaranthus palmeri</i>	2	3	7	73	4	R	105	8	22	184	6	R
<i>Amaranthus viridis</i>	3098	528	1348	403	10	V	292	23	184	1656	8	C
<i>Ammi majus</i>	1783	303	571	1868	10	V	292	23	74	491	6	R
<i>Anagallis arvensis</i>	2985	508	1458	6044	12	V	562	45	141	1411	8	C
<i>Apium leptophyllum</i>	1062	181	311	1208	10	V	-	-	-	-	-	-
<i>Aputilon theophrasti</i>	-	-	-	-	-	-	22	2	18	184	5	R
<i>Artemisia monosperma</i>	-	-	-	-	-	-	60	5	18	122	5	R
<i>Artemisia vulgaris</i>	30	5	29	219	5	R	-	-	-	-	-	-
<i>Avena fatua</i>	529	90	425	2784	9	C	285	23	129	736	7	C
<i>Avena sativa</i>	344	58	227	1172	8	C	-	-	-	-	-	-
<i>Avena sterilis</i>	77	13	55	476	5	R	-	-	-	-	-	-
<i>Bassia indica</i>	84	14	25	146	5	R	-	-	-	-	-	-
<i>Beta vulgaris</i>	355	60	238	1135	8	C	75	6	37	368	5	R
<i>Bidens pilosa</i>	335	57	132	916	7	C	997	80	294	1595	8	C
<i>Boerhavia diffusa</i>	-	-	-	-	-	-	217	17	104	675	7	C
<i>Bracharia reptans</i>	6	1	11	109	5	R	15	1	6	61	4	R
<i>Brassica nigra</i>	290	49	102	742	7	-	-	-	-	-	-	-
<i>Brassica tournefortii</i>	-	-	-	-	-	-	202	16	104	797	7	C
<i>Bromus catharticus</i>	1103	188	403	1428	10	V	-	-	-	-	-	-
<i>Calendula arvensis</i>	-	-	-	-	-	-	15	1	12	122	5	R
<i>Capsella bursa-pastoris</i>	1479	252	758	4908	11	V	502	40	37	245	6	R
<i>Casuarina sp.</i>	27	4	37	146	5	R	-	-	-	-	-	-
<i>Cenchrus echinatus</i>	269	46	91	623	6	R	255	20	92	613	6	R
<i>Chenopodium album</i>	1911	326	912	4065	11	V	322	26	141	1043	8	C
<i>Chenopodium ficifolium</i>	838	143	139	806	6	R	-	-	-	-	-	-
<i>Chenopodium murale</i>	2353	401	919	4285	11	V	1559	125	264	1595	10	V

Table (4). Cont.

Weed species	Normal cultivation						Protected cultivation					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Cichorium endivia</i>	58	9	44	403	5	R	-	-	-	-	-	-
<i>Commelina benghalensis</i>	228	39	1135	329	8	C	-	-	-	-	-	-
<i>Convolvulus arvensis</i>	991	169	469	1831	9	C	907	73	92	859	6	R
<i>Coryza bonariensis</i>	460	78	198	1318	8	C	20250	1628	5509	9079	15	D
<i>Corchorus olitorius</i>	-	-	-	-	-	-	375	30	79	429	6	R
<i>Coronopus didymus</i>	1208	206	271	1135	10	V	82	6	49	306	5	R
<i>Coronopus squamatus</i>	245	42	150	1062	8	C	210	17	86	491	6	R
<i>Cynachum acutum</i>	-	-	-	-	-	-	240	19	42	368	6	R
<i>Cyperus rotundus</i>	16139	2749	864	8278	13	D	809	65	478	1166	8	C
<i>Dactyloctenium aegyptium</i>	-	-	-	-	-	-	292	23	67	675	6	R
<i>Digitaria ciliaris</i>	798	136	219	989	8	C	959	77	294	1533	8	C
<i>Digitaria sanguinalis</i>	757	129	1198	3004	11	V	2481	199	668	3129	11	V
<i>Echinochloa colona</i>	1677	286	564	2271	11	V	90	7	37	369	5	R
<i>Echinochloa crusgallis</i>	8	1	15	73	4	R	-	-	-	-	-	-
<i>Eleusine indica</i>	-	-	-	-	-	-	150	12	42	306	6	R
<i>Emex spinosus</i>	2	-	4	37	4	R	2428	195	552	2147	11	V
<i>Eragrostis ciliaris</i>	-	-	-	-	-	-	90	7	49	306	5	R
<i>Eragrostis pilosa</i>	252	43	55	256	6	R	5538	445	712	2331	12	V
<i>Euphorbia heterophylla</i>	-	-	-	-	-	-	15	1	12	122	5	R
<i>Euphorbia peplus</i>	652	111	205	1538	9	C	292	23	42	306	6	R
<i>Euphorbia prostrata</i>	13	2	11	109	5	R	397	32	49	306	6	R
<i>Fumaria spp.</i>	15	2	22	219	5	R	-	-	-	-	-	-
<i>Galonsoga parviflora</i>	236	40	102	476	7	C	255	20	74	245	6	R
<i>Juncus acutus</i>	-	-	-	-	-	-	15	1	12	122	5	R
<i>Juncus bufonis</i>	77	13	15	146	5	R	-	-	-	-	-	-
<i>Lactuca serriola</i>	-	-	-	-	-	-	15	1	12	122	5	R
<i>Lamium amplexicaule</i>	938	159	905	3113	10	V	-	-	-	-	-	-
<i>Launaea nudicaulis</i>	-	-	-	-	-	-	44	45	24	184	5	R
<i>Lolium multiflorum</i>	112	190	410	2381	10	V	-	-	-	-	-	-
<i>Lolium temulentum</i>	15	2	15	146	5	R	22	22	48	184	5	R
<i>Malva parviflora</i>	58	9	59	586	5	R	90	7	67	675	5	R
<i>Medicago intertexta</i>	211	36	190	1318	8	C	614	49	306	2024	9	C
<i>M. polymorpha</i>	120	20	146	1099	9	C	1230	99	258	1533	9	C

Table (4). Cont.

Weed species	Normal cultivation						Protected cultivation					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Melilotus indicus</i>	750	128	388	2857	10	V	10904	876	3024	5767	14	D
<i>M. serratifolius</i>	68	11	102	952	6	R	3650	293	1202	4785	10	V
<i>Misopates orontium</i>	49	8	33	146	5	R	-	-	-	-	-	-
<i>Nothoscordon inodorum</i>	5753	980	2055	2967	14	D	-	-	-	-	-	-
<i>Orobanche aegyptiaca</i>	8	1	11	109	5	R	-	-	-	-	-	-
<i>Oxalis corniculata</i>	5440	927	1099	4505	13	D	1514	122	134	613	9	C
<i>Oxalis latifolia</i>	4223	719	850	1795	10	V	-	-	-	-	-	-
<i>Panicum repens</i>	4	*	7	73	4	R	-	-	-	-	-	-
<i>Parapholis incurva</i>	43	7	26	265	5	R	-	-	-	-	-	-
<i>Phalaris minor</i>	985	168	374	1978	9	C	82	6	49	491	5	R
<i>Phalaris paradoxa</i>	1058	180	472	2088	11	V	135	11	42	245	6	R
<i>Phragmites australis</i>	32	5	18	183	5	R	-	-	-	-	-	-
<i>Plantago lagopus</i>	-	-	-	-	-	-	15	1	12	122	5	R
<i>Plantago major</i>	206	35	102	586	7	C	-	-	-	-	-	-
<i>Pluchea dioscondis</i>	122	21	44	403	6	R	1611	13	761	4233	10	V
<i>Poa annua</i>	6638	1131	2802	7692	15	D	1624	114	196	1166	10	V
<i>Polypogon monspeliensis</i>	2813	499	623	2711	11	V	1252	100	405	1595	10	V
<i>Portulaca oleracea</i>	7217	1229	2311	5751	15	D	11654	937	999	3988	12	V
<i>Pseudognaphalium luteoalbum</i>	17	*	7	73	4	R	90	7	37	306	5	R
<i>Raphanus raphanistrum</i>	109	18	66	439	6	R	-	-	-	-	-	-
<i>Reichardia tingitana</i>	-	-	-	-	-	-	255	20	116	736	7	C
<i>Rorippa palustris</i>	8	*	7	73	4	R	-	-	-	-	-	-
<i>Rostraria cristata</i>	4	*	7	73	4	R	809	65	178	981	7	C
<i>Rumex crispus</i>	84	14	84	586	5	R	-	-	-	-	-	-
<i>Rumex dentatus</i>	961	164	549	3589	10	V	7	*	6	61	4	R
<i>Senecio glaucus</i>	17	3	29	183	5	R	255	21	141	1166	7	C
<i>Setaria viridis</i>	260	44	62	476	6	R	22	2	12	122	5	R
<i>Sida alba</i>	-	-	-	-	-	-	15	-	12	122	5	R

Table (4). Cont.

Weed species	Normal cultivation						Protected cultivation					
	RD	GD	GF	IF	CU	AB	RD	GD	GF	IF	CU	AB
<i>Silene rubella</i>	39	6	40	329	5	R	-	-	-	-	-	-
<i>Sinapis allionii</i>	17	3	29	293	5	R	-	-	-	-	-	-
<i>Sinapis arvensis</i>	2	*	3	33	5	R	-	-	-	-	-	-
<i>Sisymbrium irio</i>	208	35	157	1099	8	C	67	5	37	368	5	R
<i>Solanum nigrum</i>	241	41	135	952	7	C	330	26	184	981	9	C
<i>Sonchus asper</i>	4	*	7	73	4	R	97	8	43	368	5	R
<i>Sonchus oleraceus</i>	1533	261	1355	6631	11	V	1320	106	595	3987	11	V
<i>Spergularia</i> spp.	52	9	1040	293	7	C	45	4	18	122	5	R
<i>Stellaria media</i>	4817	821	2198	8535	13	D	172	14	67	675	5	R
<i>Symphoricarum squamatus</i>	21	3	26	210	5	R	270	21	122	981	6	R
<i>Tamarix</i> spp.	-	-	-	-	-	-	360	29	239	1533	8	C
<i>Trianthema portulacastrum</i>	2032	346	300	1135	10	V	892	72	325	1288	8	C
<i>Trifolium resupinatum</i>	1168	199	505	3223	11	V	16473	1324	3166	6625	15	D
<i>Trigonella laciniata</i>	-	-	-	-	-	-	30	2	12	122	5	R
<i>Urochloa panicoides</i>	36	6	33	293	5	R	-	-	-	-	-	-
<i>Urospermum picroides</i>	-	-	-	-	-	-	22	2	18	184	5	R
<i>Urtica urens</i>	344	59	139	1099	8	C	60	5	12	122	5	R
<i>Veronica anagallis-aquatica</i>	879	149	575	3167	10	V	-	-	-	-	-	-
<i>Veronica polita</i>	1212	206	465	2161	11	V	75	6	18	184	5	R
<i>Vicia monantha</i>	43	7	44	366	5	R	240	19	92	613	6	R
<i>Vicia sativa</i>	6	1	11	109	5	R	1933	155	423	2147	11	V

RD = Relative density ( $\times 10^{-3}$ ), GD = general density ( $\times 10^{-3}$ ), GF = general frequency ( $\times 10^{-2}$ ), IF = infested field ( $\times 10^{-2}$ ), CU = cumulative value, AB = abundance, D = dominate, V = very common, C = common, and R = rare.

\* Less than  $\times 10^{-3}$ .

New distribution of some old Egyptian flora were represented *Amaranthus blitoides*, *Commelina benghalensis*, *Cynanchum acutum* and *Trianthema portulacastrum*. This result was in accordance with Tackholm (1974), El-Hadidy (1980), Mahgoub (1985 & 1993), Soliman (1989), Abousteit *et al.* (1993), Boulos (1995 & 1999) and El-Khanagry (2004).

The new species which were not appeared as weeds in cultivated lands and recorded in this investigation, were *Bassia indica*, *Bromus catharticus*, *Commelina benghalensis*, *Cynanchus acutum*, *Eragrostis ciliaris*, *E. pilosa*, *Juncus bufonis*, *Launaea nudicaulis*, *Reichardia tingitana*, *Rorippa palustris*, *Rumex crispus* and *Trigonella laciniata*. This results were in agreement with Tackholm (1974), Abd El-Raouf *et al.* (1993), Abousteit *et al.* (1993), El-Hadidi and Fayed (1994/95), Boulos (1999, 2000 & 2002), Culpepper *et al.* (2004), Daie and El-Khanagry (2004) and El-Khanagry (2004 & 2005).

Soil treated by methyl bromide controlled or inhibited the germination of many species as *Amaranthus hybridus*, *A. viridis*, *Ammi majus*, *Anagallis arvensis*, *Capsella bursa-pastoris*, *Cyperus rotundus*, *Oxalis corniculata*, *Phalaris minor*, *P. paradoxa*, *Poa annua*, *Rumex dentatus*, *Setaria viridis*, *Sisymbrium irio*, *Stellaria media* and *Trianthema portulacastrum*. Meanwhile, legume seeds group, i.e., *Medicago intertexta*, *M. polymorpha*, *Melilotus indicus*, *M. serratifolius* and *Trifolium resupinatum* were not affected by methyl bromide. These results may be referred to the time of fumigation on July and August. These results were confirmed by Amer *et al.* (1998) and Unruh *et al.* (2002).

The dominant species in different strawberry fields were *Chenopodium murale*, *Conyza bonariensis*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Melilotus indicus*, *Nothoscordum inodorum*, *Oxalis corniculata*, *Poa annua*, *Polypogon monspeliensis*, *Portulaca oleraceae*, *Sonchus oleraceus*, *Stellaria media*, *Trianthema portulacastrum* and *Trifolium resupinatum*. Many of these species were reported by Atkinson *et al.* (1983), MacGiolla *et al.* (1989), Nonnecke *et al.* (1993) and Quarles (1999).

In addition, this study may document most of weeds found in strawberry fields, representing the new weeds and helping to find the suitable methods to controlling these weeds in the future.

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### تقدير وتوزيع حشائش الفلورا في حقول الفراولة بمصر

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مثل الحشائش مشكلة هامة في مناطق إنتاج الفراولة بمصر. أجريت دراسة حصر الحشائش لنظامين لإنتاج الفراولة. الأولى تقع في غرب الدلتا ومحافظة القليوبية حيث تبخر التربة بيروميد الميثيل (الزراعة المحمية)، والطريقة الثانية تقع في محافظات القليوبية والشرقية والإسماعيلية حيث لا يتم تبخير التربة (الزراعة التقليدية). أجريت الدراسة خلال المواسم الشتوية بداية من عام ٢٠٠٠/٢٠٠١ وحتى ٢٠٠٣/٢٠٠٤. وتم تقدير الحشائش في مساحة ١ متر مربع عشوائيا ومكررا ١٠ مرات في كل حقل. وأستخدمت ستة معايير لتقييم أنواع الحشائش، تلك المعايير عبارة عن: الكثافة المطلقة، والكثافة العامة، والتكرار العام، ونسبة الحقول المصابة، والعدد التراكمي، والوفرة. أظهرت الدراسة أن مجموع الأنواع المسجلة ١١٢ نوعا تتبع ٧٨ جنسا و ٣١ فصيلة. سجلت الأنواع اريتميزيا فولجارس، الجالينيزوجسا باريفيلورا، الأوكسالس لاتفوليا، اليوروكلورا بانتيكولويدس كأنواع جديدة في الفلورا المصرية. بينما قيمت الأنواع المنتجة، حشيشة الجبل، السعد، انفيرة، التفل، النرجس، الحامض، البواء، ديل القط، الرجل، الجمضيض، القرزة، الرجل السودانى والقرط كأهم الحشائش الضارة. بالإضافة إلى أن تأثير بيروميد الميثيل كان أقل تأثيرا على إنبات البذور البقولية عن بقية الأنواع.