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Weed Diversity of Newly Farmed Land on the Southern Border of Egypt (Eastern and Western Shores of Lake Nasser)

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Abstract: Eighty-five weed species are now growing for the first time in habitats that did not previously exist in this area. Eleven weed species (transitional) are from the local flora of desert habitats that could tolerate the new environment. These species are related to 25 families and include 65 annuals (67.7%) and 31 perennials (32.3%) species, with Gramineae as the most represented family (30.2%). The Sudano-Zambesian elements (mono, bi and pluri-regional) present 28.1% while Mediterranean elements (mono-regional) attain 5.2%. The therophytes represent 69.8% of the life-form spectrum while phanerophytes form 6.3%. Some of these weeds are derived from typically local flora of desert and lake shore which are constantly met within these newly reclaimed sites while others (specially Mediterranean elements) are from other agricultural areas in Egypt where the plants, seeds, manure and agricultural equipment are originated. It was clear that with continuous human interference, the weed species will eventually replace the natural plants in the study area.

Key words: Ruderal, agrestal, transitional weeds, Sudano-Zambesian, therophytes

Introduction

Weeds did not exist before agriculture, but evolved alongside the crops. Despite the use of clean seed, ploughing, cultivation, burning, hoeing, hand weeding, managed grazing, smother crops and crop rotation, weeds persist because of our inability to cope with maximum crop production and the massive recycling potentiality of weeds (Sen *et al.*, 1980). The proverb "one year's seeding is seven years weeding" is a recognition of man's role in the control of size of weed populations (Sagar, 1982). Losses caused by weeds are well documented in many studies (King 1966; Reeves, 1976; Roberts and Chancellor, 1982; Aldrich, 1984). Sen *et al.* (1984) mentioned that the weeds cause more loss to agriculture than all pests put together. Understanding the nature of the weeds is necessary in order to learn how to reduce their effect on crops (Radosevich and Holt, 1984).

The main factor that influences native vegetation in the Nile valley is human interference. The alluvial terraces of the valley have remained under human management for four thousands of years. Hamel and Dansereau (1949) and Curts (1959) classified the vegetation into degraded (where the disturbance of the original community is incomplete and sporadic), and ruderal (where the original community is destroyed and a destructive agent is repeatedly applied) and cultivated, (where crops are planted). All the three types of vegetations were found as a result of human interference.

The alluvial terraces of the Nile valley in upper Egypt and the desert outskirts of the farmland of the Nile delta are the subjects of active land desert annuals ranging from 18 species in north Aswan to 42 species in the eastern and western outskirts of the Nile delta. Older fields contained fewer desert populations which became gradually replaced by weed assemblage of the old farmland.

Agrestal and ruderal constitute the bulk of the flora of farmland (El-Hadidi and Fayed 1995). These were the subjects of detailed studies by El-Amary (1981) in Sharqiya governorate, Shaheen (1987) in Aswan governorate, Mahgoub (1993) in Beheira governorate. Their studies showed that assemblages are related to season, type of soil and geographic range (upper or lower Egypt).

According to El-Hadidi (1993), the percentage of Sahelian and Sudanian taxa (Wickens, 1976) is the highest in upper Egypt, decreasing gradually northwards in the Nile delta. The percentage of Mediterranean taxa is highest in the Nile delta and this decreases gradually southwards in upper Egypt. A major percentage of the weed flora is represented by the widely spread cosmopolitan, paleotropic and pantropic taxa.

The new farmed lands around the lake Nasser *khors* have created new habitats that never previously existed in this area. Planting of small gardens near houses and the constant irrigation of crops two or five years ago enabled many weeds to penetrate these habitats.

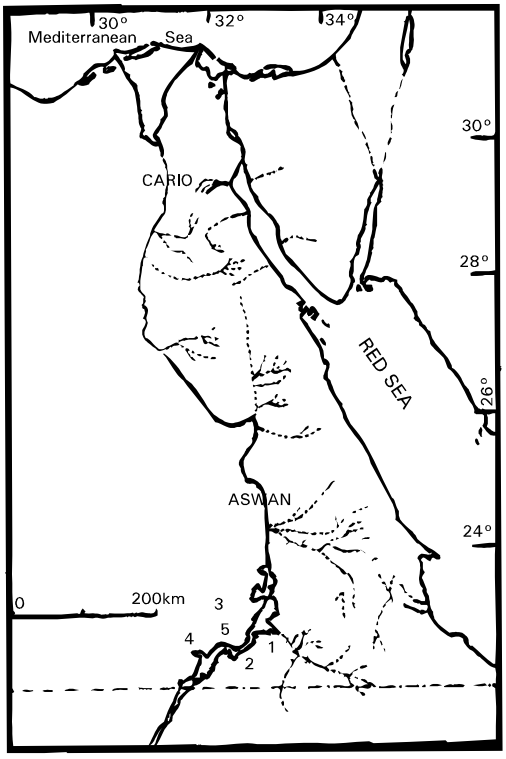

Fig. 1: Location map showing the study area; 1: Absco, 2: Tuorgomi, 3: Kalabsha, 4: El-Subai and 5: Gharf Hussein

In this article, a list of weeds in agrestal and ruderal conditions at newly farmed land is presented. The study area is located on the southern Egyptian border, 200-300 km south of the High Dam (eastern and western desert) (Fig. 1). This area was classic desert which has been promoted for cultivation. A documentary study of the flora of that region was indubitably required.

Materials and Methods

Study area: The study area is located on the perimeter of Aswan governorate, 300 km south of the High Dam. It extends from the

eastern desert (Absco and Tuorgomi) to the western desert (Gharf Hussein, Kalabsha, El-Subai) across lake Nasser. It represents a transitional zone between the adjoining desert and the shore of lake Nasser. It was a part of the Nubian eastern and western desert but is now under reclamation (two to five years old).
It is characterized by numerous wadis, or intermittent stream channels, which run through Egypt's southern and western desert to the shores of the lake Nasser. The wadis extend for more than 400 km south, deep into Sudanese territory. Lake Nasser is a vast manmade water body upstream of the Aswan high dam on the Nile, which reached its maximum height in 1998. Research suggests that the new lake has had a considerable impact on the overall physical environment of the areas around it, including that of the study area. This area has highest range of summer temperatures (40 to 50°C) and mean annual precipitation from 5 to 50 mm, with rain events occurring only about once in every five years.

Data records: Data and records were derived from newly farmed fields (two to five years old). Some fields were located in the eastern desert (Absco and Tuorgomi) and others in the western desert (Gharf-Hussein, Kalabsha and El-Subai). Seventy-five sampling stands were selected to cover the farmed lands. Each stand was 20 m wide but lengths varied from 20 to 40 m. The stands were the basic units for description of plant life and comparison of the vegetation in different fields. The quotient of similarities between different sites and species richness were calculated according to Sorenson (1948).
A list of weed species was monitored seasonally in each stand between 2000-2001. This was undertaken from just after the crop was sown until its harvest. The recorded species were identified and arranged according to El-Hadidi and Fayed (1995). For each species the most important collections are cited and are being kept in the Aswan herbarium (ASW). Floristic categories and life form spectrum for all the species are those applied by Wickens (1976) and Runnkiaer (1934) respectively.

Results and Discussion

Ninety-six weed species belonging to 25 families were recorded from the study area during the period from March 2000 to March 2001 (Table 1). This area had a remarkably uniform flora, whereas considerable difference in the floral composition has been noticed northwards and southwards of this area. Boulos (1966, 1967) recorded during the springs of 1963 and 1964 about 180 species of phanerogams in the Egyptian Nubia including Aswan (67 from Nubia). A near figure of 170 species was given by Abdallah *et al.* (1972) from the same area, also during the spring of 1963 and 1964. El-Hadidi recorded over 200 species during two visits to Nubia in 1963, 1964 (unpublished reports) and a summer visit to Aswan area in 1963 (El- Hadidi and Ghabbour, 1968). A near figure of over 200 species was given by Shaheen (1987) from north Aswan only. An early stage for the establishment of the riverain of the Nubia was studied by El-Hadidi (1976) in the Daboud area which is located about 10 km south of the high dam. The few species recorded (about 15) belong to: the adjacent desert, floating seeds, aerially dispersed fruits and some inundated species.
The most represented families were Gramineae (30.2%), Compositae and Leguminosae (11.3%), and Chenopodiaceae (5.2%). The annuals represent 65 species (67.7%) and perennials 31 species (32.3%). The agrestals form 59.4% and ruderals 40.6%.
The most common weeds (p= 100%) are: *Solanum nigrum*, *Polypogon monspeliensis*, *Chenopodium album*, *C. murale*, *Sonchus oleraceus*, *Setaria viridis* as Cosmopolitan elements; *Glinus lotoides* as Paleotropical; *Cynodon dactylon* as Pantropic; *Hyoscyamus muticus* as Sudano-Zambesian and *Malva parviflora*

Table 1: Floristic composition of weeds (%) associated to the newly farmed lands

L.F.	Species/Family	Ruderal	P%	Agrestal	P%	Fl.Cat.
		TAKGS		TAKGS		
G	*Panicum repens*/Gr.	+ +	40			COSM
TH	*Avena fatua*/Gr.	+	20			COSM
TH	*Tribulus terrestris*/Zyg.			+ +	40	COSM
TH	*Solanum nigrum*/Sol.			+ + + + +	100	COSM
TH	*Portulaca oleracea*/Por.			+ + + +	80	COSM
TH	*Polypogon monspeliensis*/Gr.	+ + + + +	100			COSM
TH	*Brassica nigra*/Cr.			+ + +	60	COSM
TH	*Chenopodium album*/Ch.			+ + + + +	100	COSM
TH	*C. murale*/Ch.			+ + + + +	100	COSM
TH	*Sonchus oleraceus*/Com.			+ + + + +	100	COSM
TH	*Eragrostis cilianensis*/Gr.			+ + + +	80	COSM
TH	*E. aspera*/Gr.			+ + + +	80	COSM
TH	*Anagallis arvensis*/Pr.			+ + +	60	COSM
TH	*Phalaris canariensis*/Gr.	+	20			COSM
TH	*Setaria viridis*/Gr.	+ + + + +	100			COSM
TH	*Amaranthus viridis*/Am.			+ +	40	PAL
TH	*Melilotus indicus*/Leg.			+ + +	60	PAL
TH	*Digitaria sanguinalis*/Gr.			+ + +	60	PAL
TH	*D. ciliaris*/Gr.			+ +	40	PAL
TH	*Dactyloctenium aegyptium*/Gr.			+ +	40	PAL
G	*Eleusine indica*/Gr.			+	20	PAL
G	*Diplachne fusca*/Gr.	+	20			PAL
H	*Glinus lotoides*/Mol.	+ + + + +	100			PAL
TH	*Chloris virgata*/Gr.	+	20			PAL
TH	*Heliotropium ovalifolium*/Bor.			+	20	PAL
G	*Dichanthimum annulatum*/Gr.	+	20			PAL
TH	*Conyza bonariensis*/Com.	+ +	40			PAL
TH	*Convolvulus arvensis*/Con.			+	20	PAL
G	*Paspalidium geminatum*/Gr.	+ +	40			PAL
G	*Paspalum paspalodes*/Gr.	+ +	40			PAL
TH	*Hibiscus trionum*/Malv.			+	20	PAL
TH	*Xanthium strumarium*/Com.	+	20			PAL
TH	*Fimbristylis bis-umbellata*/Cyp.	+ +	40			PAL
G	*Imperata cylindrica*/Gr.	+ + + +	80			PAL
H.H	*Phragmites australis*/Gr.	+ + +	60			PAL
G	*Cyndon dactylon*/Gr.			+ + + + +	100	PAN

Table 1: Continued

L.F.	Species/Family	Ruderal	P%	Agrestal	P%	Fl.Cat.
		TAKGS		TAKGS		
TH	*Echinochloa crusgalli*/Gr.			+ + +	60	PAN
TH	*E. colona*/Gr.			+ +	40	PAN
TH	*Corchorus olitorius*/Til.			+ +	40	PAN
TH	*Aster squamatus*/Com.	+ +	40			PAN
TH	*Datura stramonium*/Sol.	+	20			PAN
TH	*D. innoxia*/Sol.	+	20			PAN
TH	*Mentha microphylla*/Lab.	+	20			PAN
G	*Sida alba*/Malv.			+ +	40	PAN
G	*Cyperus rotunds*/Cyp.			+ +	40	PAN
G	*C. longus*/Cyp.			+ +	40	PAN
PH	*Ricinus communis*/Eu.	+	20			PAN
PH	*Sesbania sesban*/Leg.	+ + +	60			S-Z
TH	*Senecio aegyptius*/Com.			+	20	S-Z
TH	*Cornulaca monacantha*/Ch.	+	20			S-Z
TH	*Vigna membranacea*/Leg.			+	20	S-Z
TH	*Stipagrostis plumosa*/Gr.			+ +	40	S-Z
TH	*Reseda pruinosa*/Re.			+	20	S-Z
G	*Sorghum sudunese*/Gr	+	20			S-Z
TH	*Rhynchosia minima*/Leg.			+	20	S-Z
TH	*Conyza aegyptiaca*/Com.	+ +	40			S-Z
CH	*Aerva javanica*/Am.	+ + +	60			S-Z
H	*Crotalaria thebaica*/Leg.	+ + +	60			S-Z
H	*Morettia philaeana*/Cr.			+	20	S-Z
G	*Panicum coloratum*/Gr.	+ +	40			S-Z
TH	*Cajanus cajan*/Leg.			+	20	S-Z
TH	*Echium rauwolfii*/Bor.			+ +	40	S-Z
TH	*Lolium temulentum*/Gr.	+ +	40			S-Z
H	*Fagonia indica*/Zyg.	+ + + +	80			S-Z
TH	*Hyoscyamus muticus*/Sol.	+ + + + +	100			S-Z
TH	*Cotula anthemoides*/Com.			+	20	S-Z
PH	*Caltropis procera*/Asc.	+	20			SA-AI
TH	*Astragalus hamosus*/Leg.			+	20	SA-SI+ S-Z
TH	*A. vogelii*/Leg.			+	20	SA-SI+ S-Z
PH	*Ziziphus spina-christi*/Rh.	+	20			SA-SI+ S-Z
H	*Pulicaria arabica*/Com.	+ + +	60			SA-SI+ S-Z
PH	*Tamarix nilotica*/Tam.	+ + +	60			SA-SI+ S-Z
PH	*Salsola baryosma*/Ch.	+ + + +	80			SA-SI+ IR-TR
TH	*Emex spinosa*/Pol.			+ + +	60	ME
TH	*Ammi majus*/Um			+ + +	80	ME
TH	*Lepidium sativum*/Cr.			+	20	ME
TH	*Cichorium pumilum*/Com.			+	20	ME
TH	*Ambrosia maritima*/Com.			+	20	ME
G	*Saccharum spontaneum*/Gr.	+	20			ME+ S-Z
H	*Citrullus colocynthis*/Cu.			+ + +	80	ME+ SA-SI
TH	*Ammi visnaga*/Um.			+	20	ME+ IR-TR
TH	*Brachiaria eruciformis*/Gr.			+	20	ME+ IR-TR
TH	*Amaranthus lividus*/Am.			+ + + +	80	ME+ IR-TR
TH	*A. graecizans*/Am.			+ + + +	80	ME+ IR-TR
H	*polygonum equisetiforme*/Pol.	+ +	20			ME+ IR-TR
TH	*phalaris minor*/Gr.			+ +	60	ME+ IR-TR
TH	*Malva parviflora*/Malv.			+ + + + +	100	ME+ IR-TR
TH	*Trifolium resupinatum*/Leg.			+ + +	60	ME+ IR-TR+ ER-SR
TH	*Sisymbrium irio*/Cr.			+ + +	60	ME+ IR-TR+ ER-SR
TH	*Lactuca serriola*/Com.			+	20	ME+ IR-TR+ ER-SR
TH	*Poa annua*/Gr.			+ +	40	ME+ IR-TR+ ER-SR
TH	*Heliotropium europaeum*/Bor.			+ + +	60	ME+ IR-TR+ ER-SR
TH	*Beta vulgaris*/Ch.			+ + +	60	ME+ IR-TR+ ER-SR
TH	*Coronopus squamatus*/Leg.			+	20	ME+ IR-TR+ ER-SR
TH	*Trigonella hamosa*/Leg.			+ + + + +	100	ME+ IR-TR+ S-Z
TH	*Rumex dentatus*/Pol.			+ + +	60	ME+ IR-TR+ S-Z

T: Tuorgomi, A: Absco, K: Kalabsha, G: Gharf-Hussein, S: El-Subai, G: Geophytes, TH: Therophytes, H: Hemicryptophytes, PH: Phanerophytes, CH: Chamaephtes, COSM: Cosmopolitan, PAL: Palaeotropic, PAN : Pantropic, S-Z: Sudano-Zambesian, ME: Mediterranean, SA-SI: Saharo Sindian L.F.: Life form, Fl. Cat.: Florstic categoriesand, P(%): total percentage of ruderal and agrestal species, + : present. Gr.: Gramineae; Por.: Portulacaceae; Cr.: Cruciferae; Pr.: Primulaceae; Mol: Molluginaceae; Bor.: Boraginaceae; Malv.: Malvaceae; Til: Tiliaceae; Lab.: Labitae; Eu.: Euphorbiaceae; Ch.: Chenopodiaceae; Am.: Amaranthaceae; Re.: Resedaceae; Zyg.: Zygophyllaceae; Sol.: Solanaceae; Tam.: Tamaricaceae; Pol.: Polygonaceae; Rh.: Rhamnaceae; Com.: Compositae; Um.: Umbelliferae; Leg.: Leguminosae; Asc.: Asclepiadaceae. Con.: Convolvulaceae; Cyp.: Cyperaceae and Cu.: Cucurbitaceae

Table 2: Matrix of Sorenson similarity coefficient (Sorenson, 1948) calculated between each pair of localities

Locations	Tuorgomi	Absco	Kalabsha	Gharf- Hussein	El-Subai
No. of species	60	50	25	51	39
T		72.7	44.7	50.5	62.6
A	(40)		45.3	43.7	60.7
K	(19)	(17)		42.1	56.3
G	(28)	(22)	(16)		57.8
S	(31)	(27)	(18)	(26)	

Practice number: values of species for pairs of locations

and *Trigonella hamosa* as Mediterranean elements. The wide distribution of some weeds may be interpreted by the view that these weeds often are uniquitous. Species with large amplitude (*Cyndon dactylon, Solanum nigrum*) are often caused by phenotypic plasticity and heterogeneity (Shaltout and Sharaf El-Din 1988). Weeds of moderate occurrence (p = 60%) are: *Rumex dentatus, Anagallis arvensis, Melilotus indicus, Beta vulgaris, Sisymbrium irio, Trifolium resupinatum* and *Emex spinosa*. The restriction of distribution (e.g *Lpidium sativum, Cichorium pumilum, Avena fatua, Ambrosia maritima, Diplachne fusca*) may be related to the need for special habitat " thermic preferability ". Tuorgomi site has the highest value of species richness (62.5%) in the reclaimed land. This could be due to the distance of cultivation and method of weed control. On the other hand, Kalabsha site has the lowest species richness (26.04%) which may be due to the use of the herbicides.

There is a moderate similarity between the floristic composition of Tuorgomi vs Absco (72.7%), Tuorgomi vs El-Subai (62.6%), Absco vs El-Subai (60.7%), Gharf- Hussein vs El-Subai (57.8%) and Kalabsha vs El-Subai (56.3%) (Table 2). The lowest similarities are: Kalabsha vs Gharf-Hussein (42.1%) and Absco vs Gharf-Hussein (43.7%).

Sudano-Zambesian elements include 19 mono-regional (typically) as well as eight bi-regional species. Among these *Senecio aegyptius* and *Conyza aegyptiaca* were endemic to Egypt and *Pulicaria arabica, Vigna membranacea* and *Rhynchosia minima* were locally endemic to Nubia. The bi-regional species are primarily Sudano-Zambesian which were penetrating to the southern tributaries of Egypt. Shaheen (1987) recorded 29 species in Aswan (north) which were typically mono-regional Sudano-Zambesian taxa. These results are more in agreement with El-Hadidi and Fayed (1995), who reported that the percentage of Sahelian and Sudanian taxa is highest in upper Egypt.

Cosmopolitan species include 15 annual species, among which five species lives in ruderal condition (*Panicum repens, Avena fatua, Polypogon monspeliensis, Phalaris canariensis* and *Setaria viridis*) and the ten species consider as agrestals weeds. Shaheen (1987) recorded 29 Cosmopolitan species from north Aswan.

Paleotropic elements include 15 annuals as well as five perennials. Nine species belonging to this group were collected from agrestal habitats and eleven were from ruderals. The most limited species are the pantropic elements where only twelve species were recorded: five ruderal and seven agrestal. Shaheen (1987) recorded 28 paleotopical and 38 pantropic elements in north Aswan.

Mediterranean elements include five mono-regional (all agrestal), nine bi-regional (seven agrestal and two ruderal)) as well as nine pluri-regional (all agrestal). Shaheen (1987) recorded 27 Mediterranean species from north Aswan. These results are more in agreement with El-Hadidi (1993) who reported that the percentage of Mediterranean taxa is lowest in the governorates of upper Egypt.

Close to the boundaries of the desert and within these farmed land, species of xerophytic nature grow among the weeds of cultivation. These included *Morettia philaeana, Cornulaca monacantha, Reseda pruinosa, Pulicaria arabica, Salsola baryosma, Citrullus colocynthis, Hyoscyamus muticus, Fagonia indica* and *Crotalaria thebaica*. This indicates that these plant species are native to the desert and are remaining after the reclamation processes. On the other hand, a major group of weed species are distributed in the newly farmed land (*Portulaca oleracea, Cynodon dactylon, Aster squmatus, Ammi majus, Trifolium resupinatum, Malva parviflora, Solanum nigrum*). This suggests that land reclamation entails weed species replacing natural plant communities (Stainforth and Scott, 1991; Bazzaz, 1996). Introduced species must be capable of establishing themselves in areas of natural habitats (McDonald, 1989) and may alter the native habitat in such a way that all the native species are pushed out. The most of the perennial weeds of the newly farmed land are represented by a central core of large shrubs of *Tamarix nilotica, Sesbania sesban, Ricinus communis, Ziziphus spina-christi* and *Phragmites australis*, which must have existed before the reclamation, when these farms were part of the eastern and western deserts. Respectively a few specimens of the desert perennials, *Hyoscyamus muticus, Aerva javanica, Salsola baryosma, Pulicaria arabica* and *Morettia philaeana,* are also recorded. The perennials have the lowest value here (32.3%) and this trend is dissimilar to the spectra reported for Egyptian flora as a whole (Hassib, 1951).

In both ruderal and agrestal conditions, there are zones of annual weeds which were associated with vegetable fields. Annual growth occurs in rows identical to the treat of water at regular intervals (irrigation pipes). The annuals constitute the majority of the species in the study area (67.7%). The short life cycle of annuals as well as prevailing climatic conditions and water availability lead to their frequent occurrence (Shaltout and El-Fahar 1991). The dominance of annuals could be attributed to the fact that annuals have higher reproductive capacity ecological, morphological and genetic plasticity under high level of disturbance (Grime, 1979).

The life form spectra showed that, the recorded species comprise 69.8% therophytes, 14.6% geophytes, 7.3% hemicryptophytes, 6.3% phanerophytes while chamaeophytes represent only 1.04% of the life form spectrum. A near figure of same data was given by Shaheen (1987) from north Aswan (old cultivated land).

The weeds of irrigated agricultural crops in the southern border of Egypt grow in habitats that never previously existed in the area. Some of these weeds are plants from the local flora of the region. Among them are plants which were typical to ruderal habitats in deserts and make use of environmental conditions which are similar to their typical niche, and other species such as *Imperata cylindrica* which were normally confined to desert. Mostly, they have wind dispersed diaspores that reach on constantly irrigated plots and establish themselves there. Species such as *Hyoscyamus muticus* grow regularly in desert wadies and establish themselves at the margins of irrigated plots where it is not too wet.

Many of these weed species, such as *Ammi majus, Convolvulus arvensis Sisymbrium irio, Cichorium pumilum, Trifolium resupinatum, Melilotus indicus, Trigonella hamosa, Portulaca oleracea and Brassica nigra,* were derived from other agricultural areas in Egypt (the delta) where the plants, seeds, manure and agricultural equipment originated. The other weeds were from the local flora of the desert and lake shore habitats that can withstand the new environment. These species grow in the relatively dry micro habitats near the fields or establish themselves in the abandoned fields.

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