

REVISION OF THE DISTRIBUTION OF SOME SPECIES OF THE EGYPTIAN FLORA

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ABSTRACT

This research reviews the distribution of some species of the Egyptian flora in different phytogeographical regions. Results are compared with the suggestions given by Täckholm (1974), El- Hadidi and Fayed (1994/95) and Boulos (1995, 1999, 2000 and 2002). The research includes distribution of 37 species recorded for the first time. These species belong to 34 genera and 18 families.

Key words : *distribution, Egyptian flora, phytogeographical regions.*

1. INTRODUCTION

Distribution of plants in a flora is affected by geographical intervals, rainfall, floods, water and soil salinity, soil type (chemical and mechanical), and agricultural expansion in new areas, *i.e.*, Sahl El-Tina and Qantara Sharq (Sinai), Sharq El-Uweinat, Touthky at Western Desert and new lands at east and west Delta, in addition to agricultural practices, transference of soil and organic fertilizers from Nile valley to new areas. All the previous factors are playing major roles in changing and transferring the flora from one location to another. These changes represent problems for agricultural production and studying the flora. The Egyptian flora of the Nile valley was previously studied by many researchers; *e.g.*, El-Amry (1981), El-Bakry (1982), Mahgoub (1985,

1993), Shamloul (1986), Mashaly (1987), El-Shayeb (1989), Soliman (1989) and El-Khanagry (1993). While, Gibaly (1988, 2000) studied the flora of Sinai. Meanwhile, Abd El-Ghani (1981, 1985) and Shaheen (1987) studied the flora of Western Desert and Oases. In addition, Hassan (1987) surveyed the flora of the Eastern Desert and some sites of the Red Sea region.

This research considers the transfer of some species from a region to another, and explains the different factors which led to the new distribution of these species.

2. MATERIALS AND METHODS

The following investigations are based on specimens collected from different phytogeographical regions and lakes mainly from 2000 to 2003. The distribution of these specimens was checked to Täckholm (1974; Map 1), El-Hadidi and Fayed (1994/95; Map 2) and Boulos (1995, 1999, 2000 and 2002; Map 3). Specimens were identified by means of botanical keys before being compared with those kept in the Herbarium of Flora and Phytotaxonomy Research Section (CAIM), the Herbarium of the Faculty of Science, Cairo University (CAI), the Herbarium of Central Laboratory of Weed Research at Giza (CAIMG), at Sakha (CAIMS) and at Sids (CAIMU). Most specimens collected throughout the present study were kept in CAIM. However, some specimens were kept in CAIMG. Map 4 was constructed to illustrate the phytogeographical regions suggested in this investigation viz., Nile lands (N.), Nile Delta (Nd.), Nile Valley from Cairo to Sudan frontier and including Fayoum (Nv.); Mediterranean coastal (M.), from Alexandria to Saloum (Mm.), from Port Said to Alexandria (Md.), from Rafah to Port Said (Ms.); All desert (D.), Eastern desert (De.), Northern parts from North Galala to the line between Qena-Qousier (Den.), Southern part (Des.). Western desert (Dws.), Northern parts (Dwn.), Southern parts (Dws.), Isthmic desert (Di.), Sinai desert (Dis.), and between Damietta Nile branch, Suez Canal and North Galala (Did.); Red Sea region (R.), Red Sea coastal (Rv.), Suez Gulf coast (Rs.), Aqaba Gulf coast (Ras.); Sinai mountains (S.); Gebel Elba (GE.), Gebel Uweinat (U.); Oases (O. with name of oasis). Lakes (L. with name of lakes)] Abbreviations of different phytogeographical regions used in previous works as well as those used in this study are shown in Table (1).

Table (1): Abbreviations of different phytogeographical regions suggested by different investigators.

Region	Täckholm	El-Hadidi and Fayed	Boulous	Present work
I- Nile land	N	N	N	N
Nile Delta	Nd	N	N	Nd
Nile valley	Nv	N	N	Nv
Nile Fayoum	Nf	N	N	Nv
Nile Nubbian	N	Nn	N	N
II- Mediterranean coastal	M	M	S	M
North Delta				Md
North Sinai coastal	Mp	Ms	M	Ms
Western Med. coastal	Mma	Mm	M	Mm
III- Desert	D	D	D	D
Eastern desert	Da		De	De
(Northern part)	Da.sept	Dg	De	De.n
(Southern part)	Da.mer	Da	De	De.s
Isthmic desert (El-Tih)	Di	Di	S	Ds
& Eastern Delta)	Di	(except E.Delta)	De	Di
Western desert			Dw	Dw
Northern part	DI	DI	Dw	Dw.a
Southern part	DI	Dn	Dw	Dw.s
IV- Red Sea region	R	R	R	R
Red Sea coastal	R	Ra	R	Rr
Suez Gulf	S	Rz	S	Rs
Aqaba Gulf	S	Rq	S	Ra
Region	Täckholm	El-Hadidi and Fayed	Boulous	Present work
V- Mountains				
Sinai mountains	S	S	S	S
Gebel Elba	GE	Sa	GE	GE
Gebel Uwienat	U	Uw	O	U
VI- Oases	O	O	O	O + names of oases
Oases of north-western desert		Oi		
Oases of south-western desert		On		
VII- Lakes				L + name of lake
Northern lakes	Nd	M	N	
Quaron lake	Nf	N	N	
Bardawil lake	Mp	Ms	M	
High-dam lake	-	Nn	N	

Authors reported in this paper are abbreviated as follows :

Tack : Täckholm (1974)

Hadi : Hadidi and Fayed (1994/95)

Boul 95 : Boulous (1995)

Boul 99 : Boulous (1999)

Boul 00 : Boulous (2000)

Boul 02 : Boulous (2002)

* : New record species to the flora of Egypt.

3. RESULTS AND DISCUSSION

The revised distribution of the species collected from different Egyptian locations are given below with reference to the suggested phytogeographical regions compared to distributions of those reported by Täckholm (1974), El-Hadidi and Fayed (1994/95) and Boulos (1995, 1999, 2000 & 2002). Engler system is used by authors and all investigators in this paper.

3.1. Aizoaceae

3.1.1. *Trianthema portulacastrum* L.

(Tack : GE.; Hadi : Sa.; Boul 99 : GE.)

Rr : Hurgada, in garden, 14.9.2001, El-Khanagry, (CAIM).

O. Natroun : Wadi El-Natroun, between St. Beshowi and St. Yehnes monasteries, desert land, sandy soil, 24.10.2002, El-Khanagry, (CAIM).

Dis : Qantara Sharq, sandy soil, maize field, 30.8.2002, El-Khanagry (CAIMG).

Note : *T. portulacastrum* was reported by El-Amry (1981), El-Bakry (1982), El-Mashaly (1987), El-Shayeb (1989) and El-Khanagry (1993) at different locations in Nile Delta.

3.2. Amaranthaceae

3.2.1. *Amaranthus lividus* L. subsp. *polygonoides* (Moq.) Probst

[El-Hadidy (1980) : M, Nv., Nn.]

Did: Ababda, north Serabium, sandy soil, 11.5.2003; El-Khanagry (CAIM).

Dwn: El-Bostan sector, sandy desert soil, 24.7.2002; El-Khanagry (CAIM).

3.2.2. *Amaranthus viridis* L.

[Tack : Nd, v., M.; Hadi : M., Dr., Di., Nv., Nn., O. S.; Boul 99 : N., O., M., De., S.]

Rr. Hurgada, in parking, 12.9.2002; El-Khanagry (CAIM)

3.2.3. *Amaranthus hybridus* L. subsp. *hybridus*

[Tack : Nd, v., S.; Hadi : M., Di., O. S.; Boul 99 : N., O., M., S.]

Did : 6th October Farm at Kassasin, sandy desert soil, 5.8.2001; El-Khanagry (CAIM).

Rr. : Hurgada, in parking, 12.9.2002; El-Khanagry (CAIM).

3.2.4. *Amaranthus tricolor* L.

[Tack : Nd, Mma; Boul 99 : N., M.]

Den : St. Paul Monastery, in parking, 12.9.2002; El- Khanagry (CAIM).

3.3. Cruciferae

3.3.1. *Sisymbrium orientale* L.

[Tack : S (Wady Feiran); Hadi : S.; Boul 99 : S.]

Nv: Agric. Res. Cent., Giza, in wheat field, 3.4.2001; El-Khanagry (CAIM).

3.3.2. *Raphanus raphanistrum* L. subsp. *raphanistrum*

[Tack : Nd, v., Mma.; Hadi : Nv.; Boul 99 : N., M.]

Dis: Qantara Sharq [south Qantara Sharq city (about 30 km) and irrigated by Nile water], wheat field, 20.4.1997; Mohamed and El-Khanagry (CAIMG).

Dwn : Sugar-beet sector, wheat field, 13.4.1998; Mohamed (CAIMG).

3.4. Leguminosae

3.4.1. *Senna occidentalis* (L.) Link.

[Tack : Nd, v., O.; Hadi : Nv., O.; Boul 99 : N., O.]

Rr : Hurgada, in garden, 31.8.2003; El-Khanagry (CAIM).

3.5. Cucurbitaceae

3.5.1. *Coccinia grandis* (L.) Voigt

[Tack : GE; Hadi : Sa; Boul 00 : GE]

Nd: El-Gabal El-Asfar farm, climbing on lemon tree, 12.12.1978; El-Khanagry (CAIM).

: El-Gabal El-Asfar farm, climbing on pecan tree, 8.3.1998; El-Khanagry (CAIM).

Note : *C. grandis* was collected by M. Abdallah and A. Khattab from the same location in 18.10.1970 (CAIM).

3.6. Onagraceae

3.6.1. *Oenothera drummondii* Hook.

[Tack : Mp, (El-Sheikh Zowaied near Rafah); Hadi : M. (near Rafah); Boul 00 : N., S. (El-Sheikh Zowaied near Rafah)]

Md : North Manzala Lake, near Boughaz El-Gameel, in waste place, sandy and salty soil, 4.6.2002; El- Khanagry (CAIM).

Note : Only one specimen was kept in CAI, and was collected by Boulos from El-Sheikh Zowaied near Rafah and determined at Kew.

3.7. Umbelliferae

3.7.1. *Apium leptophyllum* (Pers.) F. Muell ex Benth.

[Tack : Nd, v., Mma.; Hadi : Nv.; Boul 00 : N., M.]

Dwn : 6th October city in parking, 24.1.2001; El- Khanagry (CAIM).

O. Natroun: St. Beshowi Monastery, in olive garden (irrigated by underground water), 19.1.2001; El- Khanagry (CAIM).

3.8. Asclepiadaceae

3.8.1. *Cynanchum acutum* L.

[Tack : O., M.; Hadi : M., N.O.; Boul 00 : N., O. M.]

Di : Cairo-Ismailia desert road near Cairo airport, sandy desert land, 5.8.2001; El-Khanagry (CAIMG).

3.9. Convolvulaceae

3.9.1. *Ipomoea pes-caprae* (L.) R.Br.

[Tack : Di (Ismailia) S.; Hadi : N.; Boul : De Suez Canal]

Dwn : Cairo-Alexandria desert road, 11.3.2001; El- Khanagry (CAIM).

Rr : Zaffarana, sandy soil, 8.9.2001; El-Khanagry (CAIM).

: Hurgada, El-Gona village, 8.9.2001; El-Khanagry (CAIM).

Note : recently, this species is cultivated as ornamental plant in many cities in Egypt, especially in desert lands.

3.9.2. *Cuscuta campestris* Yunck.

[Tack : Nd (Cairo); Hadi : Nv.; O.; Boul 00 : N.O.]

Mm : Ras El-Bar City, parasite on *Bazromia* plant, 3.6.2002; El-Khanagry (CAIM).

Dwn : Cairo-Alexandria desert road, parasite on *Alhagi graecorum*, 24.7.2002; El-Khanagry (CAIM).

3.10. Compositae

3.10.1. *Bidens pilosa* L.

[Tack : Nd, v., Mma., Di.; Hadi : M., D., N.; Boul 02 : N., M., De., S.]

Rr : Hurgada, in parking, 11.9.2002; El-Khanagry (CAIM).

3.10.2. *Conyza bonariensis* (L.) Cronquist.

[Tack : N., O., M., Di., S.; Hadi : N., O., M., D., S.; Boul 02 : N., O., M., D., S.]

Rr. : Hurgada, in garden, 11.9.2002; El-Khanagry (CAIM).

3.10.3. *Symphyotrichum squamatum* (Spreng.) Nesom.

[Tack : Tahrir Province; Hadi : M., D., N., O., S.; Boul 02 : N., O., M., D., S.]

Rr. : Hurgada, in garden, 12.9.2001; El-Khanagry (CAIM).

3.10.4. *Verbesina encelioides* (Cav.) Benth. ex A. Gray.

[Tack : Nv (Aswan); Hadi : Nn., O., S.; Boul 02 : N. (Aswan), O. (Kharga), S. (El-Arish)]

Ms : Bir El-Abd, sandy waste place, 22.6.2003, Mohamed (CAIM).

Nd : Belbeis, in mango garden, 7.8.2001; El-Khanagry (CAIM).

3.10.5. *Tagetes minuta* L.

[Tack : Nd (Khanka); Hadi : Nv. (Abu Zaabal); Boul 02 : N. (Khanka)]

Nv : Sids, Agric. Res. Sta., Beni Suef, 13.5.2003; El-Khanagry.

3.10.6. *Galinsoga parviflora* Cav.

[Boul 20 : N.]

Nd : El-Deir, Qalubia, orange garden, 12.1.2001; El-Khanagry.

: Arab E-Ghadir, Qalubia, strawberry field, 20.5.2003; El-Khanagry

: Kafr El-Ragalat, Qalubia, beside canal bank, 20.5.2003; El-Khanagry.

Nv. : Marioteia, Giza, Orange garden, 12.10.2000; Mohamed.

Note : This species was recorded in Boulos (2002) without any specimen kept in Kew collected from Egypt. The first collection was collected by El-Khanagry in 1986, determined and kept in the British Museum for Natural History. The other specimens kept in (CAIM) only.

3.10.7. *Glebionis coronaria* (L.) Tzvelev.

[Tack : M., Nd., V., S.D.; Hadi : M., Dl., Nv.; Boul 02 : N., M., S.]

Did : Ismailia, sandy soil, waste place, 9.4.1997; Mohamed.

3.11. Najadaceae

3.11.1. *Najas armata* Lindb.

[Tack : Nd., f., O., M., Di; Hadi : M., Di., N., O.; Boul 95 : N., O., M.S.]

Dwn : Nubaria canal, Cairo-Alexandria 160 km from Cairo, 27.5.1986; Triest and El-Khanagry (CAIM).

3.12. Pontederiaceae

3.12.1. *Eichhornia crassipes* (Mart.) Solms-Laub.

[Tack : N., O., M.; Hadi : M., N., O.; Boul 95 : N., O., M.]

L. Idku : near village No. 5 in fresh water, 28.5.1986; Triest and El-Khanagry (CAIM).

L. Manzala : east lake near Ras El-Esh village, in fresh water, 3.6.2002; El-Khanagry (CAIM).

3.13. Commelinaceae

3.13.1. *Commelina bengalensis* L.

[Tack : GE; Hadi : Sa.; Boul 95 : GE]

Nd : Toukh, Qalubia, maize field, 8.7.1996; Mohamed.

: Mit Kenana, Qalubia, maize field, 18.6.2001; El-Khanagry.

: Abu-Hammad, Sharkia, peanut field, 12.8.2002; El-Khanagry.

Did : El-Kassasin, peanut field, 7.8.2001; El-Khanagry. : Serabium, Sandy soil, peanut field, 23.7.2002, El-Khanagry.

3.14. Gramineae :

3.14.1. *Leptochloa panicea* (Retz) Ohwi

[Tack : Not recorded; Hadi : Nv. (canal bank and moist place); Boul 95 : N.]

Did : Serabium, sandy soil, peanut field, 30.8.2002; El-Khanagry (CAIM).

O. Natroun : St. Beshowi Monastery, sandy soil, 25.5.1986, El-Khanagry (CAIM).

Note : El-Khanagry (1993) collected this species from maize fields at Qalubia and Giza governorates.

3.14.2. *Chloris virgata* Sw.

[Tack : Nd., V., O., GE., (in fields); Hadi : Nn., O., Sa.; Boul 95 : N., O., GE.]

Did : El-Kassasin, 6th October farm, sandy desert land, 27.8.2002; El-Khanagry (CAIMG)

Dwn : Cairo-Alexandria desert road about 40 km from Cairo, sandy desert land, 24.7.2002; El-Khanagry (CAIM). : 6th October City, Oasis road, sandy desert land, 21.5.2002; El-Khanagry (CAIM)

Mm : Burg El-Arab, sandy soil, 15.5.2001; El- Khanagry (CAIM).

3.14.3. *Eleusine indica* (L.) Gaertn.

[Tack : Nd., Mma., S.; Hadi : M., N., O. S., R.; Boul 95 : N., M., S.]

Dis : Qantara Sharq, sandy soil, peanut field, 30.8.2002; El-Khanagry (CAIMG)

Dwn : El-Bostan Sector, sandy soil, peanut field, 24.7.2002; El-Khanagry (CAIMG).

3.14.4. *Acrachne racemosa* (Hyne ex Roem & Schult) Ohwi.

[Tack : Nd. (Abu Zaabal); Hadi : Nv.; Boul 95 : Nd.]

Dis : Qantara Sharq, sandy soil, peanut field, 30.8.2002; El-Khanagry (CAIMG)

Dwn : El-Bostan sector, sandy desert land, 24.7.2002; El-Khanagry (CAIMG).

Nd : Belbeis, peanut field, 7.8.2001; El-Khanagry (CAIMG)

Note : This species was recorded by Täckholm (1974), El-Hadidi & Fayed (1994/95) and Boulos (1995) without any specimens kept in CAI and CAIM.

3.14.5. *Digitaria sanguinalis* (L.) Scop.

[Tack : Nd., V., O., M., D.; Hadi : M., Dg., N., O., S.; Boul 95 : N., O., M., De., S.]

Rr : Hurgada, in parking, 12.9.2001; El-Khanagry (CAIM).

3.14.6. *Brachiaria reptans* (L.) C.A. Gardner & C.A. Hubb.

[Tack : Nd., V., M.; Hadi : M., Nv.; Boul 95 : N., M., De.]

Dis : Qantara Sharq, sandy soil, peanut field, 30.8.2002; El-Khanagry (CAIMG).

O. Natroun : Mary Guirgis Monsantery, sandy soil (east Wadi El-Natroun, and irrigated with underground water), 6.10.2002; El-Khanagry (CAIM).

Rr : Hurgada, in parking area, 12.9.2001; El-Khanagry (CAIM).

3.14.7. *Urochloa panicoides* P. Beauv.

Nd : Belbeis, peanut field, 12.8.2002; El-Khanagry (CAIMG).

Nv : Agric. Res. Sta., Fac. Agric., Cairo Univ., Giza, maize field, 23.10.2002; El-Khanagry (CAIM).

Did : Serabium, sandy soil, peanut field, 30.8.2002; El-Khanagry (CAIMG).

Dwn : El-Bostan sector, sandy soil, peanut field, 27.8.2002; El-Khanagry (CAIM).

Note : This species is a new record in Egypt, the first collection by Mohamed, A.A., in 12.10.2000, from garden at Marioteia, Giza, also it was determined by T. Cop and kept at Kew.

3.14.8. *Paspalum dilatatum* Poir

[Tack : Nd. (Cairo); Hadi : Nv., S.; Boul 95 : N., S.]

Mm : Alexandria-Matruh International road near El-Hamam, in parking, 15.5.2003; El-Khanagry (CAIM).

Rr : Hurgada, in garden, 12.9.2002; El-Khanagry (CAIM).

3.14.9. *Echinochloa crusgalli* (L.) P. Beauv.

[Tack : N., O., M., Di.; Hadi : M., N., O.; Boul 95 : N., O., M., De.]

Rr : Hurgada, in parking, 12.9.2002; El-Khanagry (CAIM).

3.14.10. *Cenchrus echinatus* L.

[Hadi : Nv.; Boul 95 : N.]

Mm : Balteim-Gamasa International road, desert land, 20.10.2003; El-Khanagry (CAIM).

Did : Qantara Sharq, sandy soil, peanut field, 30.8.2003; El-Khanagry (CAIMG) : Agric. Res. Sta., Ismailia, sandy desert land, 28.8.2002; El-Khanagry (CAIMG).

Dwn : Cairo-Alexandria desert road, sandy desert land, 24.7.2002; El-Khanagry (CAIM).

O. Natroun : sandy desert land, 14.5.2001; El-Khanagry (CAIM).

Rr : Hurgada, in parking, 12.9.2002; El-Khanagry (CAIM).

3.14.11. *Setaria viridis* (L.) P. Beauv.

[Tack : Nd., Di., GE., S.; Hadi : Di., Nv., O., S.; Boul 95 : N., O., De., S.]

Mm : Burg El-Arab, St. Mina Monastery, 6.3.2003; El-Khanagry (CAIM).

Rr : Hurgada, in parking, 12.9.2002; El-Khanagry (CAIM).

Note : El-Hadidi and Fayed (1994/95) reported that *S. viridis* was found in reclaimed lands and sandy soil, while, this species is found in all soil types in new and old lands.

3.14.12. *Dichanthium annulatum* (Forssk.) Stapf.

[Tack : N., O., Mma., Di., a.; Hadi : M., Di., Dg., N., O., S.; Boul 95 : N., O., M., De., S.]

Rr : Hurgada, in parking, 14.9.2000; El-Khanagry (CAIM).

3.14.13. *Vossia cuspidata* (Roxb.) Griff.

Nd : Desouk, in canal, 12.5.2000; El-Khanagry (CAIM)

: El-Kassasin, Ismailia canal, 12.8.2002; El-Khanagry (CAIM)

: Kafr El-Ragalat, Qalubia, in irrigation canal, 20.5.2003; El-Khanagry (CAIM).

Nv : El-Moneib, Giza, River Nile, 15.5.2003; El-Khanagry (CAIM).

: Bahr Yousef, Fayoum, 21.5.2002; El-Khanagry (CAIM).

: Assiut, River Nile, 13.5.2003; El-Khanagry (CAIM).

Note : This species was recorded by El-Hadidi and Fayed (1994/95) and Boulous (1995) without any location and collection in (CAI), while it was collected by J.R. Shabetai from Bush, Bahr Yousef, 31.12.1928 and Gheit El-Nassara, Damietta and determined as *Saccharum biflorum*. On the other hand, this species does not give flowers or fruits in Egypt. It propagates by rhizomes, or stem parts. Internodes hollow in *V. cuspidata* and solid in *S. spontaneum*.

3.15. Lemnaceae

3.15.1. *Lemna trisulca* L.

L. Idku : middle lake Idku, near village No. 5 in fresh water, 28.5.1986. Triest & El-Khanagry (CAIM). This species is a new record in Egypt determined by L. Triest and kept in Herbarium of Vrize University, Brusiel.

The previous results indicate that 38 species were recorded in Egypt for the first time in specific phytogeographical regions. The introduction of these species could be justified to various factors. This may be summarized in the following :

Trianthema portulacastrum, *Cuscuta campestris*, *Galinsoga parviflora*, *Leptochloa panicea*, *Urochloa panicoides*, *Acrachne racemosa*, *Cenchrus echinatus* and *Commelina bengalensis* were introduced with fodder compounds or wheat grains. *Lemna trisulca* emigrated with birds from foreign countries. *Cynanchum acutum*, *Conyza bonariensis* and *Symphytotrichum squamatus* transferred by means of air. Some species

might be transferred from a location to another through humans or animals as *Bidens pilosa*, *Cenchrus echinatus*. Meanwhile, *Tagetes minuta* was transferred to its new locations through agricultural experiments. *Vossica cuspidata* was transferred by water from the River Nile to various canals. Plants recorded in the Red Sea region might be introduced with soil transferred to this region from old Nile land. In addition, new recorded species in Sinai may be moved by Nile water and organic fertilizers.

It is worthy to note that some species were not reported in Sinai by Abdallah *et al.* (1984), Gibaly (1988 and 2000), El-Husseini and Hosni (1989), El-Husseini and Zareh *et al.* (1989), El-Karemy and El-Naggar (1989), El-Naggar (1989), Fayed (1989), Hosni (1989a and 1989b), Hosny (1989) and Cope and Hosni (1991).

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مراجعة توزيعات بعض الأنواع النباتية في الفلورا المصرية
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قسم بحوث الفلورا وتصنيف النباتات - معهد بحوث البساتين-
مركز البحوث الزراعية- الجيزة - مصر

ملخص

يظهر هذا البحث التوزيعات الجديدة لبعض الأنواع النباتية في الفلورا المصرية داخل المناطق الجغرافية النباتية المختلفة. قورنت نتائج البحث بالتوزيعات المختلفة التي اقترحتها كل من تاكهولم (١٩٧٤)، الحديدي و فايد (٩٥/١٩٩٤) وبولس (١٩٩٥، ١٩٩٩، ٢٠٠٠، ٢٠٠٢). ضم البحث ٣٧ نوعاً ذات توزيعات جديدة تتبع ٣٤ جنساً و ١٨ فصيلة.

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