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Phyton (Austria)	Vol. 14	Fasc. 1–2	41–53	16. XII. 1970

Contribution to the autecology of *Urginea maritima* in Egypt

By

Kamal Hassan BATANOUNY & Taha KHALIFA *)

Faculty of Science, Cairo University and Chemical Industries Development Co., Egypt

With 5 Figures

Received April 13, 1970

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1. Introduction

Urginea maritima (L.) BAKER, the squill, is reputed for its medicinal value due to the bulb contents of cardiac glycosides (Scillarin) as well as the bulb extract used in expectorants. NELSON 1951 stated that in small doses it acts as an expectorant, in large doses as an emetic, while it has a digitalis-like action on the heart. STOLL 1937 wrote that squill became neglected as a result of the enthusiasm over foxglove, but it has a value of its own and does not simply live on the failiure of other heart remedies (quoted from KREIG 1966). This old drug was known since pharaonic times. KREIG 1966 mentioned that the Ebers Papyrus of about 1500 B. C. contains an Egyptian heart-disease prescription made of specified portions of squills and parts of other plants.

*) Present address: Dr. K. H. BATANOUNY, College of Science, University of Baghdad, Iraq.

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A variety of this species with red bulbs (red squills) is used widely in commercial rodenticides (NELSON 1951 and KINGSBURY 1964). The latter author mentioned that material for commercial use is obtained from countries about the Mediterranean where the plant is common.

Recently in Egypt, the bulbs of white squill are collected from their natural habitats to get extracts used in different medical purposes. Both white and red squills grow in the semi-arid coastal region of Egypt along the Mediterranean. Autecological study on the squills may be of value in recognition of the habitats supporting each kind. Estimation of the productivity of the bulbs per unit area will throw light upon the potentialities of the natural habitats. The increasing need to the bulbs may lead to cultivation of this plant, due to limited natural resources. So the aquaintance with the environmental conditions under which the plant grows will be of great help.

In the present investigation, the distribution, habitat conditions, phytosociology of the communities dominated by this species and the productivity under natural conditions were studied.

2. The studied species

The genus *Urginea* STEINH. (= *Squilla* STEINH.) is a liliaceous plant belonging to the subfamily *Scilloideae* (MAIRE 1958) including about 75 species distributed in Europe, Mediterranean region, India, Tropical and South Africa.

The genus *Urginea* comprises two species growing in Egypt viz. *U. undulata* STEINH. and *U. maritima* STEINH. The former has small bulbs and undulated narrow linear leaves, while the latter has large bulbs and broad lanceolate leaves. *Urginea maritima* is a polymorphic species with different varieties and forms. This species grows mainly in the Mediterranean countries. TÄCKHOLM & DRAR 1954 mentioned that *U. maritima* grows in Cyrenaica, Tripolitania, Tunisia, Algeria, Marocco, Canaries, Iberian Penninsula, South France, Corsica, Italy, Sicily, Malta, Balkan, Crete, Cyprus, Anatolia, Syria, Lebanon, Palestine and Transjordan. It is cultivated as an economic plant in certain parts of the Mediterranean e. g. Cyprus and Malta.

In Egypt, *U. maritima* grows in the coastal Mediterranean region in both eastern and western zones. Moreover, it grows on stony grounds and ascending hills in the isthmic desert north of Sinai and the Lybian plateau bordering Sallum gulf.

As mentioned above, *U. maritima* is a polymorphic species with various varieties and forms. TÄCKHOLM & DRAR 1954 and TÄCKHOLM 1956 stated

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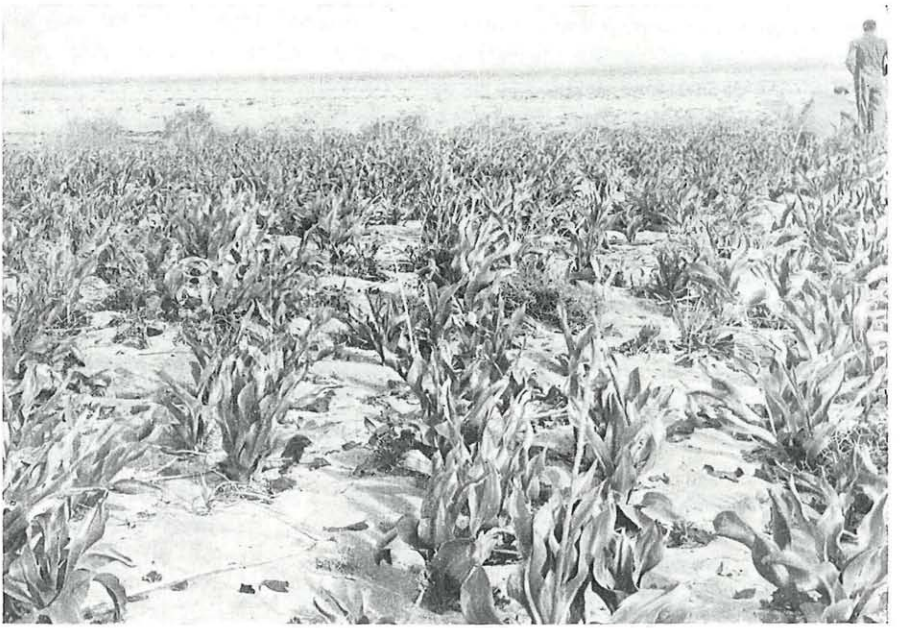

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2

Fig. 1. Photo showing the dense coverage of *Urginea maritima* in a stand at Sidi Barrani, Egypt. — Fig. 2. Top view of a group of bulbs of white squill growing together. The soil covering the bulbs is removed.

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that there is one variety (var. *pancration*) in addition to the type growing in Egypt. But the present authors believe that in Egypt there are three distinct morphological features of the bulbs collected from different localities. The specimens collected from Sidi Barrani along the western Mediterranean zone, show two features regards the colour and size of the bulb. The average diametre of the bulb of white squill is 8.5 cm while it amounts to 17 cm in the case of red squills. On the other hand, in the specimens collected from the eastern Mediterranean zone between El-Arish and Rafah, the bulbs have intermediate diametre and their white tunics have reddish tinge. So, squills growing in Egypt show three distinctive features regarding the morphology of their bulbs. One with moderate size and reddish tinge in the eastern coastal region, the second with white tunics and small size, while the third with dark-red tunics and very large bulbs, the latter two grow in the western Mediterranean coastal region. It is noteworthy to know that the phytochemical screening showed that they are different regards their constituents. Both taxonomical and phytochemical studies must be conducted on the squills growing in Egypt.

Due to the abundance of white and red squills at Sidi Barrani in the western Mediterranean zone and the unvailability of data on the plants growing in the eastern zone, the investigation will be devoted to plants growing in the former region. In addition, the white squills growing in this western Mediterranean zone represent the source of squills collected for pharmaceutical purposes in Egypt.

3. Phenological aspects of the plants

The phenology of this species is interesting, showing different aspects over the year around. The aspects vary, regards timing, according to the prevailing environmental conditions. The knowledge of these aspects is important from the phytochemical point of view. Collection of the bulbs is recommended to be before flowering. Further studies may reveal the preference of another stage for collection.

Leaves appear at the beginning of winter i. e. at the onset of the rainy season. They are broader and longer in red squills than in white squills. Leaves become dry by the onset of summer and the plant becomes dormant for a period of 2—3 months depending on the climatic conditions and mainly on the available soil moisture. In August or even one month later flowers appear. Flowers are carried on long scapes. Red squills have longer and more stout scapes (1 m), while white squills have shorter ones (60 cm). Fruits are produced by the end of October. They are larger in red squills than in white squills. Seeds are minute, very light, compressed and dark-glossy coloured.

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4. Climatic conditions

The climatological data representing the prevailing conditions in areas inhabited by squills are those recorded in El-Arish and Sidi Barrani meteorological stations along the Mediterranean coastal region. The data (Table 1) are obtained from the Climatic Normals of Egypt (1955) published by the Meteorological Department. On the basis of EMBERGER's classification of the world into climatic regions (EMBERGER 1955) the area in which the studied plants grow is of the Saharo-Mediterranean type. Rainfall is scanty, variable and irregular. The average annual rainfall in the areas inhabited by squills ranges from 97 to 149 mm at El-Arish and Sidi Barrani,

Table 1

Rainfall and mean January and July values of climatic factors at Sidi Barrani and El-Arish Meteorological stations

Climatic factor		Station	
		Sidi Barrani	El-Arish
Rainfall	Total annual (mm)	149	97
	No. of rainy days	20.8	17.1
Temperature °C	January	12.3	12.0
	July	23.8	25.4
	Annual mean	18.4	19.5
Relative Humidity %	January	72	75
	July	74	76
	Annual mean	70	74
Evaporation mm/day	January	4.8	3.4
	July	7.0	5.1
	Annual mean	6.3	4.6

respectively. Evaporation, though lower than in the inland desert, is fairly high in summer indicating considerable desiccating stress upon the plants. The studied plants live during the major part of the dry period in a leafless dormant stage. The period of vegetative growth is variable depending on the climatic conditions, particularly rainfall. The same holds true regards the date of flowering. The period of vegetative growth is longer and the date of flowering is earlier in rainy years than in years with low rainfall.

Temperature and humidity conditions are more or less favourable for plant growth specially in winter and spring when the plant is leafy.

Generally, the climatic conditions are more favourable for plant growth in the areas occupied by the studied species than in the inland deserts. Landwards, to the south of the coastal region, the amount of rainfall decreases rapidly and the climatic conditions become severe. The growth of squills is restricted to the coastal part with a width not exceeding 30 km.

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5. Soils

Field observations show the differences between soils supporting the white and red squills. White squills grow on shallows soils with stones, pebbles and lime concretions on the surface and in the profile. These soils get harder and harder by depth till a shallow hard layer at a depth of 25—40 cm. On the other hand, soils supporting the red squills are loose, easily penetrable, deep and brownish with red tinge. No stones or pebbles are present in these soils. The figures representing the average data of

Table 2

Analysis of soils supporting the communities dominated by white and red squills in the western Mediterranean coastal region in Egypt

Type of squill	Depth (cm)	Granulometric analysis (% fraction) Diametre (mm)				pH	Total Soluble Salts (%)	Total Carbonate content (%)	Organic Carbon content (%)
		2—0.2	0.2—0.08	0.08—0.04	<0.04				
White squill	0— 5	52.42	27.95	15.92	3.72	8.3	0.27	5.0	0.15
	5—10	54.38	29.34	14.44	1.84	8.4	0.24	6.3	0.20
	10—25	53.41	30.77	13.78	2.04	8.1	0.31	12.5	0.25
	25—50	46.68	29.10	18.60	5.62	8.2	0.24	21.3	0.20
Red squill	0— 5	70.3	20.4	8.3	1.0	8.2	0.23	0.5	0.15
	5—10	70.2	21.9	6.8	1.1	8.6	0.20	0.8	0.07
	10—25	68.7	19.8	10.3	1.2	8.2	0.19	1.0	0.05
	25—50	71.7	18.8	8.4	1.7	8.4	0.18	7.0	0.11

analysis of soils supporting the white and red squills are exhibited in Table 2. Examination of these data shows that soils supporting the red squill are more coarse-textured and with lower contents of total soluble salts, $CaCO_3$ and organic carbon than those supporting white squills. Both soils have pH values higher than 8 as the majority of the soil types in Egypt.

Soil depth, penetrability and $CaCO_3$ content may be considered the most important factors affecting the distribution of squills in the Mediterranean region.

6. Communities dominated by squills

The communities dominated by squills occupy areas scattered in the western coastal Mediterranean region. These communities inhabit patches in the area occupied by the alliance Thymelaeion hirsutae. This alliance

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Table 3

Floristic composition of stands in the communities dominated by white and red squills in the western Mediterranean coastal region to the east of Sidi Barrani, Egypt

Species	No. of stands (White squill)								No. of stands (White squill)				No. of stands (Red squill)							W. sq.	R. sq.
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	Presence Class	
Urginea maritima (L.) BAKER																					
White squill	2.I	2.I	2.I	2.I	3.I	3.I	2.I	2.I	I.+	2.+	3.I	2.I	–	–	–	–	–	–	–	V	–
Red squill	–	–	–	–	–	–	–	–	–	–	+.+	+.+	2.+	3.I	3.I	2.I	3.I	2.I	I.I	I	V
Thymelaea hirsuta (L.) ENDL.	I.+	I.+	I.+	I.+	I.+	I.+	I.+	I.+	2.I	+.+	I.I	I.+	I.+	I.+	+.+	+.+	+.+	+.+	+.+	V	V
Plantago albicans L.	I.I	I.+	+.+	I.+	+.+	+.+	I.+	I.+	I.+	+.+	+.+	I.I	+.+	I.+	+.+	+.+	+.+	I.+	I.+	V	V
Asphodelus microcarpus SALZM. & VIV.	+.+	I.+	I.+	I.+	I.+	I.I	I.+	+.+	+.+	+.+	+.+	I.+	+.+	–	–	+.+	I.+	+.+	I.+	V	IV
Pithyranthus tortuosus (DESF.) BENTH. & HOOK.	+.+	I.+	+.+	+.+	+.+	+.+	–	+.+	+.+	+.+	–	+.+	+.+	+.+	+.+	+.+	+.+	+.+	–	V	V
Helianthemum lippii (L.) DUM. COURS.	+.+	+.+	–	–	–	+.+	+.+	+.+	–	–	+.+	+.+	+.+	–	I.+	+.+	+.+	+.+	+.+	III	V
Salvia lanigera POIR.	–	–	–	–	+.+	+.+	+.+	+.+	+.+	–	+.+	–	+.+	+.+	–	+.+	–	+.+	+.+	III	IV
Daucus syrticus MURB.	–	–	–	–	+.+	+.+	+.+	+.+	–	–	+.+	–	–	+.+	+.+	–	+.+	+.+	+.+	III	IV
Launaea resedifolia JAH. & MAIRE	+.+	–	–	–	–	+.+	–	+.+	–	–	–	+.+	–	+.+	–	+.+	–	+.+	+.+	II	III
Adonis dentata DEL.	–	–	–	–	+.+	–	–	+.+	+.+	–	+.+	+.+	–	+.+	–	–	–	–	+.+	III	II
Noaea mucronata (FORSK.) ASCH. & SCHWEINF.	+.+	–	–	–	+.+	–	–	–	–	–	+.+	+.+	–	+.+	+.+	–	–	–	–	II	II
Echinops spinosissimus TURRA	–	–	+.+	+.+	–	+.+	–	–	–	–	–	–	+.+	–	–	–	+.+	+.+	–	II	III
Picris radicata (FORSK.) LESS.	+.+	+.+	–	–	–	–	–	–	–	–	+.+	–	–	–	+.+	–	+.+	+.+	–	II	III
Matthiola humilis DC.	–	–	+.+	+.+	–	–	+.+	–	–	–	–	–	–	–	+.+	–	–	–	–	II	I
Hedysarum spinosissimum L.	+.+	+.+	–	–	–	+.+	–	–	–	–	–	–	–	–	–	+.+	–	–	–	II	I
Medicago truncatula GAERTN.	–	–	–	–	–	–	–	–	–	–	–	+.+	–	–	–	–	+.+	–	+.+	I	II
Thesium humile VAHL	+.+	+.+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+.+	I	I
Anthemis microsperma BOISS. & KY.	–	+.+	–	–	–	–	–	–	–	–	+.+	–	–	–	–	–	–	–	+.+	I	I
Anagallis arvensis L.	–	–	–	–	–	–	–	–	+.+	–	–	–	–	–	–	–	–	–	+.+	I	I
Malva aegyptica L.	+.+	–	–	–	–	–	–	–	–	–	–	–	+.+	–	–	–	–	–	–	I	I
Erodium laciniatum (CAV.) WILLD.	–	–	–	–	–	–	–	–	+.+	–	–	–	–	–	–	–	–	–	+.+	I	I
Teucrium polium L.	+.+	–	+.+	+.+	+.+	+.+	+.+	–	+.+	+.+	+.+	–	–	–	–	–	–	–	–	IV	–
Gymnocarpus decandrum FORSK.	+.+	+.+	+.+	+.+	+.+	–	+.+	–	–	–	–	I.+	–	–	–	–	–	–	–	III	–
Scabiosa arenaria FORSK.	+.+	–	–	–	+.+	–	+.+	+.+	–	–	+.+	+.+	–	–	–	–	+.+	–	+.+	III	II
Argyrolobium uniflorum (DECNE.) JAUB. & SP.	–	–	+.+	+.+	–	+.+	+.+	–	–	–	+.+	–	–	+.+	–	–	–	+.+	–	III	II
Ranunculus asiaticus L.	+.+	–	–	–	+.+	+.+	–	–	–	–	–	–	–	–	–	–	–	–	–	II	–
Stipa lagascae ROEM. & SCH.	+.+	–	–	–	–	+.+	–	–	–	+.+	–	–	–	–	–	–	–	–	–	II	–
Echiochilon fruticosum DESF.	I.+	–	–	–	–	+.+	–	–	–	+.+	+.+	–	+.+	I.+	I.+	I.I	I.+	2.+	2.I	II	V
Arisarum vulgare TARG. & TOZZ.	+.+	–	+.+	+.+	–	+.+	+.+	–	–	–	–	–	I.I	+.+	+.+	+.+	–	+.+	+.I	III	V
Lotus pusillus MEDIK.	+.+	–	–	–	–	–	–	–	–	–	–	–	–	+.+	+.+	–	+.+	+.+	+.+	I	IV
Cutandia dichotoma (FORSK.) BATT. & TRAB.	–	–	–	–	–	–	+.+	–	+.+	–	+.+	–	+.+	–	–	+.+	–	+.+	+.+	II	III
Ifloga spicata (FORSK.) SCH.-BIP.	–	–	–	–	–	–	–	+.+	–	–	+.+	–	+.+	–	–	+.+	–	+.+	+.+	II	III
Centaurea furfuracea COSS. & DUR.	–	–	–	–	–	–	–	–	–	–	–	–	+.+	–	–	+.+	–	+.+	+.+	–	III
Pseudorlaya pumila (L.) GRANT.	–	–	–	–	–	–	–	–	–	–	–	–	+.+	–	–	+.+	–	+.+	–	–	III

Species growing only with white squills (Presence class I): *Filago spathulata* PRESL, *Bupleurum semicompositum* L., *Anabasis articulata* (FORSK.) MOQ.-TAND., *Trigonella maritima* DEL., *Ononis reclinata* L., *Launaea nudicaulis* (L.) HOOK., *Helianthemum vesicarium* BOISS., *Artemisia herba-alba* ASSO, *Stipa capensis* THUNB., *Linaria haelava* (FORSK.) DEL., *Astragalus tribuloides* DEL.

Table 3: Continuations

Species growing only with red squills (Presence class I): *Schismus barbatus* (L.) THELL., *Reichardia orientalis* (L.) HOCHR., *Hedypnois rhagadioloides* (L.) F. W. SCHMIDT, *Leoflingia hispanica* L., *Aristida plumosa* L., *Crucianella herbacea* FORSK., *Carduus getulus* POMEL, *Paronychia arabica* (L.) DEL., *Rumex pictus* FORSK.

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as well as the associations belonging to it were defined by numerous authors (MIGAHID & al. 1963, 1971; TADROS 1966 and ZAKI 1968). Those authors made no reference to the difference between habitats inhabited by white or red squills. MIGAHID & al. 1963 during their studied in a sector at Sidi Barrani, considered *Urginea maritima* to be a characteristic of the association of *Artemisia herba-alba*. MIGAHID & al. 1971 during their study of another sector at Sidi Barrani, considered *Urginea maritima* to be a characteristic of the association of *Plantago albicans — Echiochilon fruticosum*. The latter opinion was considered by ZAKI 1968. TADROS 1966 considered *Urginea maritima* "without specification of white and red squills" to form a sub-association among the communities inhabiting the coastal zone of Sidi Barrani. This classification was considered by him as provisional.

According to the study of the present authors, the species considered by MIGAHID & al. 1963 to be one of the characteristics of the association of *Artemisia herba-alba*, is the white squill. The other considered to be a one of the characteristics of the *Plantago — Echiochilon* association, is the red squill. Both are included in the classification of TADROS 1966.

The communities dominated by squills occupy patches of different areas ranging from few square metres to 2 sq. km. Their appearance is controlled by variations in the soil conditions. In patches occupied by white or red squill, the plant cover is more dense than the surroundings during spring time. During that time, an area occupied by squills could be easily spotted from bird's eye view due to their broad green leaves covering a considerable area of the ground surface which may amount to 80% (Photo Fig. 1). By the onset of summer, their green foliage dries out and the plant cover diminishes to a great extent reaching about 20%. The collection of bulbs at that time "before flowering" represents a problem due to the absence of the leaves and the disappearance of the bulbs below the ground surface. The native Bedouins have the experience to spot the location of the underground bulbs. The most interesting feature, facilitating the collection of the bulbs is the growth of *Urginea maritima* with high gregariousness. This is more evident in red squill than in white squill. More than 30 bulbs may grow together beside each other. Photo Fig. 2 shows a top view of numerous bulbs growing together, the soil covering them being removed.

Twelve stands in the community dominated by white squill and seven stands in that dominated by red squill were studied. The data collected are shown in Table 3. The area of the stand studied represent the minimal area. Each species is given 2 figures, the first represents the mixed abundance-dominance scale and the second represents the sociability scale (BRAUN-BLANQUET 1964).

The data in Table 3 show that each of the studied squills has its own associate species showing high presence values in the stands dominated by

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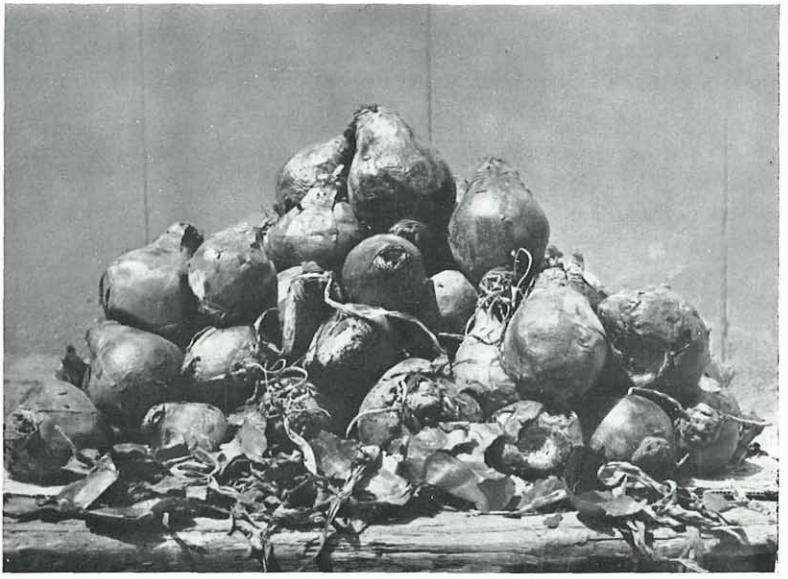

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Fig. 4. Bulbs of white squill collected from an area of 84 m² in the coastal Mediterranean region, Egypt. — Fig. 5. Bulbs of red squill collected from an area of 42 m² in the coastal Mediterranean region, Egypt.

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each of them. It may be considered that the group of these species growing with white squills has more fidelity to the habitat inhabited by white squills than to that inhabited by red squills. The species showing higher presence values in the habitat occupied by white squill than with red squill are: *Teucrium polium*, *Gymnocarpus decandrum*, *Scabiosa arenaria*, *Argyrolobium uniflorum*, *Ranunculus asiaticus* and *Stipa lagascae*. The group of species with higher presence values in habitats of red squill than those of white squill are: *Echiochilon fruticosum*, *Arisarum vulgare*, *Lotus pusillus*, *Cutandia dichotoma*, *Ifloga spicata*, *Centaurea furfuracea*, and *Pseudorlaya pumila*.

An interesting observation is that the majority of the species with high fidelity to the habitat of white squill are characteristics of the *Gymnocarpus decandrum* association (Migahid & al. 1963, 1971 and Zaki 1968). On the other hand the majority of the species with high fidelity to the habitat of the red squill are characteristics of the *Plantago albicans* — *Echiochilon fruticosum* association defined by the latter authors. It is noteworthy to know that soils supporting *Gymnocarpus decandrum* association are shallow, rocky, hardly penetrable with stones on the soil surface and in the profile and exposed to erosion. Soils supporting the *Plantago albicans* association are deep, loose, easily penetrable and without stones. As evident from the data of soil analysis shown in Table 2, soils supporting white and red squills show different characters regards depth, texture and $CaCO_3$ content. Such differences are comparable to those between soils supporting the association of *Gymnocarpus decandrum* and *Plantago albicans*.

In addition to the two groups of species with high fidelity to each of the habitats supporting white and red squills, there are other two groups of species with low presence values in these habitats. Moreover, there is another group of species growing in both habitats with more or less equal presence values. The important species of this group in both communities are: *Thymelaea hirsuta*, *Plantago albicans*, *Asphodelus microcarpus*. *Pithyranthus tortuosus*, *Helianthemum lippii*, *Salvia lanigera*, and *Daucus syrticus*.

As evident from Table 3, both white and red squills may grow in the same area, with one dominating the other. This may be attributed to the soil conditions. The soil depth is one of the effective factors on the distribution of both types of squills. In an undulating area with sand accumulation of varying depths, the distribution of squills is studied. Charts were made at different levels on the sandy hill as well as in the surrounding flat area with shallow soil. These charts shown in Fig 3, were drawn along a transect crossing a sandy hill about 4 m high till a distance of 150 m apart from the top of the hill in a flat area. Fig. 3a represents a chart on the top of the hill, Fig. 3b a chart on the slope, Fig. 3c a chart in a flat area exposed to erosion while Fig. 3d is located 150 m apart from the first one. Spot "a" has the deepest soil being more than 1 m deep, spot "b" has soil of about

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50 cm deep, spot "c" has the shallowest soil being 15 cm deep while spot "d" has a soil 35 cm deep.

Examination of the charts in Fig. 3 reveals that in spot "a" with the deepest soil, the red squills are prosperous and attain their highest growth. In spot "b", the growth is less prosperous and the red squills have low cover. In shallow soils of spot "c", white squills begin to appear, but both types show poor growth and low cover. In spot "d", no red squills appear

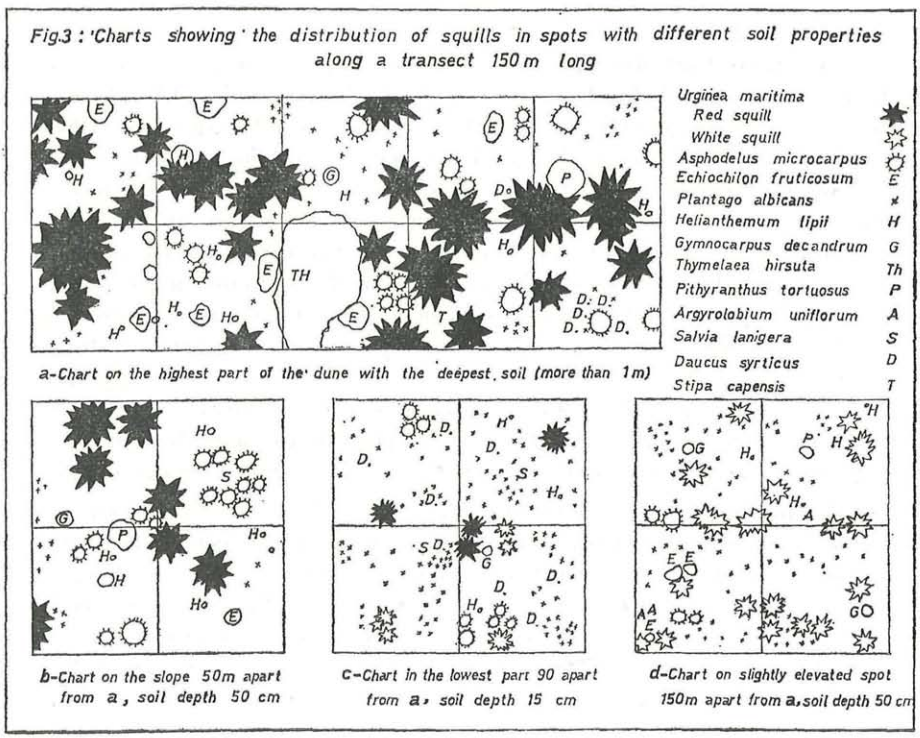

Fig. 3

and the white squills dominate the plant cover. So the deep sandy soils of spot "a" represent a favourable habitat for the red squills. Spot "d" with relatively shallow soil represent a favourable habitat for the white squills. It is not only the depth which affects the distribution of the squills but also the origin of the soil. The sandy hill supporting the red squills is mainly of sandstone origin, while the spot occupied by white squills has soils of limestone origin. In the latter spot, stones are present on the soil surface as well as in the soil. These findings are in agreement with the data of soil analysis shown in Table 2.

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7. Productivity of squill bulbs under natural conditions

Bulbs of naturally growing plants represent the source for pharmaceutical industries. Hence, it is important to evaluate the productivity of bulbs under natural conditions. Bulbs growing in an area of 42 m² (0.01 acre) were collected, counted, weighed and their diametres measured. This was repeated in different stands (10 for each kind) in areas inhabited by white and red squills. Photo Fig. 4 shows the bulbs collected from an area of 84 m² of white squill. Photo Fig. 5 shows the bulbs collected from half the area of red squill. Table 4 shows that an area of 100 m² has an average number of white squill bulbs amounting to 430, with an average weight of 70 kg. In analogous area, there are 250 bulbs of red squills weighing on the average 123 kg. The average weight of one bulb is about 163 and 492 gms, in white and red squills, respectively. It must be taken into

Table 4

Productivity of white and red squills in the Mediterranean coastal region at Sidi Barrani, Egypt

	White squill		Red squill	
	Range	Average	Range	Average
Total plant cover (%)	50—70	60	60—80	68
Cover of squills (%)	20—40	25	50—75	60
Diametre of the mature bulb (cm)	6—12	8.5	12—23	17
No. of the bulbs/100 m²	181—700	430	108—400	250
Wt. of the bulbs/100 m² (kg)	62—132	70	92—158	123

consideration that the number and weight of bulbs include very small as well as mature bulbs in the sample area. Measurements of the diametre of the bulbs were conducted only on mature bulbs. The mean diametre of red squill bulbs is as twice as that of white squill bulbs, being 17 and 8.5 cm in the two kinds, respectively.

Regards the percentage cover of the individuals of any kind in its community, there is a wide difference. The average cover of white squills is 25%, while it reaches 60% in case of red squills. Such percentages of cover represent about 40% of the total plant cover in the community dominated by white squills and about 88% with respect to red squill. This shows how far red squills dominate the area inhabited by them.

It is interesting to know the number of bulbs per 100 m² in an area from which the white bulbs were collected since three years before the present investigation. This number amounts to 185, which is not below the minimum number of bulbs from a similar area from which no bulbs were collected. This means that after the removal of white bulbs from an area,

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a more or less equal number of plants will be established after a period of three years. But it must be noted that the weight of the newly established bulbs amounts to 13.7 kg compared with 70 kg from a natural area. In other words, the average weight of newly established bulb after a period of three years is 74 gm. This confirms that reestablishment of a community of white squills needs more than three years. The continuous exploitation of the natural resources without management may lead to the deficiency of the needed bulbs for pharmaceutical uses. Here arises many problems, viz. germination of seeds, cultivation of the plant and the optimum conditions for its growth. These problems must be dealt with and solved. The present investigation throws light upon the favourable habitat conditions for plant growth. The plant being unpalatable, there is no fear to cultivate it in the coastal Mediterranean region without exclosure. Reseeding of this plant must be in the areas from which the bulbs were collected. One must note that the collection of bulbs before flowering, as recommended, leads to the diminution of the number of produced seeds.

8. Summary and conclusions

Urginea maritima is a medicinal plant growing in the Mediterranean coastal region in Egypt. It comprises two main kinds of squills different regards the colour of the tunics, leaf shape, scape length and fruit size.

The phenological aspects of this species all the year around are very interesting. They are dependent regards timing on the prevailing climatic conditions particularly rainfall. They could be summarised as follows:

Leafy stage	from December—January	to April
Dormant stage	from May	to August
Flowering stage	from August—September	to October
Fruiting stage	from November	to December.

The growth of *Urginea maritima* is restricted to the Coastal region in Egypt, where the climatic conditions are favourable for plant growth. To the south of the coast about 30 km there are no squills. The climate conditions in the inland desert are unfavourable for their growth.

Soils supporting both types of squills are different regards their physical and chemical properties. Soils supporting white squills are shallower, more compact, with higher content of carbonates and soluble salts than those supporting red squills. The soils inhabited by red squills are of sandstone origin while those supporting white squills are of limesone origin.

Communities dominated by different types of squills occupy patches of different areas ranging from few sq. m to 2 sq. km. The total plant cover during spring time is higher in the communities dominated by red squills than in communities dominated by white squills. The plant cover is 60% in case of white squills and 68% in the communities of red squills.

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The species with high fidelity to the habitat of the community dominated by red squill are characteristics of the *Plantago albicans-Echiochilon fruticosum* association. Those with high fidelity to the habitat of the community dominated by white squill are characteristics of the *Gymnocarpus decandrum* association. The soils supporting the white and red squill communities are comparable to those supporting the *Gymnocarpus* and *Plantago* associations.

The average weight of white squill bulbs produced from 100 m^2 is 70 kg for an average number of 430 bulbs. In case of red squills the average weight is 123 kg for 250 bulbs.

Reestablishment of the white squill community needs more than three years. An area from which white squill bulbs were removed since three years produced a number of bulbs not less than the minimum number of bulbs found in a natural area. In spite of this, the weight of the newly produced bulbs is about 20% of that produced from a similar area under natural conditions.

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Digitale Literatur/Digital Literature

Zeitschrift/Journal: Phyton, Annales Rei Botanicae, Horn

Jahr/Year: 1970

Band/Volume: 14_1_2

Autor(en)/Author(s): Batanouny Kamal Hassan, Khalifa Taha

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