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AUCES

THE BIOLOGY OF EGYPTIAN WOODY PERENNIALS
1. *Nitraria retusa* (Forssk.) Asch.

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ABSTRACT :

Nitraria retusa is one of the leading shrubs in steppes, deserts and salines forming almost pure stands on the periphery of marshes and occurs mainly in inland salines, but sometimes reaches the sea shore (e.g. Egypt). It is definitely Saharo-Arabian with some trends towards Sudanian territories. Its distribution in Egypt includes the Nile region, oases of the western desert, the Mediterranean and Red Sea coastal strips, eastern and western deserts and Sinai. The phytochemical investigation of this plant reveals the presence of carbohydrates and/or glycosides, reducing sugars, tannins, saponins, sterols, alkaloids, flavonoids, sulphates and chlorides. Thirteen free amino acids and four unsaturated fatty acids were also detected. *Nitraria retusa* is an indicator of shallow water table, sand controller, palatable to grazing animals, phytoremidator of polluted soil, used as fuel and its fruits are edible by birds and local inhabitants. The effective flowering process occurs during two periods: March-May and October-December. This salt tolerant bush has considerable tolerance for drought due to deep and well developed root system, and has the ability to form huge phytogenic mounds which conserve considerable moisture in its body. The maximum seed germination of this plant was 35%, thus further studies are recommended to explore the reasons of this dormancy. Its size structure along the Egyptian Red Sea coast is characterized by the preponderance of the young individuals comparing with the old ones.

INTRODUCTION:

The Egyptian woody perennials approximate 465 species (19.6% of the whole Egyptian flora): 33 trees, 256 shrubs and 176 shrublets. Based on the local abundance, 346 of these species (74.4% of the woody perennials) are categorized under the rare or very rare species (census of Khedr *et al.* 2002, based on the data of Täckholm 1974). This figure may be increased if we take into account the geographical distribution and habitat specificity, in addition to the local abundance of species (see Shaltout 2002). 142 of these woody perennials are considered as threatened species in Egypt (El-Hadidi *et al.* 1992). No doubt, these plants are subjected to severe human impacts such as habitat destruction (e.g. land reclamation and construction of recreation resorts), over grazing and over cutting (e.g. for use as timber, fuel and drug).

The aims of the present series of review articles are: 1- to throw the light on the existing information about the biology of the Egyptian woody perennials, 2- to identify the gaps in the existing information, and 3- to focus the attention of the Egyptian biologists for filling these gaps. This may help in preparing any management plan for conserving the threatened species and their habitats. Comparable series of articles have been publishing by *Canadian Journal of Plant Science* under the title "The Biology of Canadian Weeds" (e,g Grace & Harrison 1986), and *Journal of Ecology* under the title "Biological flora of the British Isles" (e. g. Hill & Price 2000). The collected information in the present series are titled under the following topics: taxonomy and nomenclature, description, distribution, habitat, communities, phytochemistry, economic importance, growth aspects, adaptive mechanisms, propagation and population dynamics. The addition of new topics and/or the modification of the existing ones are encouraged, if necessary. All the Egyptian biologists are invited to enrich this series by their writings.

TAXONOMY AND NOMENCLATURE:

Nitraria **(7 species: Mabberley 1987) has been considered as a member of subfamily Nitrarioideae of the Zygophyllaceae (Engler 1931, Cronquist 1981 & 1988) or family Nitrariaceae separate from the Zygophyllaceae (R. Dahlgren 1977, 1980 & 1983, G. Dahlgren 1989). The study of Ronse Decraene and Smets (1991) indicated that *Nitraria retusa* (Forssk.) Asch. differs from the members of Zygophyllaceae in many aspects of floral development and vascular anatomy. *Nitraria retusa* (Forssk.) Asch., Verh. Bot. Vereins. Prov. Brandenb. 18:94 (1876) has the following synonyms (see Daoud 1985 and Boulos 2000):- *Peganum retusum* Forssk., Fl. Aeg.-Arab. LXVI, 211 (1775), *Nitraria senegalensis* Lam., III. des Genr. 2:t. 403, f. 2 (1779); Poiret in Lam. Encycl. Method. 4:493 (1797), *Nitraria tridentata* Desf., Fl. Atlant. 1:372 (1798); Boiss., Fl. Orient. 1:919 (1867), and *Nitraria sericea* Jaub. & Spach., III. Pl. Orient. 3: 142, t. 294 (1850). The English name of this plant is salt tree or nitre bush, while the French is nitraire. Its Egyptian vernacular name is Gharqad which appears to be universal in Arab speaking countries. The description under this name by Abu-Hanifah Al-Dynouri and other early Islamic writers matches this species very closely (Mandaville 1990). Somtimes it is pronounced with variations such as Gharghad and Ghardaq. The local name of Hurghada City at the Egyptian Red Sea coast, Ghardaqa, is very similar to the name of this plant.**

DESCRIPTION:

1-Macromorpholgy: ***Nitraria retusa*** **is characterized by morphological plasticity in response to habitat conditions. Its description in the literature indicates considerable geographical variations in leaf shape and petiole length. Boulos (2000) described it in Egypt as follows: shrub of 1 to 2 m length; stems many, spinescent and appressed-canescent. Leaves of 10 to 25 mm length, 5 to 15 mm width, alternate or in fasciles, petiolate, fleshy, obovate-cuneate, retuse or crenate-dentate at the apex. Stipules minute and persistent; flowers bisexual, of 5 to 8 mm length, persistent; petals of 4 to 5 mm length, greenish-white and hispid; stamens 15; fruit is a fleshy drupe, 6 to 10 mm length and 5 to 6 mm width, trigonous, pear-shaped and red. Zohary (1972) and Daoud (1985) added that the fruit is 1-celled, 1-seeded with wrinkled boney endocarp, splitting lengthways at the apex into 6 short valves. Seeds ovoid with membranous coat, acuminate, pendulous, without**

endosperm; cotyledons obovate-elliptical and plano-convex (Fig. 1).

Fig. (1) :Line drawing of *Nitraria retusa* shrub: 1- flowering branch, 2- part of branch bearing fruits, 3- flower (after Zohary 1972).

2-Micromorphology: The anatomy of the leaf and stem of *Nitraria retusa* were studied by Halim *et. al.* (1996) in order to demonstrate the diagnostic features of these organs by which they could be identified and characterized in the entire and powdered forms. The transverse section of the leaf appears slightly biconvex in outline. The upper and lower epidermises are covered with numerous non-glandular trichomes, and nearly similar in shape and size. Stomata are of anomocytic type, sunken, nearly oval in shape and present on both surfaces. It shows a dorsiventral structure of heterogeneous mesophyll with a continuous layer of palisade. The vascular tissue is represented by a median pyramidal collateral vascular bundle surrounded by upper and lower arcs of pericycle. The stem is more or less circular in outline with slightly raised ridges. It shows an epidermis covered with numerous non-glandular trichomes with stomata similar to those of the leaf, and surrounding a relatively wide cortex that occupy about 1/3 the diameter of the stem, with a well defined endodermis. The stele shows a more or less complete ring of pericycle, enclosing about 12 pyramidal vascular bundles traversed by narrow medullary rays and surrounding a central wide pith occupying about 1/3 the diameter of the stem. The powdered leaf (yellowish green) and

stem (yellow) have faint characteristic odor and slightly bitter mucilaginous salty taste.

DISTRIBUTION:

1-Global Distribution: ***Nitraria retusa*** **is one of the leading shrubs in steppes, deserts and salines. It has a fairly continuous range of distribution extending from Arabia in the north to Somali in the south, and from Palestine in east to Senegambia in the west. It is definitely Saharo-Arabian with some trends towards Sudanian territories (Zohary 1973). It is mainly recorded in North Africa, Sinai, Palestine, Syria, Jordan, Iraq, Arabia, Iran and Pakistan.**

2-National Distribution: According to Täckholm (1974), the distribution of *Nitraria retusa* in Egypt includes Nile region (Delta and Valley), oases of the western desert, the Mediterranean and Red Sea coastal strips, eastern and western deserts, Gebel Elba mountainous region, and Sinai peninsula. Although Simpson (1932) and Täckholm (1974) recorded this plant as one of the common species in Nile Delta, the extensive recent surveys carried out by Mashaly (1987), Shaltout and his collaborators (e.g. Shaltout *et al.* 1992, 1994 & 1995), El-Sheikh (1989 & 1996) and Al-Sodany (1992 & 1998) indicated the extinction of this plant from Nile Delta region. Moreover, the studies of Hassib (1951), Kassas and Zahran (1971) and Zahran and Mashaly (1991) indicated the absence of this plant from Gebel Elba mountainous region (Fig. 2).

Fig. (2): Map indicating the distribution of *Nitraria retusa* in Egypt.

Regarding the oases and depressions of the western desert, the plant was recorded in the northern oases and absent from the southern ones (Bornkamm 1986, Shaltout 1997, Sharaf El-Din 2000). It was recorded in Baharyya (Ahmed 1981), Siwa (Zahran 1972), Wadi El-Natrun (Zharan & Girgis 1970), Wadi El-Rayyan (Amin 1998), Moghra (Girgis *et al.* 1971), Qattara depression (El-Ghonemy *et al.* 1982) and Farafra (Springuel & Abd El-Ghani, unpublished paper). On the other hand, this plant was not recorded in Kharga and Dakhla (Abu-Ziada 1980), Kurkur and Dungul (Boulos 1966, Zahran 1966) and Darb El Arba'in spot-like oases (Bornkamm 1986). Along the Mediterranean coastal strip west of Alexandria, the plant was recorded only west Ras El-Hikma (El-Ghareeb 1975, Shaltout 1983 and Kamal 1988). Along the Red Sea coast, Kassas and Zahran (1967) reported that (and also Shaltout *et al.*, unpublished paper) the plant is confined to the northern 650 km and absent southwards (i.e. south of Marsa Alam). Comparable distribution was detected along the Saudi Arabian Red Sea coast (Zahran 1983). Moreover, it was not recorded in the survey of Sudan Red Sea coast (Kassas 1957). In northern Sinai the plant was recorded by Gibali (1988) and in southern Sinai by Ramadan (1988) and Helmy *et al.* (1996).

HABITAT:

***Nitraria retusa* forms almost pure stands mainly on the periphery of marshes and occurs in inland salines, but sometimes also reaches the seashore (e.g. Egypt). Along the Egyptian Red Sea coastland, *Nitraria retusa* inhabits three types of habitat: the first is the coastal salt marshes where *Nitraria* forms saline mounds that stud the flat ground of the salt marsh; commonly, *Nitraria* covers the north-facing slopes of the mounds while the rest is barren. The second habitat comprises less saline sandbars (actually chains of sandy hillocks fringing the shoreline); associated species share the space on these bars (Kassas & Zahran 1967). The third habitat is the channels of some main wadis near the coastal belt where it is restricted to localities with deep deposits, terraces or island-like patches. The silt deposits covered by this plant is usually protected and stabilized which entails the accumulation of plant detritus in the soil and may also entail the building up of the soluble salts (Kassas & Girgis 1965).**

Along the western Mediterranean coast, the plant inhabits the salt marshes of relatively deep water table and high salinity, where salt crusts may appear on the soil surface. It is completely absent in the salt marshes of shallow water table of less than 1 m deep (El-Ghareeb 1975). Shaltout (1983) and Kamal (1988) recorded it on coastal sand sheets that overly saline flats west Ras El-Hekma. In northern Sinai it inhabits the salt affected coastal dunes and saline depressions (Sharaf El-Din 1999), while in southern Sinai it inhabits the salt marsh strips of lower elevations (<100m) along the coastal plains of Gulves of Suez and Aqaba (Ramadan 1988 and Helmy *et al.* 1996).

In Wadi El-Rayyan in the western desert, *Nitraria retusa* builds up large mounds which sometimes reach 12 m length and 3 m height (Amin 1998). The soil just below the mound body has a coarse texture comparable to that outside the mound. A profile in the mound body shows that *Nitraria retusa* growth is very dense and formed of numerous interwoven chains of thick woody branches. The buried branches produce fibrous- and thread-like adventitious roots ending with tufts of fine root hairs. These adventitious roots are fine and produced at

different levels according to sand accumulation.

The surface of the newly formed roots is covered with adherent sand particles (Amin 1998). It is noteworthy that most of the chemical characters of the mounds formed by this plant are higher in the deeper strata than the uppermost layers (Table 1), and also those of the soil of the mound body are higher than those of the soil between mounds.

Table (1): Mean (M) and standard deviation (SD) of some soil variables of *Nitraria retusa* mounds in Wadi El-Rayyan in the western desert of Egypt (calculated from data presented in Amin 1998).

Soil depth (cm)		Ph	EC (mS/cm)	OM	CO_3	Cl	Na	K	Ca
				(%)					
0-10	M	7.76	0.78	0.12	4.98	0.61	0.84	0.44	3.97
	SD	0.31	0.50	0.06	3.26	0.20	0.31	0.26	1.85
50-100	M	7.61	1.26	0.14	3.16	0.83	1.61	0.39	4.76
	SD	0.32	0.72	0.06	0.87	0.41	0.41	0.32	2.15

COMMUNITIES:

In the eastern desert, *Nitraria retusa* is a member of two communities inhabiting the beds of mature wadis (*Zygophyllum album* and *Zilla spinosa* communities) and a leading dominant in a third one where *Zygophyllum coccineum*, *Z. album*, *Zilla spinosa*, *Tamarix nilotica* and *Alhagi graecorum* are common associates. Moreover, of the 13 communities identified by Kassas and Zahran (1967) along the Egyptian Red Sea littoral salt marshes, *N. retusa* was a leading dominant in one community, a member of moderate occurrence (presence = 20-40%) in three ones (*Limonium pruinosum*, *Zygophyllum album* and *Halocnemum strobilaceum* communities) and a member of low occurrence (presence <20%) in other four ones (*Limonium axillare*, *Aeluropus lagopoides*, *Suaeda monoica* and *Tamarix nilotica* communities). Kassas and Girgis (1965) considered the community type dominated by *Nitraria retusa*, as well as those dominated by *Lycium arabicum* and *Atriplex halimus*, as pre-ultimate stages in the succession development in this region, with *Tamarix nilotica* as the climax stage.

In northern Sinai *Nitraria retusa* is a member of low occurrence in *Artemisia monosperma* community, and of moderate occurrence in three communities: *Zygophyllum album*, *Halocnemum srtobilaceum* and *Cressa cretica* communities (Sharaf El-Din 1999). In southern Sinai, it is a leading dominant species in one community (Helmy *et al.* 1996), a common associate in three ones (*Avicennia marina*, *Halocnemum strobilaceum* and *Limonium axillare* communities), and a rare associate in other three ones (*Panicum turgidum*, *Pulicaria undulata* and *Salvadora persica* communities) (El-Demerdash *et al.* 1996). Along the western Mediterranean coastal desert, it has a very limited occurrence in only one community dominated by *Aleuropus lagopoides* with *Limoniastrum monopetalum* and *Salsola tetrandra* as common associates (El-Ghareeb 1975). In the Oases of the western desert it is recorded in four communities dominated by *Alhagi graecorum*, *Tamarix nilotica*, *Tamarix nilotica-Cynodon dactylon*, and *Sporobolus spicatus* (Sharaf El-Din 2000).

PHYTOCHEMISTRY:

The phytochemical investigation of *Nitraria retusa* revealed the presence of carbohydrates and/or glycosides, reducing sugars, tannins, saponins, sterols, alkaloids, flavonoids,

sulphates and chlorides. Fructose, glucose and sucrose were detected as soluble sugars; xylose, arabinose and galactose as combined sugars. Thirteen free amino acids were only detected including lucine, phenylalanine, valine, methionine, tyrosine, threonine, ∝-alanine, proline, glutamine, aspartic acid, arginine, histidine and cystine. The same amino acids in addition to isoleucine and serine were also detected in the hydrolyzed protein. The identified unsaturated fatty acids were lauric, palmitic, myrstic and stearic (Amer 1976, Shalaby *et al.* 1977). The total amount of carbohydrates, crude fiber and total nitrogen were 1.5, 35.0 and 4.0%, respectively. The amount of fixed oil was 4.65% with acid value of 19.07% and saponification value of 36.47, and the amount of crude alkaloid was 0.033%. Chromatographic investigation revealed the presence of Harmol alkaloid which had a value of 26 mg%. In addition, the following falvonol glycosides were isolated from the leaves and young stems of *Nitraria retusa* in Egypt (Halim *et al.* 1995): the new flavonol trioside, isorhamnetin 3-*O*-4^{Rham}-galactosylrobinobioside, isorhamnetin 3-robinobioside, isorhamnetin 3-rutinoside, isorhamnetin 3-galactoside, isorhamnetin 3-glucoside and free isorhamnetin. Isorhamnetin 3-xylosylorobinobioside was also tentatively identified. However, El-Laqqani (1991) isolated two new alkaloids (nitramisridine and nitramisrine) from the basic alcoholic extract of *N. retusa*.

ECONOMIC IMPORTANCE:

1-Habitat Indicator: The scrubland dominated by *Nitraria retusa* indicates high levels of water revenue in the desert, effective storage in the soil and shallow ground water that is partially salinized (Girgis 1971). This plant is also useful for detecting potable water (Danin 1983) and gypsophillous soil (Jafri & El-Gadi 1977).

2-Sand Controller: *Nitraria retusa* is a mound (i.e. hummock or hillock) and dune former of considerable value. The morphology and physiology of its shrubs favor the accumulation of wind-driven sediments. They are salt resisting, poorly grazed, thorny and characterized by wide porous crowns and strong root systems that horizontally and vertically penetrate the sediment substrate. Moreover, the shrubs are capable of growing quickly over the accumulated wind-driven sediments. Therefore, thorough understanding of the development and aerodynamic behavior of its mounds, which called nabkhas in the Arab region, may provide useful information for the design of biological sand control measures in desert areas (Khalaf *et al.* 1995). Out of 8 mound-forming species in Wadi El-Rayyan in the weastern desert of Egypt, *Nitraria retusa* builds up the largest mounds which sometimes reach 12 m length and 3 m height (Amin 1998).

3-Phytoremediation of Soil: The study of Ben-Abdallah and Boukhris (1990) near a phosphate fertilizer plant in Tunisia indicated that *Nitraria retusa* could accumulate as much as 4000 ppm in its leaves without showing damage, while the accumulation of 100-200 ppm in the leaves of the cultivated plants (e.g. grapevine, apricot and mulberry) cause severe damage. In view of this, and in response to recent interest in the utilization of native plants for phytoremediation of soil contaminated with chemical pollutants such as heavy metals and petroleum, some wild plants including *Nitraria retusa* were selected in Kuwait (the country that was subjected to heavy petroleum pollution during the second Gulf war) for the application of tissue culture techniques in order to restore or rehabilitate the damaged areas (Abo El-Nil *et al.* 1996 &1997).

4-Palatability to Grazing Animals: Le Houérou (1980) classified *Nitraria retusa* under

the poorly or occasionally palatable species. The domestic animals that graze this plant include sheep, goats and camels, and the consumed parts are leaves and twigs. Its chemical and mineral composition vary widely (Table 2), but it is relatively nutritious in the winter season. Shrub consumption by animals is greatly improved when it is mixed with other feeds such as broiler litter, molasses, date seeds and fodder beet (El-Shaer *et al.* 1997). The gas tests confirm that this plant is not a valuable feed resource (Haddi *et al.* 1999). An experiment was conducted by Abou El-Nasr *et al. (*1990) to study the effect of feeding some agricultural by-products as supplementary feeds (e.g. date seeds, redicyl and linseed cake) or as the sole diet (e.g. grape pulp) on nylon bag dry matter disappearance (NBDMD) of 5 desert pasture plants (*Salsola tetrandra, Limoniastrum monopetalum, Atriplex halimus, Nitraria retusa* and *Pituranthus tortosus*) in the sheep and camels. The results indicated that the NBDMD values of *Nitraria retusa* were the hiighest in both animals. In addition, the experiments carried out in the Jordan Valley (Schlein and Muller 1995) indicated that this plant, among others, is a natural resource for the diet of sand flies (e.g. *Phlebotomus papatasi*) and mosquitoes (e.g. *Culex pipiens molestus*), and also the desert locust *Schistocerca gregaria* (Stoate 1995). A new species of gall-forming armored scale insect (*Diaspidiotus roseni* sp.nov.) living on *N. retusa* in Israel was described by Danzig (1999).

5-Other Uses: The fleshy red fruits of this plant are eaten by birds (e.g. bustard) and even by human beings (Batanouny 1994). Its wood is used as fuel by the local inhabitants (Kassas & Girgis 1965, Ayyad 1998) and the bitter fleshy leaves are used as poultice (Jafri & El-Gadi 1977).

Table (2):Chemical composition and nutritive value of *Nitraria retusa* in Egypt (Abo E-Nasr *et al.* 1990, Heneidy 1996), comparing with the average of North Africa range plants (Le Houérou 1980). DM: dry matter, CP: crude protein, CF: crude fibre, FAT: crude fat, NFE: nitrogen free extract (i.e. carbohydrates), DP: digestible protein, NE: net energy, NR: nutritional ratio.

Variable	CP	CF	FAT	NFE	DP	ASH	NE (MJ/kg)	NR
	(%)							
Mean	8.6	18.5	3.6	40.0	4.5	28.5	4.3	74
Stand. Dev.	1.8	12.4	0.3	7.5	1.7	2.4	0.6	34
North Africa	11.4	25.3	4.6	47.5	7.1	11.9	4.9	99
Green legume	16.7	17.4	5.3	51.1	12.6	9.5	5.9	148

GROWTH ASPECTS:

Many authors indicated that the flowering period of *Nitraria retusa* extends from March to May (e.g. Zohary 1972, Daoud 1985), but Simpson (1932) reported that some specimens of this plant were seen in flowering most of the year. Moustafa *et al.* (1996) in their study on the wild trees and shrubs in South Sinai reported that the effective flowering process of *Nitraria retusa* occurred during two periods: March-May and October-December (Fig. 3). The most distinct months of ripe fruiting were June and July. In November and December, most of *Nitraria* leaves fall. New leaves grow mainly during January and February.

Fig. (3): Phenological sequence of *Nitraria retusa* in southern Sinai (after Moustafa *et al.* 1996).

ADAPTIVE MECHANISMS:

Nitraria retusa **is characterized by morphological plasticity in response to local habitat conditions. This spinescent plant has large pungent spines and small leaves under desert conditions and relatively delicate spines under less arid conditions (Girgis 1971). It can be considered with regard to transpiration as oligo-hydric such as *Suaeda palestina* and *Suaeda monoica* (Zohary 1973). The partly or wholly shedding of leaves (i.e. defoliation process) is an adaptive mechanism for reducing the transpiring surface. This process is developed by the xerophytes to balance their water economy and to limit the plant growth and production of carbohydrates as photosynthesis is confined to restricted area. It is worthy to indicate that the low water content together with the high salt load of the shriveled leaves have created severe degree of stress that causes leaf desiccation and hasten the senescence symptoms (Evenari *et al.* 1971, Boyer 1976, Fahmy *et al.* 1990). This species has considerable tolerance for drought due to deep and well developed root system. Also it has the ability to form huge phytogenic mounds which conserve considerable moisture in its body. The shedding of the leaves is affected mainly by seasonal variation where it is obviously recorded during August and October.**

The analysis of green and shed leaves of *Nitraria retusa,* as carried out by Amin (1998), indicated that the total soluble salts, chlorides, sulphates, sodium and calicum are higher in the shed leaves (12.6, 5.0, 6.8, 3.1 and 4.7%, respectively) than in the green ones (10.1, 4.2, 5.6, 2.5 and 4.2%, respectively). This may interpret why Kassas and Imam (1954) stated that the ground parts of the leaves of this plant

are little or no room for individuals of subordinate species. *Nitraria retusa*, as a leaf succulent crynohalophyte (i.e. excretive), is able to avoid high internal salt accumulation through specialized salt removal mechanism (i.e. salt glands), and this seems to be the most prominent feature in its adjustment to avoid adverse habitat conditions (Ahmed and Shalaby 1985). Its ash content is markedly low and accumulated lower Na, Ca and Cl comparing with its common associate *Zygophyllum album.* Consequent upon the selectivity of salt excretion mechanism, *Nitraria* retained generally higher K and P. Furthermore, it obviously contained higher structural amino acids and carbohydrates (Table 3).

Table (3):Mean (M) and standard deviation (SD) of succulence ratio and chemical composition of *Nitraria retusa* and its common associate *Zygophyllum album* in Sinai region (calculated from Ahmed and Shalaby 1985).

Content	*Nitraria retusa*		*Zygophyllum album*	
	M	SD	M	SD
Succulence ratio	2.8	0.7	4.2	1.1
Ash content (%)	14.1	3.6	30.3	5.9
Inorganic contents (me/100gm)				
Cl	85.9	33.2	193.6	53.6
Na	90.8	52.0	108.0	13.1
K	28.9	17.5	16.0	3.7
Ca	196.0	24.7	319.0	109.4
Mg	53.7	43.6	103.2	140.2
P	15.9	7.9	12.2	5.4
Organic contents (mmole/100gm)				
Free carbohydrates	15.7	5.7	19.3	6.1
Structure carbohydrates	178.0	48.9	114.2	25.4
Free amino acids	2.4	1.6	0.9	0.6
Structure amino acids	61.0	16.5	53.8	14.5

Comparing the physiological behavior of *Nitraria retusa* in winter with that in summer, the recent study of Ahmed (2002) indicated that the population near the Red Sea coast retained higher values of photosynthetic pigments during summer; this may be attributed to an adaptive mechanism experienced by this plant to the reduced soil moisture availability and low solubility of salts. On the other hand, the inland population retained lower values during the same season (this was associated with higher contents of soil soluble salts); this behavior may be due to the toxic action of NaCl on the biosynthesis of photosynthetic pigments leading to increase their degradation or due to damage of chloroplast thylakoid and/or to the increased activity of chlorophyll degrading enzyme (see also Mosallam & Abd El-Maksoud 1996).

PROPAGATION:

Propagation trials using seeds and stem cuttings of *Nitraria retusa* were carried out under Laboratory conditions by Moustafa *et al.* (1996). Using filter paper as a substrate, the seeds completely failed to germinate at 20°C, but at 25°C seeds start to germinate after 10 days reaching a maximum germination of 14% after 25 days. Using saline soil, seeds start to germinate after 15 days: at 20 °C the maximum

germination was 26% after 25 days, while at 25°C it was 35% after the same period). Further studies are recommended to explore the reasons for the low germination of this plant. On the other hand, 25% of the tested stem cuttings of *Nitraria retusa* had a successful propagation. In Morocco, this plant, among six halophytes, was tried to grow in concrete pounds filled with coastal sand and watered with 25, 50, 75 and 100% seawater, but it did not survive during the experimental setup (Harrouni *et al.* 1999). *N. retusa* seems to be among the plants that need relatively fresh water for germination and establishment but can tolerate much more saline conditions as mature plants. This may indicate that the area occupied by this plant was once fresh but now saline (Danin 1983).

POPULATION DYNAMICS:

The study by Shaltout *et al.* (2003) indicated that the size structure of *Nitraria retusa* along the Egyptian Red Sea coast is characterized by the preponderance of the young individuals comparing with the old ones (Fig. 4). This criterion may characterize the rapidly growing populations with high reproductive capacity, since in most stable populations one would expect an excess of juvenile over mature individuals (Harper 1977). However this plant tolerates a wide salinity gradient, but the hyper salinity stands seem to stress its growth particularly the juveniles. This is often associated with decrease of the density and cover but the increase of individual size, which probably means that the size of this plant is density dependent.

Fig. (4): Size distribution of *Nitraria retusa* along the Egyptian Red Sea coast (after Shaltout *et al.* 2003).

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بيولوجية النباتات الخشبية المعمرة في مصر
١- نبات الغرقد

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نبات الغرقد هو أحد الشجيرات الهامة في السهوب والصحاري والسبخات مكونا مواقع نقية على حوافها. يوجد هذا النبات بصفة أساسية في السبخات الداخلية ، لكن يصل أحيانا إلى شاطئى البحر (مثل مصر).

ويعتبر الغرقد أحد عناصر منطقة الصحراء العربية مع بعض الميل تجاه الأقاليم السودانية. يشمل توزيعه فى مصر منطقة النيل، والواحات، والصحراء الشرقية والغربية وسيناء. ويدل الفحص الكيماوي لهذا النبات على وجود المواد الكربوهدراتية و/أو الجليوكوسيدات، والسكريات المختزلة، والتانينات، والصابونينات، والاسترولات، والقلوانيات، والفلافونيدات، والكبريتات والكلوريدات. يحتوى النبات أيضا علي ١٣ حمض نووى حر وأربعة أحماض دهنية غير مشبعه.

ويعتبر انتشار نبات الغرقد دليل علي ضحالة مستوى سطح الماء، كما أنه مثبت للرمال، ومستساغ للحيوانات الرعوية، كما أنه يعمل على استشفاء الأراضي الملوثه، ويستخدم كوقود، وتؤكل ثماره بواسطة الطيور و السكان المحليين. تتم مرحلة الإزهار الفعالة لهذا النبات علي فترتين: مارس – مايو، وأكتوبر–ديسمبر. وهذه الشجيرة المتأقلمة مع الملوحة ذات تأقلم معتبر للجفاف أيضا بسبب مجموعها الجذري العميق والغزير، وقدرتها على تكوين أكمات (نبكات) ضخمه تستطيع اختزان كمية كبيرة من المياه داخلها. تصل نسبة الإنبات القصوى لهذا النبات ٣٥%، ولهذا فإننا نوصى بإجراء دراسات مستقبلية لاكتشاف أسباب كمون بذور هذا النبات. ويتميز التركيب الحجمى لنبات الغرقد على طول الساحل المصرى للبحر الأحمر بوفرة الأفراد الصغيرة مقارنة بالأفراد المسنة.

Egyptians were familiar with many medicinalherbs and were awareof their usefulness in treatment of various diseases.The healing of sick persons wascarried out by priest doctors who prescribed and prepared medicaments. The first recorded prescriptions were foundin Ancient Egyptian tombs. The writing on the temple walls and in the papyri revealed that Ancient Egyptians used many herbal drugs for the same purposes as they are used today. They used drugs of animal, plant, as well as mineral origins. Nitraria retusa is a salt-tolerant and drought-resistant shrub in the family Nitrariaceae. It can grow to heights of 2.5 metres (8 ft 2 in), although it seldom exceeds more than 1 m in height. It produces small white/green coloured flowers and small edible red fruit. The plant is native to desert areas of northern Africa, where it grows in primary succession on barren sand dunes, and in areas with high salinities such as salt marshes. Investigation of Nitraria retusa â€œForskâ€ Asch., Roemeria hybrida (L.) Dc. and Fumaria judaica Boiss. Growing in Egypt. Ph. D. Thesis, Fac. Pharmacy, Alex. Univ., Alexandria.Â 69-Shalaby A. F., Etman M. A., Youssef M., Habibi A. M. & Amer K. F. 1977. A chemical investigation of Nitraria retusa Forssk. Desert Inst. Bull., 27 (2): 199-204. 70-Shaltout K. H. 1983. An Ecological Study of Thymelaea hirsuta (L.) Endl. in Egypt. Ph. D. Thesis, Tanta Uinv., Tanta, 165 pp.