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THE BIOLOGY OF EGYPTIAN WOODY PERENNIALS 3. *PLUCHEA DIOSCORIDIS* (L.) DC.

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REVIEW ARTICLE:

ABSTRACT:

The present article is the third in a series of review articles deal with the biology of Egyptian woody perennials. Available literatures dealt with the biology of the evergreen ruderal shrub Pluchea dioscoridis (L.) DC. was reviewed. It includes the distribution, preferable habitats, shoot macro- and micromorphology, palynology, goods and services, phytochemistry, biological control and toxicity, associated biota, size structure, associated growth due to post-agricultural succession, nutrient status, above-ground standing-crop biomass and seed characteristics of this shrub. Ecotypic variability among its local populations needs further studies, particularly the physiological and genetical adaptations along the prevailing environmental conditions.

INTRODUCTION:

***Pluchea dioscoridis* (L.) DC. is an important wild evergreen shrub, attaining a height of one to three meters, richly branched, hairy and glandular, belongs to family Asteraceae (Compositae). The plant is widely distributed in the Middle Eastern and surrounding African countries. In Egypt, it occurs mainly in Nile region, Oases of the Western Desert, Mediterranean coastal strip, Eastern Desert and Sinai Peninsula (Boulos 2002). It inhabits the banks of water courses, moist habitats, abandoned fields, depressions along the roads and railways, demolished houses, solid and liquid refuses (Shaltout *et al.* 1999). It is considered as an invasive species which can rapidly and seriously degrade the quality of the fallow lands by altering the natural processes and reducing biodiversity (Simpson 1932).**

***Pluchea dioscoridis* has a good reputation in folk medicine, its marketing is local and depends on collection from the wild and it is used in popular medicine for rheumatic pains (Boulos & El-Hadidi 1989). Crude extracts of *Pluchea dioscoridis* has insecticidal activity against many insects due to the effects of the natural products as far as botanical extracts against the insects and it is one of the best methods which aid in reducing the environmental pollution with chemical insecticides. The possible economic utilization of this plant calls for information on its autoecology, which would include phytosociological relations with associated**

species and the prevailing environmental conditions, and the explanation of such behaviour by laboratory experiments. Information on its reproductive capacity and population attributes (e.g. size structure, survival, natality and mortality) enables us to explain its ecological and sociological behaviour. Morphological and anatomical variations of the plant organs, germination of seeds, survival and growth rates of seedlings are also important.

The present article is the third in a series of review articles dealing with the biology of Egyptian woody perennials (see Shaltout 2003 and Shaltout *et al*. 2006). It aims at reviewing the available literatures dealt with the biology of the evergreen ruderal shrub *Pluchea dioscoridis* (L.) DC. Such type of review articles may focus the attention of the Egyptian plant biologists, among others, not only to fill the gaps of information about the local populations of this plant, but also to innovate the earlier ones.

TAXONOMY AND NOMENCLATURE:

The genus *Conyza* (L.) Desf. belongs to family Asteraceae (Compositae). Lindley (1853) classified genus *Conyza* under tribe Conyzeae; while Post (1933) included *Conyza* under tribe lnuleae, subtribe Plucheinea.

***Pluchea dioscoridis* (L.) DC. was unsettled since Linneaus (1753), where Engler and Prantal (1897) treated *Conyza dioscoridis* as *Baccharis dioscoridis* L., *Conyza dioscoridis* (L.) Desf. and *Baccharis aegyptiaca* Forssk. ex DC. Feinburn-Dothan (1978), Fayed (1987), Khafagi (1995) and Boulos (2002) treated *Conyza dioscoridis* under genus *Pluchea* [*Pluchea dioscoridis* (L.) DC.]. Its synonyms are: *Baccharis dioscoridis* L., *Conyza odora* Forssk., *Conyza dioscoridis* (L.) Desf., *Baccharis aegyptiaca* (Forssk.) ex DC. and *Pluchea dioscoridis* (L.) DC. var. *glabra* (Oliv.) Hiern. *Pluchea* was named after the French naturalist Noel Antoine Pluche (1688-1761), while species *dioscoridis* was named in honor of the first century Greek physician and herbalist Dioscoridis (Batanouny 1981).**

The common names of this plant are conyza, ploughman's spikenard and marsh fleabane (English), conyze (French), dörrkraut (German), barnuf and kenevir otu (Turkish), barnûf and kûsh (Arabic). The name barnûf is general throughout Egypt, and other names being applied to it (Bedevian 1936).

DISTRIBUTION:

1-Global Distribution:

The global distribution includes East Sudanian and East Saharo-Arabian (Feinbrun-Dothan 1978); the plant is widely distributed in the Middle Eastern and surrounding African countries, Eastern, Southern and Tropical Africa, it has been reported to grow widely in Angola, Burundi, Chad, Congo, Djibouti, Egypt, Eritrea, Ethiopia, Iran, Iraq, Jordan, Palestine, Kenya, Lebanon, Libya, Oman, Saudi Arabia, Qatar, Sudan, Syria, United Arab Emirates and Yemen (Boulos 2002 and Zaghloul 2005).

2-Local Distribution:

***Pluchea dioscoridis* was recorded in Egypt by several collectors including Efflaton (1925), Simpson (1932), Hassib (1951), Boulos and E1-Hadidi (1967), Täckholm (1974), Migahid and Hammouda (1974) Boulos (1995) and Boulos (2002). The local distribution includes mainly the Nile region, Oases of the Western Desert, Western Mediterranean coastal strip, Eastern Desert and Sinai Peninsula.**

HABITAT:

Simpson (1932) reported that it grows every where near water banks, ways and marshes. It

is presented in the new reclaimed area north-west of the Nile especially north Tahreer, Maruit and Abbis (Aly and Hassan 1980). Springuel (1981) recorded *Pluchea dioscoridis* as a common shrub along the banks of the Nile and islands, and also a pioneer of the moist rocky habitats. Shaltout and Sharaf El-Din (1988) and Shaltout *et al.* (1999) recorded this plant in the fine loamy soils of Nile Delta along the banks of canals and drains, waste moist ground, salinized and non-salinized abandoned fields, depressions between the terraces of roads and railways, demolished houses, solid and liquid refuses.

MORPHOLOGY:

1-Macromorphology:

***Pluchea dioscoridis* is a richly branched hairy perennial shrub, often 1-3 m high, puberulent and glandular, with simple, lanculate, acute, serrate and sessile leaves which either elliptic or oblong and tapering towards the base which is auriculate (Fig. 1: after Slima 2006). Branches leafy, ending in many headed dense corymbs. Flowers pale yellow, purplish or pink, and inflorescences of numerous heads. Involucral bracts are scarious and acute to acuminate, the outer soft hairy, somewhat shorter than the pappus. Receptacle is flat and naked. Outer florets are in many rows, pistillate and filiform. Central florets are tubular, few and hermaphrodite, but functionally staminate. Pappus are much longer than achene. The plant flowering in March-September (Feinbrun-Dothan 1978). Boulos (2002) mentioned that its leaves are 2-7x1-3.5 cm, involucre 3-4.5 mm, phyllaries 3-4 seriate (1.5-4x0.8-1 mm, the outer 1.5x1 mm), marginal florets 2.8-4 mm, disc florets 3-10 (4-5.5 mm), achenes 0.9-1.1 x 0.2-0.3 mm, and pappus of 10-25 free barbellate deciduous bristles (2.5 mm).**

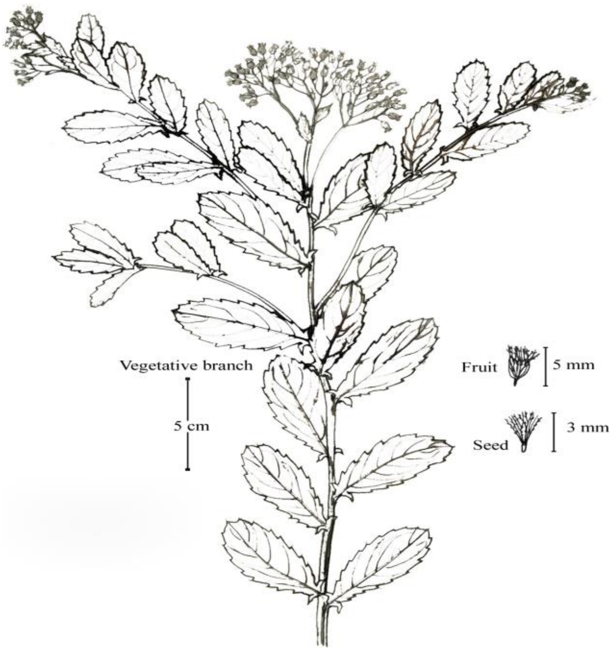

Fig. (1): *Pluchea dioscoridis* (L.) DC. Barnûf برنوف (after Slima 2006)

2-Micromorphology:

A-Stem:

The epidermis is covered with trichomes which are multicellular, uniseriate, and some of them are of glandular type. Collenchyma cells of the cortex are lamellar in thickness and most of them are spherical and others are tetra or pentagonal in shape, these cells containing numerous silica crystals. The parenchyma cells of the cortex are either spherical or penta or hexagonal in shape, containing silica crystals more than the collenchymatous tissue (Fig. 2: after Slima 2006). The parenchyma cells contain wide intercellular spaces between them. Resin ducts are schizogenous and scattered in the cortex (their secreted substances are of high economic importance: Fahn 1990). The old stem is characterized by abnormal secondary growth where there are vascular bundles formed in the cortex.

The study of Slima (2006) in Nile Delta reveals that the habitat type affects greatly the anatomical features of *Pluchea dioscoridis.* In comparison with the other habitats, wastelands are characterized by wide pericyclic fibers and pith as well as a great number of resin ducts and vascular bundles. This may be associated with the moisture status of these habitats. Fahn (1990) reported that individuals in arid habitats contain well developed conducting tissue if compared with those grown in the moist ones. Simons (1956), El-Hadidy (1984) and Patterson and Tanowttz (1989) reported that vessels density and size could be considered as good criteria for drought conditions. On the other hand, the individuals of drain terraces are characterized by small width of parenchymatous tissue, percicyclic fibers and pith width, and the number of vascular bundles is relatively small. This may be relatively due to high moisture content of this habitat.

b-Leaf:

Leaf anatomy of *Pluchea dioscoridis* indicates that trichomes are present on the lower epidermis more than the upper epidermis (Fig. 3: after Slima 2006) and they are multicellular and uniseriate. The midrib region consists of three to four layers of collenchyma cells which are isodiametric and spherical in shape containing small amounts of silica crystals. The upper parenchyma cells are hexa or heptagonal in shape containing very small amount of silica crystals and contain small intercellular spaces between them. Vascular bundles consist of xylem in two to three layers and three to five rows, followed by five to eight layers of phloem and four to seven layers of pericyclic fibers. The lower parenchyma cells are spherical, penta or hexagonal in shape and contains small amount of silica crystals; while the lower collenchyma cells are penta or heptagonal containing small amount of silica crystals. Lower epidermal cells are globoid, penta or hexagonal in shape, containing high amount of silica crystals. Resin ducts are found in the lower parenchyma cells (Slima 2006).

Leaf anatomy of wasteland individuals in Nile Delta resembles that of stem as it is characterized by wide parenchymatous tissue, and a great number of vascular bundles with small size of xylem vessels, as well as resin ducts. On the other hand, leaves of individuals grown on canal terraces are characterized by wide collenchymatous tissue, at the same time parenchymatous tissue is relatively narrow, and the number of resin ducts is small.

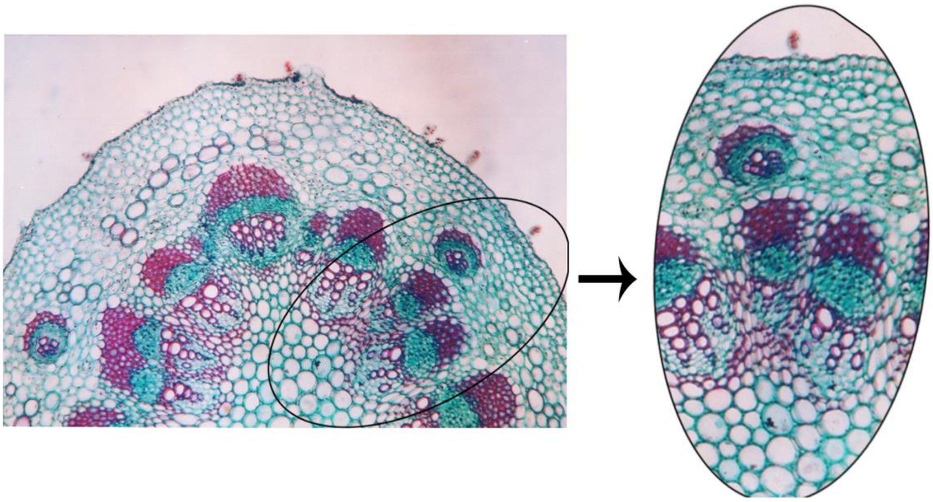

Fig. (2): Transverse section of *Pluchea dioscoridis* (L.) DC. stem (after Slima 2006). (X = 10x10).

Fig. (3): Transverse section of *Pluchea dioscoridis* (L.) DC. leaf (after Slima 2006). (X = 10x10).

PALYNOLOGY:

The pollen grains of *Pluchea dioscoridis* are monads, isopolar, radially symmetrical, 28x29 µm, oblate-spheroidal, tricolporate; membrane smooth (Fig. 4: after El-Nagar and Abd El-Hafez 2003). Exine tectate; lectum perforate; perforation narrow circular regularly distributed; echinate; spine conical, acute apices, longer than broad, borne on raised and perforated cushion bases (El-Nagar and Abd El-Hafez 2003).

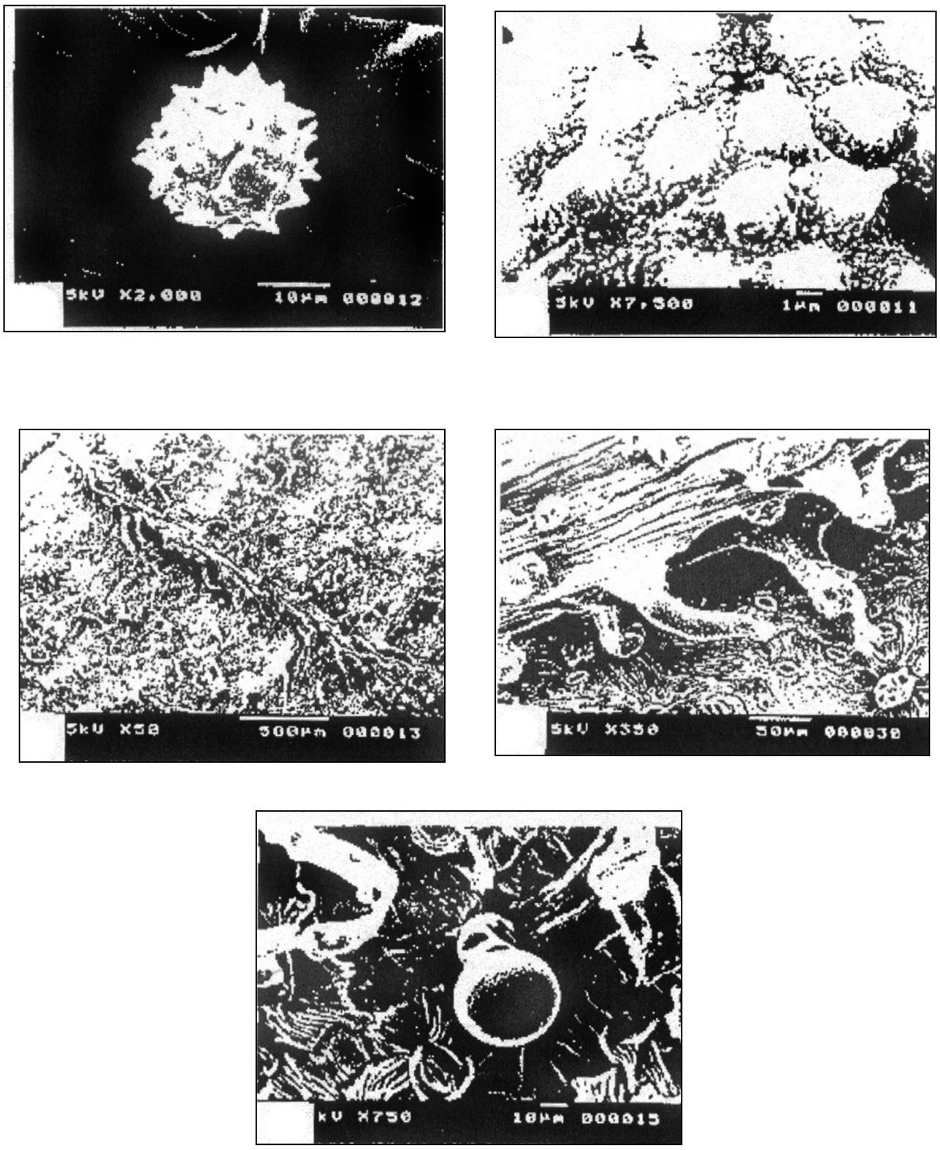

Fig. (4): SEM micrographs of pollen and exine sculpture of *Pluchea dioscoridis* (L.) DC. (after El-Nagar and Abd El-Hafez 2003)

GOODS AND SERVICES:

1-Goods:

The plant has a good reputation in folk medicine, its marketing is local and depends on collection from the wild and it is used in popular medicine for rheumatic pains (Boulos & El-Hadidi 1989). Ibn E1-Bitar and Al-Antaki reported that the decoction of fresh leaves is use in the treatment of epilepsy in children, in colic, as carminative and as remedy for cold (Batanouny *et al.* 1999). The aromatic leaves of the plant which have a pleasant scent were used in Ancient Egypt to perfume ladies' hair plaits. In Tanzania, the plant is used by traditional healers as: a decoction of root bark and cooking fat (a few drops) drunk against sterility in women and impotence in men, a decoction of

the root to treat colds, the roots and leaves are a stimulant, comforting medicine and an aromatic and the decoction of the leaves is used for curing children and infantile ailments (Hedberg *et al*. 1982).

2-Services:

This plant is an invasive species with thick, woody and much branched root system that is valuable for consolidating the banks of water courses. Its bushy growth prevents other plants from colonizing the banks, and stifles harmful weeds that are already there (e.g. smoother plant and bank holder shrub).

PHYTOCHEMISTRY:

Many active constituents have been reported in the different parts of *Pluchea dioscoridis*. Dawidar and Metwally (1985) reported a typical thiophenacetylenes, eudesmane derivatives such as the plucheines, and eudesmanolides from the aerial parts of *Pluchea dioscoridis* which may be of chemotaxonomic importance (they afforded three new compounds: 15-hydroxyisocostic acid, the corresponding aldehyde and the eudesmanolide). Other known products were also isolated such as 9β- hydroxycostunolide. In addition, Ahmed *et al*. (1987) isolated four sulfated flavonoids (one of which was characterized for the first time) and four non-sulfated flavonoids, while Abdallah and lbraheim (1995) isolated a new eudesmane derivative from the aerial parts of this plant.

Mahmoud (1997) re-examined the chemical constituents of the leaves of this plant and reported seven new sesquiterpene derivatives (two 7-epi- eudesmanes, two eudesmanoic acids, eudesmanolide, guaiane and xanthane epoxide). Grace (2002) identified 36 components in the volatile oil of *Pluchea dioscoridis,* where farnesol was the major component (16.5%) accompanied by a high percentage of sesquiterpene alcohols. Oxygenated sesquiterpenes (26.4%) and sesquit-erpene hydrocarbons (39.4%) represented the main constituents in the oil. El-Hamouly and Ibraheim (2003) reported that the leaves of *Pluchea dioscoridis* containing 3-5% volatile oil, where 112 compounds were detected consisting mainly of sesquiterpene hydrocarbons (mainly β-maaliene and α-elemene), oxygenated sesquiterpenes (mainly α-cadinol, muurolol and caryophyllene oxide isomer). The plant also containing triterpenoid as hexacosanol, octacosanol, tetracosanol, cholesterol and campesterol.

BIOLOGICAL CONTROL AND TOXICITY:

Insects play an important role as biological control agents of weeds and wild plants (Swailem 1973, Hegazi *et al*. 1979, El-Kady 1980 and Kolaib 1991b). The larvae of *Schistopterum moebiusi* feed on ovaries of *Pluchea dioscoridis* flowers, it seems to occupy the first rank in the biological control of Barnûf. The destroyed heads of the plant reached a maximum of 100% during winter and spring months (Kolaib 1991a). The tephritid *Terellia planiscutellata* was noticed to occupy the second rank in destroying the reproductive organs of *Pluchea dioscoridis.* The infestation rate started from April (13-27%) and increased till reaching a maximum of 60% during June.

Abdallah *et al*. (1986) recorded that the ethanol crude extract of *Pluchea dioscoridis* has insecticidal activity against the curculionid *Sitophilus granarius* and the tenebrionid *Tribolium castaneum*. Peterson *et al*. (1989) reported effective insecticidal activity with crude extract of *Pluchea dioscoridis* flowers. Mogahed and Mohanna (1992) attempted to

investigate the potency of the crude extract of *Pluchea dioscoridis,* against egg stage and different larval instars of the Egyptian cotton leaf warm *Spodoptera littoralis* (Boisd), under laboratory conditions in order to find a safe, biodegradable alternatives to chemical insecticides which would be effective and available as a natural tool in pest management program. They provided that all concentrations adversely affected the egg viability, and unhatchability was positively correlated with the extract concentration. This may be attributed to the lipophilic properties of Barnûf extract which might facilitate its permeability through egg membranes where it destroys the reproductive tissues or inhibit some vital enzymes. The plant substances could be considered as developmental insecticides that affect the life cycle of the insects (e.g. oviposition, hatchability and moulting of larval instars). Amer and Rasmy (1994) reported that larvae of the two-spotted spider mite *Tetranychus urticae* did not develop to the protonymphal stage when they were reared on excised leaves of *Pluchea dioscoridis* as the crude extract of it showed pronounceable toxic effects on adults and eggs.

The toxic and repellent effects of acetone and petroleum ether extracts of *Pluchea dioscoridis* leaves against three insects of stored products in Egypt (i.e. *Sitophilus oryzae, Rhizopertha dominica* and *Tribolium castaneum*) was investigated by El-Lakwah *et al.* (1998). They found that petroleum ether extract was more effective on *Sitophilus oryzae* adults than acetone extracts.

Mazyad *et al.* (1999) studied the efficacy of the volatile oils of *Pluchea dioscoridis*, among other species, for controlling myiasis (*Lucilia sericata*) which is one of the most important parasitic disease affecting the human welfare. Grace (2002) reported that *Pluchea dioscoridis* showed a marked mosquito larvicidal activity against *Culex pipiens* which is a carrier of several diseases including malaria, yellow fever dengue, filariasis and encephalitis. The study of Shoukry *et al*. (1998) on the effect of antibiotics (vibramycin and streptomycin) and volatile oils of *Pluchea dioscoridis* on some biological and technological aspects of silkworm (*Bombyx mori* L.) infected and non infected with *Bacillus thuringiensis*, revealed that the percent larval mortality and duration significantly decreased, while the fecundity, hatchability, emergence and cocoon production increased when the larvae were treated with the antibiotics or volatile oils either separately or when they were combined together. In addition, treatments increased the weight of shell cocoon, silk content ratio, weight and size of filament. However, concentrations higher than 30 ppm caused adverse effects on either the biological and technological characters of infected mulberry silkworm.

Atta and Abo El-Soud (2004) examined the antinociceptive effect of the methanolic extract *Pluchea dioscoridis* aerial parts on mice, while Atta and Mouneir (2004) studied the antidiarrheal activity of the same extract on rabbits. Both studies indicated significant effects under certain conditions.

ASSOCIATED BIOTA:

The inspection of the Database in the Ecological Research Unit (Botany Department-Faculty of Science-Tanta University) indicated that 213 species are associated with the distribution of *Pluchea dioscoridis* in Nile Delta (118 annuals, 6 biennials and 89 perennials). The species of high association with *Pluchea dioscoridis* are *Cynodon dactylon, Rumex dentatus, Phragmites australis* subsp. *australis, Polypogon monspeliensis* and *Symphyotrichum squamatum* (presence >50%); while those of low associattion are *Arthrocnemum macrostachyum*,

***Centaurea pumilia* and *Suaeda pruinosa*, as *Pluchea dioscoridis* can not tolerate the high salinity prevailing with the distribution of these species.**

A great number of pests associated with *Pluchea dioscoridis* use it as breeding site or shelter and become a source of infestation to economic plants (Abo El-Ghar *et al*. 1982). The study of El-Nagar and Abdel-Hafez (2003) indicated that the widest spectrum of fungal genera on the leaves of this plant was that of *Aspergillus* and *Alternaria* (comprised about 43 and 34% of the total fungal species, respectively). *Aspergillus* was represented by 13 species and one variety and most of them were saprophytes on several substrates (e.g. plant and animal debris, seeds and grains, textiles, foodstuffs and soils). Members of *Cladosporium*, *Cochliobolus* and *Fusarium* were also observed. Three types of leaf spots were recorded; they were small, dark brown or olive brown in color (*Alternaria*, *Cladosporium* and *Cochliobolus*). Cellulose decomposing fungi were recorded also on the echinate pollen and anthers of this plant, the most common species was *Alternaria niger*.

In addition, egg-larval parasite *Copidosoma* species was collected from the leaves of *Pluchea dioscoridis*. The eriophyoid mite *Neooxycenus plucheae* was found infesting its leaves and causing rusting symptoms (Abou-Awad 1981). *Vittacus plucheae*, in association with *Eriophyes dioscoridis*, infest both leaf and stem surfaces of this plant causing irregularly shaped galls with high density (Abou-Awad and Nasr 1986).

SIZE STRUCTURE:

Slima (2006) reported that the population of *Pluchea dioscoridis* inhabiting the canal edges was characterized by the largest mean of individual height (171.4 cm), diameter (216.0 cm) and size index (mean of height and diameter = 193.7 cm); but the lowest height to diameter ratio (0.8). On the other hand, drain terraces population was characterized by the lowest height (123.9 cm), diameter (128.3 cm) and size index (126.1 cm); but the largest height to diameter ratio (Table 1).

Table (1): Means and standard deviation (SD) of the size variables of *Pluchea dioscoridis* populations. The maximum and minimum values are underlined. All the F-values are significant at P≤ 0.001. The habitats are: WL: wasteland, CE: canal edges, CS: canal slopes, CT: canal terraces, DS: drain slopes and DT: drain terraces (after Slima 2006)

Size character (cm)	Habitat type						Mean ± SD	F
	WL	CE	CS	CT	DS	DT		
Height (H)	139.9	171.4	157.9	160.8	141.5	123.9	144.3± 69.0	12.3
Diameter (D)	176.4	216.0	196.0	212.3	150.0	128.3	172.4±118.6	17.9
Size Index	158.2	193.7	176.9	186.6	145.7	126.1	158.3 ± 90.6	16.3
H /D	1.1	0.8	0.9	0.8	1.0	1.1	1.0 ± 0.5	11.8

The structure of plant populations can be assessed in terms of ages, sizes and forms of the individuals that compose them (Harper and White 1974). Age distribution is an important population characteristic of a species, which influences both its natality and mortality. The ratio of the various age groups in a population determines its current reproductive status and indicates what may be expected in the future (Odum 1971). There is abundant evidence that size or vigour is better predictors than age of the onset of reproduction or of repeated reproductive output (Werner 1975). Size frequency distribution of *Pluchea dioscoridis* in Nile Delta (Fig. 5) indicated that the large size class 3.4-3.6 m was the less frequent (1.2%),

while the small one 1.0-1.2 m was the most frequent (10.2%). The mean height varies from 14.5 cm ind^{-1} in the first class to 286 cm ind^{-1} in the last class, mean diameter varies from 9.4 cm ind^{-1} to 509.3 cm ind^{-1}, size index varies from 11.9 cm ind^{-1} to 397.6 cm ind^{-1}; while height to diameter ratio varies from 2.0 to 0.6. In general, there is a continuous increase in the height, diameter and size index with the increasing of size class.

The study of Slima (2006) indicated that the mean height to diameter ratio is more than unity for the small size classes (0-120 cm) of *Pluchea dioscoridis* population, which means that the height exceeds the diameter and hence populations tend to expand vertically rather than horizontally. This may be due to that the juvenile individuals usually grow in dense populations which often lead to reduce the available area for each individual. Also, the crowding may affect the light availability, and hence the plants seek for light through increasing their heights. For the spaced adult individuals of the bigger size classes this ratio was less than unity (i.e. the plants tend to expanded horizontally rather than vertically). This may be a strategy of some plants to provide safe sights for their regeneration. The same study indicated that the young individuals are preponderant than the old ones in the wasteland habitat, which is an indication of vitality and prosperity of the species; it is mostly due to successful germination of seeds and survival of seedlings in this habitat. On the other hand, the populations along the edges, slopes, and terraces of canals and drains had relatively low number of small individuals which indicates that the regeneration capacity of *Pluchea dioscoridis* in these habitats is relatively lower than that of the wasteland. This may be attributed to lower fertility and / or higher mortality rate of young seedlings in these habitats.

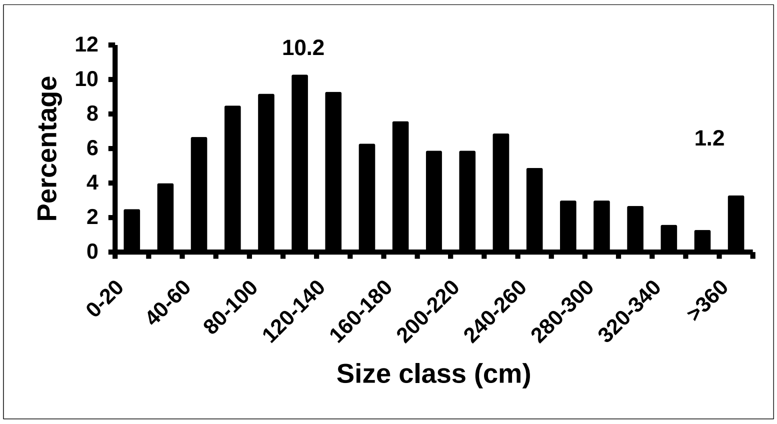

Fig. (5): Size frequency distribution of *Pluchea dioscoridis* populations in Nile Delta. The size classes are based on the size index of the individuals: i.e. mean of individual height and diameter (after Slima 2006).

ASSOCIATED GROWTH:

Shaltout (1993) evaluated the post-agricultural succession in an abandoned military base in Nile Delta and observed heavy growth of *Pluchea dioscoridis* (up to 2 m tall) and *Tamarix nilotica* (up to 6 m tall) populations. The plots of associated growth of both species had intermediate values of soil variables, however the two species had higher densities but lower individual sizes compared with their separate growth (Fig. 6: after Shaltout 1993).

In general, the correlations between the density and size of both species are significantly negative (Shaltout 1993). On the other hand, size inequality increased with increasing density, indicating that size hierarchy was becoming more pronounced and suggesting that the intra-specific competition was asymmetrical (Weiner & Thomas 1986). It seems also that both species avoid the inter-specific competition due to differences in the depths of their active roots (Fig. 7: after Sharaf El-Din *et al.* 1999).

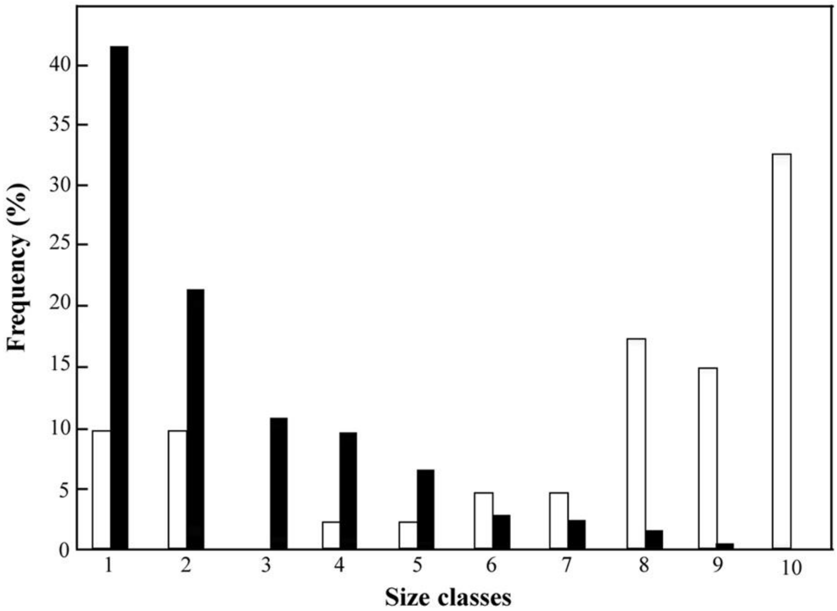

Fig. 6. Size distribution of *Pluchea dioscoridis* non-associated (□) and associated (■) with *Tamarix nilotica*. The ranges of size classes are:1= < 25 cm ; 2 = 25 - 50 cm ; 9 = 200 - 225 cm ; 10 = > 225 cm. (after Shaltout 1993).

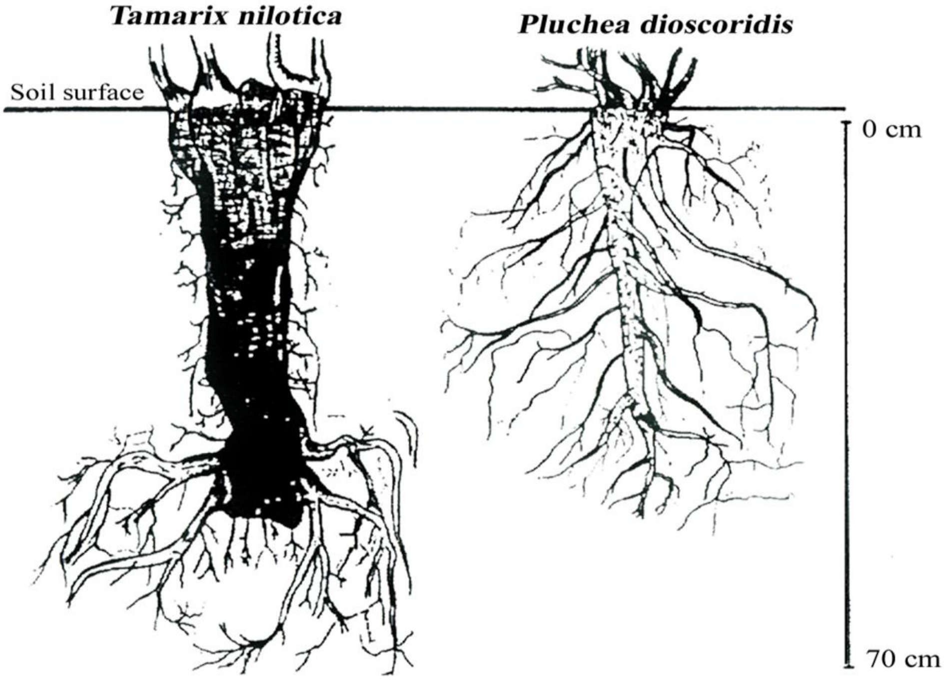

Fig. 7. Root systems of small sized individuals of *Pluchea dioscoridis* and *Tamarix nilotica.* (after Sharaf EL-Din *et al.* 1999).

NUTRIENT STATUS:

The nutrient status and nutritive value of *Pluchea dioscoridis* with emphasis on its competitive ability during post-agricultural succession in Nile Delta was evaluated by Sharaf El-Din *et al.* (1999). The sequence of elements concentrations in its organs was K > Na > Mg > Ca > N < = > Fe > P > Mn (Table 2: after Sharaf El-Din *et al.* 1999). The general trend of most elements in the organs of the plant is: leaf > flower > stem > root.

Table (2): Mean ± standard error of the concentration of different elements in the organs of *Pluchea dioscoridis* (after Sharaf El-Din *et al*. 1999).

Element (mg g^{-1})	Root	Stem	Leaf	Flower
N	1.3 ± 0.1	0.6 ± 0.1	1.0 ± 0.0	1.1 ± 0.0
P	0.4 ± 0.0	0.3 ± 0.0	0.6 ± 0.1	0.4 ± 0.4
Na	8.9 ± 1.8	8.9 ± 0.9	18.9 ± 0.7	12.8 ± 0.7
Ca	3.9 ± 0.6	5.2 ± 0.5	9.7 ± 0.0	6.3 ± 0.1
K	17.2 ± 0.4	17.9 ± 0.6	19.4 ± 1.3	24.5 ± 0.9
Mg	4.5 ± 0.1	6.3 ± 0.5	16.9 ± 0.6	11.2 ± 0.1
Fe	1.3 ± 0.1	0.6 ± 0.0	1.4 ± 0.0	0.6 ± 0.0
Mn	0.02 ± 0.01	0.01 ± 0.0	0.04 ± 0.01	0.01 ± 0.0

The mean contents of total proteins, ether extract and crude fiber was 2.5, 3.5 and 64.5%, respectively. The general trend is: crude fiber> total carbohydrate> ether extract> total protein (Table 3: after Sharaf El-Din *et al.* 1999).

Table (3): Mean ± standard error of the organic contents and nutritive values in the above ground parts of *Pluchea dioscoridis* (after Sharaf El-Din *et al*. 1999).

Variables		Mean ±SD
Total carbohydrates	%	21.0 ± 0.8
Total protein	%	2.5 ± 0.1
Ether extract%	%	3.2 ± 0.4
Crude fibers	%	64.4 ± 0.2
Ash	%	8.6 ± 0.0
Ca / P		14.6 ± 2.0
Ca / Mg		0.6 ± 0.0
Net energy MJ (Kg DM^{-1})		1.2 ± 0.3
Total digestible nutrients (%)		51.1 ± 0.2

STANDING-CROP BIOMASS:

The standing-crop biomass of *Pluchea dioscoridis* shoots in the abandoned fields in Nile Delta ranged between 3.5 to 3.9 ton dry weight ha^{-1} (Shaltout and El-Komi 2006). This estimate is much higher than those of many shrubs and trees in some related studies, although the rainfall in the areas of these studies is higher than that of *Pluchea dioscoridis*. The area of Shaltout and El-Komi's study, being a part of the Nile Delta, is characterized by high nitrogen content and receives additional water due to seepage from the adjacent canals, drains and irrigated fields. The same authors prepared simple linear and logarithmic regression equations for predicting the individual shoot weight using its size index (average of shoot height and diameter) as an independent variable: $Y = -479.4 + 13.1 X$ and $\log Y = -3.5 + 2.98 \log X$, where Y is the shoot weight (g dry weight $ind.^{-1}$) and X is the shoot size index (cm $ind.^{-1}$). This non-destructive technique is useful for the long-term periodical monitoring of the biomass.

SEED CHARACTERISTICS:

1-Seed Viability:

Slima (2006) tested the viability of seed embryo of *Pluchea dioscoridis* by the tetrazolium chloride method, using 100 embryos for each location and habitat (seed coat was detached), the viable seeds were those stained with pink color (Table 4: Slima 2006). The seeds collected from the wastelands attained the highest viability and germination (63.0 and 56.0%), while the seeds of the canal terraces attained the lowest (38.0 and 37.6%).

Table (4): Viability and germination percentage of *Pluchea dioscoridis* seeds collected from different habitats in Nile Delta. WL: wastelands, CE: canal edges, CS: canal slopes, CT, canal terraces, DS, drain slopes and DT, drain terraces. SD: standard deviations. The F-values are significant at $P \leq 0.001$ (after Slima 2006).

Character (%)	Habitat type						Mean ± SD	F
	WL	CE	CS	CT	DS	DT		
Seed Viability	63.0	56.0	42.0	38.0	48.0	45.0	49.3 ± 8.5	14.2
Germination	56.0	50.4	36.0	37.6	41.6	38.0	44.0 ± 6.9	17.4

2-Seed Color:

Significant variation in the seed color was depicted in *Pluchea dioscoridis* populations from Nile Delta (Slima 2006). It is interested to compare between the seed color and the other seed characteristics. For example, seeds which attained the dark brown or black color had relatively low percentages of viable embryos and germination (e.g. canal terraces). On the other hand, the light brown or pink colored seeds had high percentage of seedling survival (e.g. wastelands). Zayed (1983) on his study on seed germination of *Retama raetam* reported that the green colored seeds had higher and faster germination than the yellow seeds. Change in seed color may be due to the effect of fungi and insects that invade the plant and affect the seed viability and color (see item No. 10).

3-Seed Germination:

The effect of temperature on seed germination of *Pluchea dioscoridis* was studied by Slima (2006). Her results indicated that a maximum percentage 0f 56% was attained at Lab temperature by the seeds collected from the wastelands (Table 4 and Fig. 8: after Slima 2006). Thus, one may report that the abundance of *Pluchea dioscoridis* individuals in wasteland habitats, compared with the other habitats, may be not only due to more favorable environmental conditions, but also due to some degree of ecotypic variation in its seed characteristics (Shaltout and El-Shourbagy 1989). The verification of this point needs further ecological and genetical studies.

Atia (1982) and Slima (2006) reported that *Pluchea dioscoridis* seeds can germinate at different temperatures ranging between 5 and 30 ºC with a maximum germination of at 15 ºC. Various processes respond differently to changes in temperature, and this might result in either accumulation of certain growth promoting substances or elimination of some growth inhibiting substances. The relatively low germination capacity of this plant is due to the low viability of its seed embryos (about 50% of the seed embryos are not viable according to the tetrazolium chloride test). In some Egyptian desert shrubs, e.g. *Thymelaea hirsuta*, the percentage of viable seeds varies between 20 to 49% according to habitat type (Shaltout *et al*. 1989).

4-Seedling Emergence:

The suitable depth of sowing is one of the important requirements for seedling emergence. Weaver and Clements (1938) stated that there is an optimum depth for germination of each species, which varies with habitat type. The depth of sowing for optimum seedling emergence from *Pluchea dioscoridis* seeds was 0.2 cm below soil surface, but decreased with depth increasing (Fig. 9: after Slima 2006). Abdel-Rahman and Batanouny (1959) reported that seeds of some Egyptian desert species that are buried to a depth below 4 cm fail to emerge. The same conclusion was reported by Zayed (1983) in his study on *Retama raetam* and Shaltout and El-Shourbagy (1989) in their study on *Thymelaea hirsuta*; the deeper the depth of sowing, the lower was the emergence percentage.

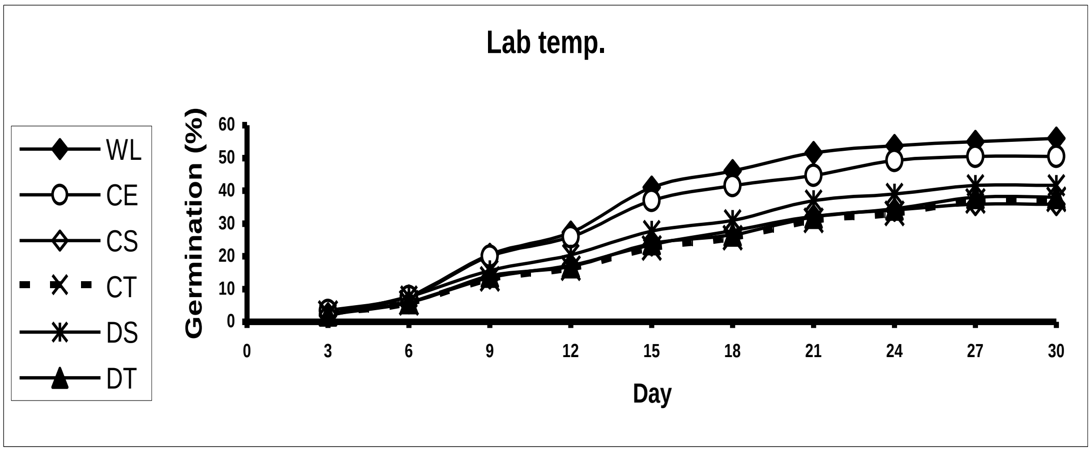

Fig. (8): Seed germination percentage of *Pluchea dioscoridis* seeds collected from different habitats (after Slima 2006)

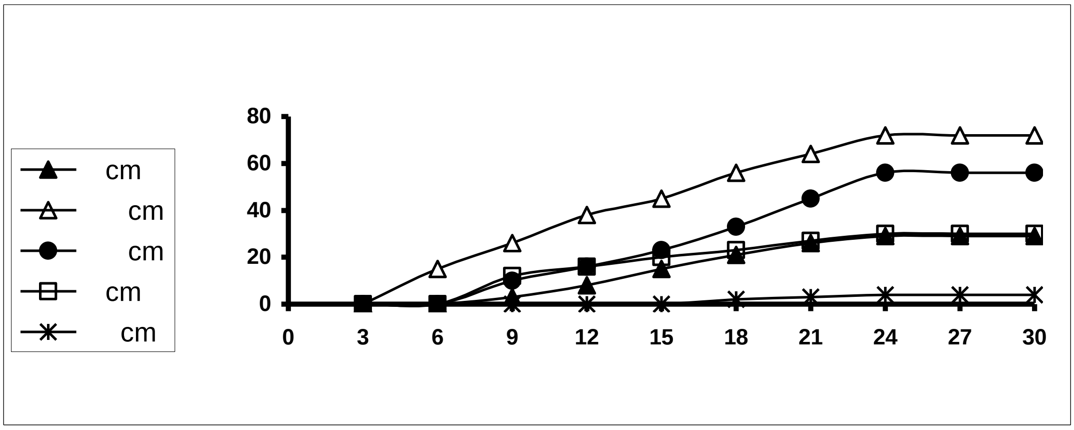

Fig. (9): Effect of depth of sowing (cm) on the percentage of seedling emergence of *Pluchea dioscoridis* (after Slima 2006).

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بيولوجية النباتات الخشبية المعمرة في مصر
3- نبات البرنوف *Pluchea dioscoridis* (L.) DC.

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يهدف هذا البحث إلي استطلاع المراجع المتعلقة ببيولوجية نبات البرنوف، وهو شجيرة دائمة الخضرة تستوطن البيئات المستحدثة، ويعتبر الثالث في سلسلة من البحوث المرجعية تتناول بيولوجية النباتات الخشبية المعمرة في مصر. مثل هذه الدراسات توجه اهتمام علماء بيولوجية النبات المصريين، ليس فقط نحو استكمال النقص في المعلومات عن جماعات النباتات البرية المصرية، ولكن أيضاً لتحديث القديم منها. يشتمل هذا المقال علي معلومات عن تصنيف وتسمية نبات البرنوف، توزيعه العالمي (شرق المنطقة السودانية وشرق منطقة الصحاري العربية) والمحلي (منطقة النيل، واحات الصحراء الغربية، ساحل البحر المتوسط، الصحراء الشرقية وسيناء)، البيئات المفضلة (جوانب المجاري المائية، البيئات الرطبة، الحقول المهملة، الانخفاضات الموازية للطرق والسكك الحديدية، المنازل المهدمة، مناطق الفضلات الصلبة والسائلة)، شكل وتشريح الساق والأوراق، وصف حبوب اللقاح، الخدمات (نبات حامي للشواطئ) والسلع (نبات طبي)، كيمياء النبات، التحكم البيولوجي والسمية (نشاط مضاد للحشرات)، الكائنات الصاحبة (النباتات الوعائية، الحشرات والكائنات الدقيقة)، التركيب الحجمي، النمو المصاحب نتيجة تعاقب ما بعد الزراعة في الحقول المهملة، المركز الغذائي (يشمل المكونات العضوية وغير العضوية)، الكتلة الحية للمجموع الخضري (3.5–3.9 طن هكتار$^{-1}$ في الحقول المهملة بدلتا النيل). يتناول هذا البحث أيضاً خصائص البذرة والبادرة مثل الشكل، الحيوية، الإنبات وبزوغ البادرة. وقد دل استطلاع المراجع على وجود نقص في المعلومات المتعلقة بالتغير في فسيولوجية النبات وتركيبه الوراثي علي امتداد التدرجات البيئية المصاحبة للنبات، كما أن تقييم التغيرات علي مستوي الأشكال البيئية لجماعات هذا النبات تحتاج أيضاً لدراسات مستقبلية.