

Urban flora of Sousse (Tunisia)

Dietmar Brandes

1. Introduction

2. Ancient town centre (medina) of Sousse

3. Modern town

3.1. Colonial and post-colonial quarters

3.2. Cultivated trees and weeds of the unsealed areas around them

3.3. Epiphytes

3.4. Weeds of flower bowls in the streets

3.5. Further species in the modern quarters

4. Flora of railway land

5. Flora of the outskirts

6. Coastal flora

7. Comparison with urban flora of Central Europe

8. References

9. Figures

Prof. Dr. Dietmar Brandes

Arbeitsgruppe für Vegetationsökologie und experimentelle Pflanzensoziologie

Botanisches Institut und Botanischer Garten der TU Braunschweig

D-38023 Braunschweig

E-mail: D.Brandes@tu-bs.de

Homepage: <http://www.biblio.tu-bs.de/geobot/geobot.htm>

1. Introduction

Sousse is situated in North Africa on the southern shore of the Gulf of Hammamet. The town was founded in the 9th century by the Phoenicians as Hadrumet. Hannibal used Hadrumet as a military basis at the end of the Second Punic War (218-201 BC), which was lost by him. Later on – during the Third Punic War – the city changed over to the Romans and avoided therefore demolition. The city gets the new name Hadrumetum, became a part of the Roman Empire and gained the status of a free city. Under the rule of Emperor Trajan it became an important commerce centre: The number of inhabitants rised to about 40.000; the port got great importance for the exportation of olive oil. Due to the devastations of the following periods there are no Roman ruins to be seen. The archaeological museum exhibits nice Roman mosaics, and also Christian catacombs in the outskirts. In the 5th century the city suffered destruction by the Vandals and got the name Hunerikopolis. The name changed to Justinianopolis when the Byzantines took over control. The city became one of the most important Byzantine bases in North Africa.

The Arab conquest occured first in 647; the city was destroyed and pillaged, therefore no ancient monuments are preserved. The city was founded again by the Arabs about 800. Sousse (arabic: sūsa) served the capital Kairouan as port and became the main commercial and military port in the times of the Aghlabites (800-909). The city formed an important part of the coastal defense system with kasbah, medina, ribat, and ramparts. Sousse bears an exceptional testimony to the civilization of the first centuries of Islamic culture in North Africa (fig. 1, fig.2, fig. 3, fig. 4). Therefore the medina of Sousse is recorded on the list of the UNESCO World Heritage.

The further history was eventful, Normans (12th century) and Spaniards (16th century) tried the occupation of the city. From the 16th century Tunisia belonged to the Turkish Empire. 1883 Tunisia became French colony, 1956 it got finally independent. Today Sousse has more than 125.000 inhabitants and is the biggest town of Tunisia after Tunis and Sfax. Sousse is capital of the northern part of the Sahel, which is one of the oldest and most important landscapes of the Maghreb. Sousse is twin town of Braunschweig (Germany), where my working group for vegetation science is located.

The nomenclature of the plants follows as far as possible POTTIER-ALAPETITE (1979-1981) and CUÉNOD, POTTIER-ALAPETITE & LABBE (1954).

2. Ancient town centre (medina) of Sousse

The medina is the traditional heart of Sousse with its great mosque and the old ribat. The medina has a nearly rectangular shape (700 m x 500 m), is guarded by the kasbah and surrounded by the city-wall.

The following species have been recorded for the old arabic town:

<i>Amaranthus cf. muricatus</i>	<i>Melilotus indica</i>
<i>Arisarum vulgare</i>	<i>Mercurialis annua</i> *
<i>Aster squamatus</i> [relatively rare]	<i>Mesembryanthemum cristallinum</i> *
<i>Bromus madritensis</i> *	<i>Nicotiana glauca</i> *
<i>Carduus pteracanthus</i> *	<i>Oryzopsis miliacea</i> *
<i>Chenopodium album</i>	<i>Oxalis corniculata</i> *
<i>Chenopodium murale</i>	<i>Oxalis pes-caprae</i>
<i>Convolvulus althaeoides</i>	<i>Parietaria judaica</i> * [rare] (fig.7)
<i>Conyza bonariensis</i> * (fig. 5)	<i>Peganum harmala</i> (fig. 8)
<i>Coronopus didymus</i>	<i>Phagnalon rupestre</i> *
<i>Cynodon dactylon</i> *	<i>Plantago afra</i> *
<i>Diplotaxis cf. tenuifolia</i> *	<i>Poa annua</i>
<i>Echium cf. colonum</i>	<i>Polycarpon tetraphyllum</i>
<i>Emex spinosa</i> *	<i>Reseda alba</i> *
<i>Erodium spec.</i> *	<i>Ricinus communis</i>
<i>Euphorbia peplus</i>	<i>Senecio cf. leucanthemifolius</i>
<i>Fagonia cretica</i> *	<i>Sisymbrium irio</i> *
<i>Ficus carica</i> *	<i>Sonchus oleraceus</i>
<i>Hordeum leporinum</i> *	<i>Sonchus tenerrimus</i> *
<i>Hyoscyamus albus</i> *	<i>Solanum nigrum</i>
<i>Lamarckia aurea</i>	<i>Spergula spec.</i> *
<i>Lamium amplexicaule</i>	<i>Stellaria media</i>
<i>Lolium cf. rigidum</i>	<i>Urtica pilulifera</i>
<i>Lycopersicon esculentum</i>	<i>Verbascum sinuatum</i> *
<i>Malva parviflora</i> (fig.6)	

The species marked with asterisk (*) are growing in fissures of walls or on the top of walls or even at the flat roofs of buildings (fig. 9).

Stands with *Hyoscyamus albus* are characteristic for walls of the old ramparts and even for walls of inhabited houses (tab. 1).

Table 1: *Hyoscyamus albus*-community

Number of the relevé	1	2	3	4	5	6	7	8
Area [m ²]	10	50	2	20	10	160	20	10
Cover [%]	30	10	5	10	20	15	10	20
Number of species	1	1	2	3	4	3	3	4
<i>Hyoscyamus albus</i>	3.2	2.1	+	2.1	1.1	2.2	2.1	1.1
<i>Nicotiana glauca</i>	.	.	+	.	2.1	.	.	2.1
<i>Mercurialis annua</i>	.	.	.	2.2	.	2.2	2.2	.
<i>Reseda alba</i>	.	.	.	1.1	.	.	1.1	2.1
<i>Sonchus tenerrimus</i>	.	.	.	.	1.1	+	.	1.1
<i>Sisymbrium irio</i>	.	.	.	.	2.1	.	.	.

The vegetation of the top of the walls resp. of the staircases to the city-wall is nearly identical with the vegetation of the fissures with respect to the species combination (fig. 9). It differs however in the occurrence of *Parietaria judaica* (tab. 3) and in the opulence of the vegetation which indicates a better supply of water at the top of the walls. Oblique walls (angle < 90°) are also more suitable habitats to plants than vertical walls.

Stepped crown of the city-wall of Sousse. 2.4.1993. O 45°, 5 m², vegetation cover 90 %:

5.5 *Parietaria judaica*, 1.1 *Sonchus tenerrimus*, + *Hyoscyamus albus*.

Table 2: Weed flora of flat roofs in the medina of Sousse

Species	Records 1993	Records 1994
<i>Reseda alba</i>	6	11
<i>Sonchus tenerrimus</i>	6	11
<i>Sisymbrium irio</i>	5	5
<i>Echium cf. confusum</i>	1	1
<i>Mercurialis annua</i>	1	.
<i>Fagonia cretica</i>	1	.
<i>Ficus carica</i>	.	1
<i>Hyoscyamus albus</i>	.	1
<i>Lobularia maritima</i>	.	1
<i>Opuntia cf. ficus-indica</i>	.	1
<i>Oryzopsis miliacea</i>	.	1
<i>Parietaria judaica</i>	.	1

Table 3: Stands with *Parietaria judaica*

Number of the relevé	1	2	3	4	5	6	7	8
Area [m ²]	2	6	10	3	50	3	3	1
Cover [%]	70	100	70	40	10	95	45	40
Number of species	9	12	6	4	3	3	3	2
<i>Parietaria judaica</i>	2.2	2.2	3.4	2.1	2.2	5.5	2.1	2.1
<i>Hyoscyamus albus</i>	2.2	2.3	1.1	2.2	1.1	+	.	.
<i>Sonchus tenerrimus</i>	.	2.2	1.1	.	1.1	1.1	1.1	.
<i>Mercurialis annua</i>	2.3	1.2	.	.	.	.	2.1	2.2
<i>Sisymbrium irio</i>	1.2	2.2	.	2.2	.	.	.	.
<i>Reseda alba</i>	2.2	3.2	.	.	.	.	.	.
<i>Geranium molle</i>	1.2	1.2	.	.	.	.	.	.
<i>Poa annua</i>	+	+2	.	.	.	.	.	.
<i>Malva parviflora</i>	+2	.	.	.	.	.	.	.
<i>Bromus madritensis</i>	+	.	.	.	.	.	.	.
<i>Emex spinosa</i>	.	1.2	.	.	.	.	.	.
<i>Marrubium vulgare</i>	.	+	.	.	.	.	.	.
<i>Capsella rubella</i>	.	+	.	.	.	.	.	.
<i>Erodium moschatum</i>	.	+	.	.	.	.	.	.
<i>Oxalis pes-caprae</i>	.	.	+2	.	.	.	.	.
<i>Silybum marianum</i>	.	.	+	.	.	.	.	.
<i>Euphorbia helioscopia</i>	.	.	+	.	.	.	.	.
<i>Conyza bonariensis</i>	.	.	.	1.1	.	.	.	.
Musci indet.	.	.	.	.	+2	.	.	.

3. Modern town

Public services are situated in the modern (municipal administration, big shops, schools, police department, bus terminal, railway station, harbour), while factories and warehouses are settling along the radial routes.

3.1. Colonial and post-colonial quarters

The colonial quarters and the high class suburban district both are situated in the north of the medina. These quarters are built up in the 20th century. The hotels are built up along the coastline between the medina and Port El Kantoui. Nitrophilous plant communities of the alliance *Chenopodium muralis* (tab. 4 and 5) grow in the gaps between the houses and hotels.

Table 4: Chenopodio muralis-Malvetum parviflorae Lohm. & Trautm. 1970

Number of the relevé	1	2	3	4	5	6
Area [m ²]	3	18	5	25	50	20
Cover [%]	55	95	90	75	100	85
Number of species	13	10	12	8	6	11
<i>Malva parviflora</i>	2.2	2.2	.	4.3	3.3	1.2
<i>Chenopodium murale</i>	.	.	3.3	1.2	.	2.2
<i>Sisymbrium irio</i>	3.4	2.2	2.2	3.3	2.2	1.2
<i>Urtica urens</i>	+2	+2	3.4	.	.	.
<i>Lolium multiflorum</i>	+2	.	+	.	1.2	.
<i>Emex spinosa</i>	.	2.2	2.2	.	.	1.2
<i>Hordeum leporinum</i>	.	2.2	.	2.2	.	+2
<i>Cynodon dactylon</i>	+	.	2.2	.	.	.
<i>Sonchus oleraceus</i>	1.1	.	.	+	.	.
<i>Poa annua</i>	+	.	.	.	.	2.2
<i>Carduus pteracanthus</i>	.	3.4	.	.	1.2	.
<i>Sonchus tenerrimus</i>	.	.	+	.	.	+
<i>Urtica pilulifera</i>	.	.	.	.	4.4	4.3
<i>Fumaria spec.</i>	+	.	.	.	.	.
<i>Lamium amplexicaule</i>	+	.	.	.	.	.
<i>Euphorbia helioscopia</i>	+	.	.	.	.	.
<i>Euphorbia pepus</i>	+	.	.	.	.	.
<i>Coronopus didymus</i>	+	.	.	.	.	.
<i>Papaver rhoeas</i>	+	.	.	.	.	.
<i>Crysanthemum coronarium</i>	.	1.1	.	.	.	.
<i>Calendula officinalis</i>	.	2.2	.	.	.	.
<i>Reseda alba</i>	.	1.2	.	.	.	.
<i>Silybum marianum</i>	.	1.1	.	.	.	.
<i>Beta vulgaris ssp. maritima</i>	.	.	1.1	.	.	.
<i>Oxalis pes-caprae "flore pleno"</i>	.	.	2.2	.	.	.
<i>Polygonum aviculare s. l.</i>	.	.	1.2	.	.	.
<i>Linaria triphylla</i>	.	.	r	.	.	.
<i>Anagallis arvensis</i>	.	.	r	.	.	.
<i>Echium cf. confusum</i>	.	.	.	1.2	.	.
<i>Erodium spec.</i>	.	.	.	2.2	.	.
<i>Hyoscyamus albus</i>	.	.	.	+	.	.
<i>Amaranthus muricatus</i>	.	.	.	.	+	.
<i>Stellaria media s.l.</i>	.	.	.	.	.	2.2
<i>Convolvulus arvensis</i>	.	.	.	.	.	1.2
<i>Coriandrum sativum</i>	.	.	.	.	.	+

Table 5: *Amaranthus muricatus*-[*Chenopodium murale*]-community

Number of the relevé	1	2	3	4	5	6
Area [m ²]	10	8	6	10	10	6
Cover [%]	60	80	60	80	35	85
Number of species	2	2	2	6	6	12
<i>Amaranthus muricatus var. tenuifolius</i>	3.2	5.4	3.3	3.3	3.2	3.3
<i>Amaranthus muricatus var. latifolius</i>	.	.	2.3	2.2	.	+
<i>Cynodon dactylon</i>	3.3	.	.	2.3	.	.
<i>Citrullus lanatus</i>	.	r	.	.	.	+
<i>Tribulus terrestris</i>	.	.	.	+	+	+
<i>Malva parviflora</i>	.	.	.	+	+	.
<i>Chenopodium murale</i>	.	.	.	2.2	.	+
<i>Conyza bonariensis</i>	.	.	.	.	1.1	.
<i>Setaria verticillata s.l.</i>	.	.	.	.	+	.
<i>Diptotaxis spec.</i>	.	.	.	.	+	.
<i>Amaranthus cf. viridis</i>	.	.	.	.	.	1.2
<i>Amaranthus retroflexus</i>	.	.	.	.	.	1.1
<i>Hyoscyamus albus</i>	.	.	.	.	.	1.1
<i>Echium cf. confusum</i>	.	.	.	.	.	1.1
<i>Emex spinosa</i>	.	.	.	.	.	+
<i>Portulaca oleracea</i>	.	.	.	.	.	+
<i>Sisymbrium irio</i>	.	.	.	.	.	+

3.2. Cultivated trees and weeds of the unsealed areas around them

Ficus microphylla is the most frequent tree within the colonial quarters. It sets the tone on Place Ferhard Hachet as well as on some great boulevards. *Schinus terebinthifolius* is another tree often grown for shading the streets. *Olea europaea*, the olive tree seems to be the most important tree in modern high-class suburban districts (fig. 10). In Sousse often cultivated trees and shrubs are:

<i>Acacia spp.</i>	<i>Melia adzedrach</i>
<i>Araucaria excelsa</i>	<i>Nerium oleander</i>
<i>Bougainvillea spp.</i>	<i>Olea europaea</i>
<i>Eucalyptus spp.</i>	<i>Phoenix canariensis</i> (fig. 14)
<i>Ficus lyrata</i> (fig. 11)	<i>Prunus armeniacus</i>
<i>Ficus microcarpa</i> (fig. 12, fig. 13)	<i>Punica granatum</i>
<i>Hibiscus rosa-sinensis</i>	<i>Schinus molle</i>
<i>Lantana camara</i>	<i>Schinus terebinthifolius.</i>

The unsealed areas around the stems of street trees are growing places of some species of the alliance *Chenopodium muralis* resp. of the class *Polygono-Poetea*:

<i>Anagallis arvensis</i>	<i>Malva parviflora</i>
<i>Chenopodium murale</i> (fig. 15)	<i>Poa annua</i>
<i>Coronopus didymus</i>	<i>Polygonum aviculare</i>
<i>Cynodon dactylon</i>	<i>Sisymbrium irio</i>
<i>Hordeum leporinum</i>	<i>Stellaria media</i>
	<i>Urtica urens</i>

Table 6: *Sisymbrium irio* stands around the stems of *Ficus microcarpa*

Number of the relevé	1	2	3
Area [m ²]	1	1	3
Cover [%]	40	40	45
Number of species	8	7	13
<i>Sisymbrium irio</i>	1.1	3.2	3.4
<i>Chenopodium murale</i>	2.2	+	.
<i>Stellaria media</i> s. l.	+	1.2	.
<i>Polygonum aviculare</i> s. l.	+	1.1	.
<i>Cynodon dactylon</i>	2.2	.	+
<i>Amaranthus deflexus</i>	2.2	.	.
<i>Silybum marianum</i>	+	.	.
<i>Erodium moschatum</i>	+	.	.
<i>Sonchus tenerrimus</i>	.	1.1	.
<i>Herniaria hirsuta</i>	.	+	.
<i>Daucus carota</i>	.	r	.
<i>Malva parviflora</i>	.	.	2.2
<i>Sonchus oleraceus</i>	.	.	1.1
<i>Euphorbia pepulus</i>	.	.	+2
<i>Lolium multiflorum</i>	.	.	+2
<i>Urtica urens</i>	.	.	+2
<i>Lamium amplexicaule</i>	.	.	+
<i>Euphorbia helioscopia</i>	.	.	+
<i>Poa annua</i>	.	.	+
<i>Fumaria</i> cf. <i>agraria</i>	.	.	+
<i>Papaver rhoeas</i>	.	.	+
<i>Coronopus didymus</i>	.	.	+

As in Central Europe *Poa annua* and *Stellaria media* are the most common species – in spring time. *Oryzopsis miliacea* as well as seedlings of *Carduus spec.* and *Onopordum spec.* are sporadically to be found. Along representative streets palms (*Phoenix canariensis*) are planted which are in good condition. Under *Phoenix canariensis* the following weeds are growing which might be brought together with the young palms:

Anacyclus clavatus
Beta vulgaris
Bromus madritensis
Euphorbia peplus
Mercurialis annua

Sonchus oleraceus
Sonchus tenerrimus
Spergula div. spec.
Torilis nodosa
Urospermum picroides

A small border under a cypress hedge showed the following spring aspectus [fragmentary *Chenopodium murale*-*Malvetum parviflorae*]:

24.3.1994. 3 m x 0,5 m, vegetation cover (herb layer) 90 %:

2.3 *Malva parviflora*, 2.2 *Sisymbrium irio*, 2.2 *Urtica urens*, 2.2 *Tropaeolum majus*.

3.3. Epiphytes

Remarkable are the epiphytes in the lower crown area of the palms, where the armpits of cut palm leafs form good growing places which have especially in winter half-year good water supply. An analysis of 85 palms between the medina and the port resulted in the following list, ranked according to the frequency of the species:

Ficus carica (20 x)
Parietaria judaica (14 x)
Sonchus tenerrimus (14 x)
Chenopodium giganteum (11 x)
Ficus microcarpa (6 x)
Mercurialis annua (6 x)
Hyoscyamus albus (4 x)
Reseda alba (3 x)
Chenopodium album (2 x)

Sisymbrium irio (2 x)
Chenopodium murale (1 x)
Conyza bonariensis (1 x)
Lycium europaeum (1 x)
Phalaris canariensis (1 x)
Polygonum equisetiforme (1 x)
Sonchus oleraceus (1 x)
 Indet. (5 x)

How can the diaspores reach the crowns of the trees? Anemochory and zoochory should be the most important way of spreading. Autochory is of no importance. Notable is the high number of zoochorous species: *Ficus carica* (fig. 14), the most frequent species, *Ficus microcarpa*, *Lycium europaeum*, *Phalaris canariensis* and perhaps *Polygonum equisetiforme* are spread by birds. *Parietaria judaica*, the second frequent species, is myrmekochorous. The others are anemochorous.

Epiphytes on *Phoenix canariensis* are also characteristic for other towns in the Mediterranean region: Tunis (own observations), Rabat (MAIRE 1942), and Italy (RICHTER 1985).

3.4. Weeds of flower-bowls in the streets

The following weeds are common in flower-bowls and tubs in front of shops and restaurants:

Chenopodium murale
Coronopus didymus
Cynodon dactylon
Lolium multiflorum
Melilotus indica

Oxalis pes-caprae
Sisymbrium irio
Sonchus oleraceus
Stellaria media
Urtica urens

3.5. Further species in the modern quarters

Amaranthus muricatus (fig. 16)
Anagallis arvensis
Arisarum vulgare
Aster squamatus
Calendula arvensis
Chenopodium album
Chenopodium giganteum
Chenopodium murale
Chrysanthemum coronarium
Citrullus colocynthis
Cynodon dactylon
Datura stramonium
Echinochloa colonum

Ecballium elaterium
Euphorbia peplus
Ficus carica
Fagonia cretica
Helianthus annuus
Heliotropium europaeum
Hordeum leporinum
Hyoscyamus albus
Inula graveolens
Inula viscosa
*Gomphrena globosa**

<i>Linum usitatissimum</i>	<i>Plantago major</i>
<i>Lobularia maritima</i>	<i>Portulaca oleracea</i>
<i>Lycium europaeum</i>	<i>Ricinus communis</i>
<i>Lycopersicon esculentum</i>	<i>Salsola oppositifolia</i>
<i>Lygaeum espartum</i>	<i>Schinus terebinthifolius</i> *
<i>Malva parviflora</i>	<i>Setaria verticillata</i> s. l.
<i>Mercurialis annua</i>	<i>Silybum marianum</i>
<i>Mesembryanthemum crystallinum</i>	<i>Sisymbrium irio</i>
<i>Mirabilis jalapa</i>	<i>Solanum nigrum</i>
<i>Moricandia arvensis</i>	<i>Sorghum halepense</i>
<i>Nicotiana glauca</i>	<i>Sonchus tenerrimus</i>
<i>Opuntia ficus-indica</i>	<i>Thymelaea hirsuta</i>
<i>Oxalis pes-caprae</i>	<i>Tribulus terrestris</i>
<i>Panicum miliaceum</i>	<i>Urtica pilulifera</i> (fig. 17)
<i>Parietaria judaica</i>	<i>Withania somnifera</i> (fig. 18)
<i>Phagnalon rupestre</i>	
<i>Phoenix canariensis</i> *	

*cultivated and subsponaneous

4. Flora of railway land

Tunisia has a narrow-gauge railway net since about 100 years (SNCFT). Sousse is situated at the main line Tunis-Sfax and is also the starting point of the electrified "Metro du Sahel" which links Sousse to Monastir and Mahdia. The main station is

Sousse SNCFT (fig. 19, fig. 20), whereas the „Metro du Sahel“ starts from Sousse Bab Djedid. Three other stops are called Sousse Mohamed V, Sousse Sud, and Sousse Zone industrielle.

The following species are recorded on railway land in Sousse (fig. 21, fig. 22, fig. 23):

<i>Acacia spec. juv.</i>	<i>Bupleurum lancifolium</i>
<i>Adonis microcarpa</i>	<i>Calendula arvensis</i>
<i>Amaranthus albus</i>	<i>Carduus cf. pteracanthus</i>
<i>Amaranthus blitoides</i>	<i>Carduus pycnocephalus</i>
<i>Amaranthus cf. deflexus</i>	<i>Centaurea calcitrapa</i>
<i>Amaranthus muricatus</i>	<i>Centaurea nicaeensis</i>
<i>Amaranthus cf. viridis</i>	<i>Chamaesyce spec.</i>
<i>Ammi majus</i>	<i>Chenopodium ambrosioides</i>
<i>Anagallis arvensis</i>	<i>Chenopodium giganteum</i>
<i>Arisarum vulgare</i>	<i>Chenopodium murale</i>
<i>Aster squamatus</i>	<i>Chenopodium opulifolium</i>
<i>Beta vulgaris</i>	<i>Chrysanthemum coronarium</i>
<i>Bromus madritensis</i>	<i>Citrullus colcyntis</i>

<i>Convolvulus arvensis</i>	<i>Panicum cf. miliaceum</i>
<i>Conyza bonariensis</i>	<i>Papaver rhoeas</i>
<i>Coronopus didymus</i>	<i>Parietaria judaica</i>
<i>Cynodon dactylon</i>	<i>Peganum harmala</i>
<i>Cyperus spec.</i>	<i>Phalaris minor</i>
<i>Dittrichia viscosa</i>	<i>Phoenix canariensis</i>
<i>Ecballium elaterium</i>	<i>Poa annua</i>
<i>Echinochloa colonum</i>	<i>Polycarpon tetraphyllum</i>
<i>Echium confusum</i>	<i>Polygonum aviculare</i>
<i>Emex spinosa</i>	<i>Portulaca oleracea</i>
<i>Erodium spec.</i>	<i>Ranunculus sardous</i>
<i>Eruca sativa</i> (fig. 24)	<i>Raphanus sativus</i>
<i>Euphorbia peplus</i>	<i>Reseda alba</i>
<i>Fagonia cretica</i>	<i>Ricinus communis</i>
<i>Ficus carica</i>	<i>Salsola oppositifolia</i> (fig. 26)
<i>Foeniculum vulgare</i>	<i>Scandix pecten-veneris</i>
<i>Galactites tomentosa</i>	<i>Schinus terebinthifolius</i>
<i>Galium tricornutum</i>	<i>Scolymus hispanicus</i>
<i>Glaucium flavum</i>	<i>Senecio gallicus ssp. coronopifolius</i>
<i>Hedypnois cretica</i>	<i>Senecio leucanthemifolius</i>
<i>Heliotropium europaeum</i>	<i>Senecio vulgaris</i>
<i>Hirschfeldia incana</i>	<i>Setaria verticillata s. l.</i>
<i>Hordeum leporinum</i>	<i>Sheradia arvensis</i>
<i>Hyoscyamus albus</i>	
<i>Lamarckia aurea</i>	<i>Sisymbrium irio</i>
<i>Linaria triphylla L.</i> (fig. 25)	<i>Solanum nigrum</i>
<i>Lycium europaeum</i>	<i>Sonchus oleraceus</i>
<i>Lycopersicon esculentum</i>	<i>Sonchus tenerrimus</i>
<i>Malva parviflora</i>	<i>Sorghum halepense</i>
<i>Marrubium vulgare</i>	<i>Spergularia bocconii</i>
<i>Medicago hispida</i>	
<i>Melilotus indica</i>	<i>Thymelaea hirsuta</i>
<i>Mercurialis annua</i>	<i>Torilis nodosa</i>
<i>Mirabilis jalapa</i>	<i>Tribulus terrestris</i>
<i>Nicotiana glauca</i>	<i>Triticum spec.</i>
<i>Nigella sativa</i>	<i>Tropaeolum majus</i>
<i>Onopordum nervosum ssp. platylepis</i>	<i>Urtica pilulifera</i>
<i>Oryzopsis miliacea</i>	<i>Valantia hispida</i>
<i>Oxalis pes-caprae</i>	

Whereas *Chenopodium murale* communities are very frequent at the sites of the railway stations, the lines are accompanied by communities of *Hordeum leporini*, at shaded places also by *Urtica pilulifera* stands. *Nicotiana glauca* and *Ricinus communis* are growing in the front of walls along the railway lines in the industrial areas resp. outskirts.

More out of the town Onopordetalia communities with *Onopordum div. spec.*, *Carduus spec.* and *Marrubium vulgare* are to be found in contact to garbaged and grazed olive groves. The vegetation of the bordering areas as well as of the ballast is dominated more and more by species of the central steppe of Tunisia like *Thymelaea hirsuta*, often accompanied by *Marrubium vulgare*.

5. Flora of the outskirts

The outskirts have been grown and are growing disordered: grazed olive groves, new settlements, and industrial areas are interlocked narrowly. The olive groves are disturbed and more or less contaminated by garbage. The following ruderal species are to be found in grazed olive groves in the southern and western outskirts:

<i>Carduus pteracanthus</i>	<i>Datura innoxia</i>
<i>Carduus pycnocephalus</i>	<i>Marrubium vulgare</i>
<i>Carthamus lanatus</i>	<i>Peganum harmala</i>
<i>Convolvulus lineatus</i>	<i>Thymelaea hirsuta</i>

The following relevé reflects the species combination of a grazed and highly contaminated olive grove in the southern outskirts of Sousse:

15.4.1998. Area 40 m², cover 50 %:

2.1 *Onopordum cf. arenarium* (fig. 27), 3.4 *Carduus pteracanthus*, 1.2 *Marrubium vulgare*, + *Carthamus lanatus*, + *Verbascum sinuatum*, + *Hirschfeldia incana*;
 1.2 *Urtica pilulifera*, 1.2 *Malva parviflora*, 1.2 *Emex spinosa*, +.2 *Lophochloa cf. cristata*, +.2 *Plantago lagopus*, +.2 *Bromus madritensis*, + *Torilis nodosa*, + *Hordeum leporinum*, + *Aster squamatus*, + *Beta vulgaris ssp. maritima*, + *Sonchus oleraceus*, *Solanum nigrum*, *Trachynia distachya*, + *Chenopodium giganteum*.

Peganum harmala and *Urtica pilulifera* are even growing on partly burned garbages together with *Carduus pteracanthus*, *Centaurea calcitrapa*, *Nicotiana glauca*, *Onopordum acanthium*, *Silybum marianum* and others.

The following nitrophytes were found at the lower part of a steep embankment of a canal which was extremely polluted by garbage and sewage:

<i>Aster squamatus</i>	<i>Parietaria judaica</i>
<i>Beta vulgaris ssp. maritima</i>	<i>Ranunculus sceleratus</i>
<i>Cotula coronopifolia</i>	<i>Urtica pilulifera</i>
<i>Mercurialis annua</i>	<i>Xanthium spinosum</i>

Cotula coronopifolia (fig. 28) is characteristic for banks of all extremely polluted canals in Sousse (see table 7). At the hotel area the following species have been found in the concrete river bed besides the here and there dominant *Cotula coronopifolia*:

<i>Agropyron junceum</i>	<i>Malva parviflora</i>
<i>Arthrocnemum indicum</i>	<i>Polypogon monspeliense</i>
<i>Aster squamatus</i>	<i>Rumex pulcher</i>
<i>Bassia cf. indica</i>	<i>Solanum nigrum</i>
<i>Beta vulgaris ssp. maritima</i>	<i>Sonchus maritimus</i> (fig. 29)
<i>Cyperus laevigatus ssp. distachyos</i>	<i>Sonchus oleraceus</i>
<i>Datura innoxia</i>	<i>Spergularia marina</i>
<i>Emex spinosa</i>	<i>Typha angustifolia</i>
<i>Frankenia laevis</i>	<i>Urtica pilulifera</i>
<i>Hedypnois cretica</i>	

Table 7: *Cotula coronopifolia* dominated riparian vegetation of polluted canals in Sousse

Number of relevé	1	2	3	4	5	6	7	8	9
Area [m ²]	5	8	12	15	20	12	10	20	20
Cover [%]	85	90	85	90	90	95	75	90	90
Number of species	4	7	5	8	6	7	6	9	8
<i>Cotula coronopifolia</i>	4.4	4.3	4.5	4.4	4.5	3.4	4.3	4.4	4.5
<i>Polypogon monspeliensis</i>	+	+	1.2	1.1	1.2	1.2	1.2	1.1	1.1
<i>Tamarix cf. gallica juv.</i>	.	1.1	+	1.1	.	1.1	1.1	1.1	.
<i>Spergularia salina</i>	.	.	.	+2	1.2	2.2	3.3	2.3	2.2
<i>Arthrocnemum indicum</i>	.	.	.	1.2	+	2.2	.	1.2	.
<i>Rumex pulcher</i>	1.2	+	+	.	.	.	.	.	.
<i>Cakile maritima var. aegyptiaca</i>	.	2.2	1.2	.	1.2	.	.	.	.
<i>Beta vulgaris ssp. maritima</i>	.	.	.	+	.	3.4	.	.	1.1
<i>Malva parviflora</i>	.	.	.	.	.	+	.	+	1.2
<i>Polygonum aviculare</i>	1.2	+	.	.	.	.	.	.	.
<i>Frankenia laevis</i>	.	.	.	.	+	.	+	.	.
<i>Aster squamatus</i>	.	+	.	.	.	.	.	.	.
<i>Typha angustifolia</i>	.	.	.	+	.	.	.	.	.
<i>Cichorium intybus</i>	.	.	.	+	.	.	.	.	.

<i>Heliotropium curassavicum</i>	.	.	.	.	.	.	1.2	.	.
<i>Frankenia pulverulenta</i>	.	.	.	.	.	.	.	1.2	.
<i>Sonchus oleraceus</i>	.	.	.	.	.	.	.	+	.
<i>Urtica pilulifera</i>	.	.	.	.	.	.	.	+	.
<i>Solanum nigrum</i>	.	.	.	.	.	.	.	.	1.2
<i>Emex spinosa</i>	.	.	.	.	.	.	.	.	1.1
<i>Datura innoxia</i>	.	.	.	.	.	.	.	.	+

Nicotiana glauca was only found in settlements, especially along walls and in courts, on freshly stirred garbage as well as on the slopes of polluted waters. Obviously *Nicotiana glauca* grows not yet in wadis outside of settlements and avoids also salty soils.

6. Coastal flora

On ruderalized seashores near to the harbour resp. industrial zones on coarse stones and gravels *Cakileum maritima* and *Chenopodium murale* penetrate each other with the following species:

Cakile maritima

Chenopodium murale

Hyoscyamus albus

Malva parviflora

Sousse has a long intensively used beach with only few growing places due to the care. We can find however fragmentary stands of the *Cakileum maritima* with *Cakile maritima*, *Salsola kali*, and *Hyoscyamus albus*. On the higher strengthened beach areas and on low dunes numerous sandy plants are growing:

Agropyron junceum

Carpobrotus edulis

Centaurea sphaerocephala

Coronopus didymus

Cyperus capitatus (?)

Emex spinosa

Limonium sinuatum (fig. 30)

Lotus creticus

Medicago marina (fig. 31)

Mesembryanthemum crystallinum

(fig. 32)

Plantago coronopus

Senecio gallicus ssp. *coronopifolius*

Silene nicaeensis

The following relevé shows the vegetation of a dune about 2 m in height (18.4.1998; area 50 m², vegetation cover 50 %):

3.3 *Lavatera cretica*, 2.3 *Mesembryanthemum crystallinum*, 2.2 *Carpobrotus edulis*, 2.2 *Cakile maritima*, 1.2 *Salsola kali*, 1.2 *Emex spinosa*, + *Avena barbata*.

7. Comparison with urban flora of Central Europe

(i) In contrary to towns on Central Europe nitrophilous and sciophilous species accumulate in the city, because of better supply in water and nutrients. So Sousse is no „island of heat and dryness“ with respect to the surrounding steppe. This trend is also to be seen in cities at the northern mediterranean shore (BRANDES 1988; SCHULTE 1989).

(ii) The flora of old towns in (Central) Europe is characterized by a larger number of common species (BRANDES 1995). Some Stellarietea species of them are also to be found in Sousse, whereas the broad-leaved nitrophytes and the deciduous tree species are missing. Taking into account the distance and the climatic differences the number of common species between Braunschweig and its twin town Sousse is remarkable:

<i>Anagallis arvensis</i>	<i>Parietaria judaica</i>
<i>Bromus madritensis</i>	<i>Plantago major</i>
<i>Chenopodium album</i>	<i>Poa annua</i>
<i>Chenopodium murale</i>	<i>Polygonum aviculare s.l.</i>
<i>Cichorium intybus</i>	
<i>Convolvulus arvensis</i>	<i>Portulaca oleracea</i>
<i>Coronopus didymus</i>	<i>Ranunculus sceleratus</i>
<i>Cynodon dactylon</i>	<i>Scandix pecten-veneris</i>
<i>Datura stramonium</i>	<i>Silybum marianum</i>
<i>Ephorbia helioscopia</i>	
<i>Euphorbia peplus</i>	
<i>Ficus carica</i>	<i>Solanum nigrum</i>
<i>Lamium amplexicaule</i>	<i>Sonchus oleraceus</i>
<i>Lobularia maritima</i>	<i>Stellaria media</i>
<i>Lolium multflorum</i>	<i>Typha angustifolia</i>
<i>Mercurialis annua [M ambigua]</i>	<i>Urtica urens</i>

(iii) Species of the alliance *Chenopodium muralis* accumulate clearly in ancient settlements resp. in their surroundings. The most important plant community is the *Chenopodio muralis-Malvetum parviflorae* (winter and springtime). The stands of *Amaranthus muricatus* and other *Amaranthus* species are presumably the autumnal aspect of the same community; they grow at least at the same places.

A rich ruderal vegetation with biennial and perennial species is developing at places with enough water and nutrients as well as disturbance. These conditions exist at shadowed rubble heaps in suburban quarters and rubbished olive groves. With enough water for example at sewage canals a rich nitrophilous vegetation develops also without being shadowed.

(iv) The wall flora is in contrary to rainy areas of the northern mediterranean region and Western Europe not well developed in Sousse (and also in Tunis and Sfax). Even *Parietaria judaica* is very seldom in the medina of Sousse. It plays however a part at the railway stations and at north exposed cuttings. Wall flowers accumulate significantly at the flat roofs as well as on the cut leaves of palm trees.

(v) Neophytes have only significance for the flora of the outskirts, but not for the Medina. Gardening is the main source of alien plants, for species running wild as well as for introduced weeds:

<i>Acacia div. spec.</i>	<i>Datura innoxia</i>
<i>Amaranthus albus</i>	<i>Datura stramonium</i>
<i>Amaranthus blitoides</i>	<i>Ficus microcarpa</i>
<i>Amaranthus deflexus</i>	<i>Gomphrena globosa</i>
<i>Amaranthus muricatus</i>	<i>Helianthus annuus</i>
<i>Amaranthus cf. viridis</i>	<i>Lycopersicon esculentum</i>
<i>Aster squamatus</i>	<i>Mirabilis jalapa</i>
<i>Carpobrotus edulis</i>	<i>Nicotiana glauca</i>
<i>Chenopodium giganteum</i>	<i>Opuntia ficus-indica</i>
<i>Conyza bonariensis</i>	<i>Oxalis pes-caprae</i>
<i>Coronopus squamatus</i>	<i>Phoenix canariensis</i>
<i>Cotula coronopifolia</i>	<i>Schinus terebinthifolius</i>

(vi) The railway areas reflect the surrounding vegetation: In Sousse and in the nearby Sahel saharo-sindian species are growing on ballast: *Diplotaxis harra*, *Echium confusum*, *Erodium glaucophyllum*, *Helichrysum stoechas*, and *Reichardia tingitana*. The reason is, that railway areas in North Africa are in contrary to Central Europe no special growing places for plants. There is also no hint for an enriched number of neophytes at the railway areas than in the environs.

8. References

BRANDES, D. (1988): Spontane Vegetation von ligurischen Küstenorten. – Braun-Blanquetia, 3(1): 229-240.

BRANDES, D. (1995): The flora of old town centres in Europe. – In: H. Sukopp, M. Numata & A. Huber (eds.): Urban ecology as the basis of urban planning. Amsterdam, p. 49-58.

BRANDES, D. (1998) *Parietaria judaica* L. - Zur Morphologie, Ökologie und Soziologie einer verkannten nitrophilen Saumpflanze. - *Tuexenia*, 18: 357-376.

BRANDES, D. & E. BRANDES (1999): The flora of Maltese walls. - 25 S.
Elektron. Veröff.: <http://www.doku.biblio.etc.tu-bs.de/opus/volltexte/1999/55>

BUROLLET, P. (1927): *Le Sahel de Sousse: monographie phytogéographique*. – Tunis. 270 S.

CUENOD, A., G. POTTIER-ALAPETITE & A. LABBE (1954): Flore analytique et synoptique de la Tunisie: Cryptogames vasculaires, gymnospermes et monocotylédones. – Tunis. 39, 287 S.

MAIRE, R. (1942): Sur la florule des troncs de *Phoenix canariensis* des plantations de la ville de Rabat. – Comptes rendus des séances mensuelles de la Société des Sciences Naturelles du Maroc, 4: 26-27. Rabat.

POTTIER-ALAPETITE, G. (1979-1981): Flore de la Tunisie. Vol. 1.2. – Tunis. XIX, XIV, 1190 S.

RICHTER, M. (1985): Der Epiphytenbewuchs auf *Phoenix canariensis* Chaub. in Italien. – *Tuexenia*, 5: 537-548.

SCHULTE, W. (1989): Zur Flora und Vegetation der Städte Rovinj und Krk (Jugoslavien). – *Tuexenia*, 9: 199-223.

9. Figures



Fig. 1: Kasbah and medina of Sousse.



Fig. 2: Great mosque.



Fig. 3: Medina of Sousse.



Fig. 4: Wall flora on demolished buildings.



Fig. 5: *Conyza bonariensis*.



Fig. 6: *Malva parviflora*.



Fig. 7: *Parietaria judaica*.



Fig. 8: *Peganum harmala*.



Fig. 9: Spontaneous flora of flat roofs.



Fig. 10: Sub-urban district.



Fig. 11: High-class suburban district with *Ficus lyrata* and others planted in the gardens.



Fig. 12: *Ficus microcarpa* planted along boulevards.



Fig. 13: *Ficus microcarpa*.



Fig. 14: *Phoenix canariensis* with *Ficus carica* as epiphyte.



Fig. 15: *Chenopodium murale*.



Fig. 16: *Amaranthus muricatus*.



Fig. 17: *Urtica pilulifera*.



Fig. 18: *Withania somnifera*.



Fig. 19: Railway station of Sousse.



Fig. 20: Railway station of Sousse.



Fig. 21: Railway tracks in the modern town near the harbour.



Fig.. 22: Mechanical weeding along the tracks.



Fig. 23: Railway cuttings.



Fig. 24: *Eruca vesicaria*.



Fig. 25: *Linaria triphylla*.



Fig. 26: *Salsola oppositifolia*.



Fig. 27: *Onopordum arenarium*.



Fig. 28: *Cotula coronopifolia*.



Fig. 29: *Sonchus maritimus*.



Fig. 30: *Limonium sinuatum*.



Fig. 31: *Medicago marina*.



Fig. 32: *Mesembryanthemum crystallinum*.