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Variation of the chemical composition of floral volatiles in the endangered Tunisian *Pancratium maritimum* L. populations (Amaryllidaceae)

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ABSTRACT

Floral volatiles from thirteen populations of Tunisian *Pancratium maritimum* L. (sea daffodil), growing wild in mainland and island habitats were assessed by GC and GC/MS. Eighteen compounds representing 77.73% of the total oil were identified. The major components at the species level were heptacosane (12.07%), hexadecanoic acid (11.91%), benzyl benzoate (8.17%), octacosane (8.13%), and hexacosane (7.28%). Volatile composition varied highly among populations. Four chemotypes could be reported in the Tunisian *P. maritimum* populations. PCA analysis according to axes (1–2) and (1–3) revealed four and five groups of populations, respectively. The model of population grouping could result from local adaptation to micro-ecological factors contributing to the selection of particular compounds dictated by the isolation. Mainland and island populations showing high amounts of minor compounds should be collected, multiplied and preserved.

1. Introduction

The Amaryllidaceae family, a group of monocotyledonous species, consists of about 1100 species in 85 genera, is widely distributed in several countries in the world (Willis, 1988). Plants from this family are known to synthesize a particular type of bioactive compounds, named Amaryllidaceae alkaloids, responsible for valuable medicinal properties (Bastida et al., 1987; Berkov et al., 2008; Jensen et al., 2011). Chemical studies of fragrance compositions have been largely restricted to only few *Narcissus* species that are valued for their perfumery and medicinal properties such as *Narcissus poeticus* and *Narcissus pseudonarcissus* oils used to treat uterine tumors (Dobson et al., 1997).

The genus *Pancratium* (Amaryllidaceae) comprises about 20 species, extending from the Canary Islands through the Mediterranean region to tropical Asia, and southwards through West Africa to Namibia (Walters et al., 1986). *Pancratium maritimum* L. is distributed in the Mediterranean, the Atlantic, the Black and Caspian coasts (Dothan, 1986). The habitat of *P. maritimum* in the immediate vicinity of the sea is characterized by direct exposure to sea breezes and to continuous sprays by high air humidity and by strong radiation (Eisikowitch and Galil, 1971). The species is severely threatened in its original range, the sandy coasts of the Mediterranean Sea by over collection, urbanization and tourism development. The current status of *P. maritimum* in Lebanon is vulnerable. In Italy, France, Spain and Crete, populations of this species have significantly decreased in number and size and the species is considered endangered (Zahreddine et al., 2004).

The species has been cultivated in European and American gardens as an ornamental plant for centuries due to its white scented flowers (Kilinç and Yuksel, 1995). Besides, *P. maritimum* has attracted considerable attention due to the complex structural types of its alkaloids with significant therapeutic properties (Berkov et al., 2004). Moreover, several cuticular waxes were reported in the species (Berkov et al., 2010).

P. maritimum is distributed in the relatively restricted coastal range in mainland (1400 km) and often occurs in island coasts of Tunisia. The adult plant is 30–60 cm high on sand surface. In summer, it produces 3–14 white scented flowers which are grouped in inflorescences. The stem forms big bulbs that sink down to 140 cm in the sand. The seeds are produced from late September to early December. They are black and extremely light (50 g for 1000 seeds). The species is mainly associated with *Ammophila arenaria* L. Link, *Silene succulenta* Forsk., *Polygonom martimum* L., *Elytrigia juncea* L., *Sporobolus pungens* L., *Otanthus maritimum* L., *Medicago marina* L., *Eryngium maritimum* L., *Anthemis maritima* L., *Urginia maritima* L., *Cakile maritima* Scop., *Crucianella maritima* L., *Echinophora spinosa* L., *Euphorbia paralias* L., and *Cutandia maritima* L. Brabey.

Tunisian populations of *P. maritimum* are at present endangered and represented by scattered individuals as a result of coastal

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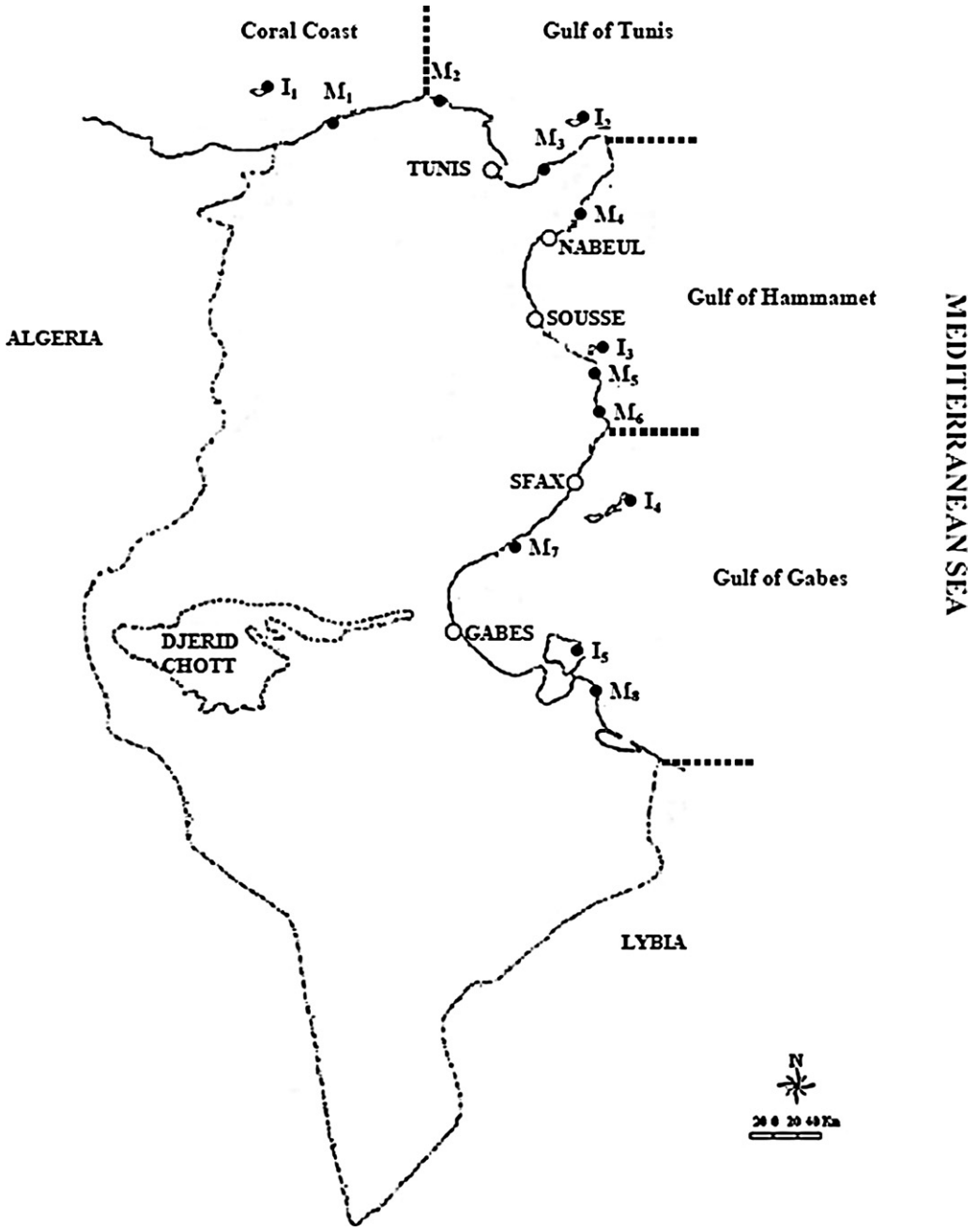

Fig. 1. Map of Tunisia: location of *Pancratium maritimum* L. populations analysed. M_1: Cap serrat; M_2: Bizerte; M_3: Oued labid; M_4: Dar allouch; M_5: Monastir; M_6: Mahdia; M_7: Chaffar; M_8: Zarzis; I_1: Galite; I_2: Zembra; I_3: Kuriat; I_4: Karkennah; I_5: Djerba; ○, Great cities.

habitat destruction, especially those on prime tourist areas such as sandy beaches, and overharvesting for its significant ornamental interest (Sanaa and Ben Fadhel, 2010).

The aim of this study is to assess the variation of flower volatiles among Tunisian *P. maritimum* in mainland and island populations. It is a part of wider study concerning both chemical and genetic diversities among Tunisian populations of *P. maritimum* in order to elaborate improvement and conservation programs.

2. Materials and methods

2.1. Surveyed populations and sampling

We assessed 5 island and 8 mainland populations of *P. maritimum* L. located in different geographical regions belonging to the Coral Coast, Gulf of Tunis, Gulf of Hammamet and Gulf of Gabes (Fig. 1). The habitat of *P. maritimum* in the close proximity of the sea is marked by direct exposure to breezes and salt water droplets carried by the wind, by strong radiation and by high air humidity (Table 1). Although the underdeveloped area of Cap Serrat (M_1) and the uninhabited islands populations of (I_1, I_2 and I_3; Galite, Zembra and Kuriat, respectively) are highly distributed, the inhabited Karkennah island and the well-known touristic island of Djerba (I_4 and I_5, respectively) populations added to many mainland ones are characterized by their small size and growing in destroyed habitats and replaced with beach resorts and large commercial and industrial ports. In addition to that, *P. maritimum* populations have been subjected to frequent visitors who picked flowers for their significant ornamental interest.