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An update and catalogue of alien vascular plant species in the Naâma region of Algeria

Belkacem Gordo [1]*, Hamid Khamar [2], Emilio Laguna [3], Filip Verloove [4]

[1] University Centre of Naâma, Laboratory of Sustainable Management of Natural Resources in Arid and Semi-Arid Zones, B. P. 66, Naâma, Algeria
[2] Scientific Institute, University Mohammed V in Rabat, Department of Botany and Plant Ecology, B. P. 703, Rabat, Morocco
[3] Generalitat Valenciana, Centre for Forestry Research and Experimentation (CIEF) Avda. Comarques del País Valencià Avenue 114, Quart de Poblet, Valencia, Spain.
[4] Meise Botanic Garden, Nieuwelaan Str. 38, Meise, Belgium
*Corresponding author. E-mail: gordo.belkacem@cuniv-naama.dz
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Abstract

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Arid Mediterranean ecosystems undergo a profound transformation when subjected to climatic aridification combined with anthropogenic degradation. These fragile environments are vulnerable to the proliferation of alien species. This study presents a comprehensive and updated list of alien vascular plants recorded in the Naâma region of Algeria between 2022 and 2025. The catalogue includes 51 taxa (49 species, one hybrid and one variety), belonging to 20 families and 40 genera. Two of these were observed for the first time in Algeria: *Atriplex suberecta* and *Euphorbia hypericifolia*. Morphological characteristics and notes on geographical origin, distribution, ecology and degree of naturalisation are provided for each of these species. Additionally, an overview of all other non-native taxa in the study area is provided, ranging from rare to common. With the exception of *Atriplex canescens*, which invades steppe formations, all other alien species are found in soils of varying humidity.

Keywords: alien species, arid lands, checklist, flora, steppes.

INTRODUCTION

Since its emergence in the 1980s, the field of biological invasions has become an integral component of ecological research, receiving significant attention from both biologists and biogeographers (Simberloff, 1981; Usher, 1988; Lodge, 1993; Parker, 1999; Richardson et al., 2000; Perrings, 2002; Pyšek et al., 2004; Pyšek & Richardson, 2010; Bellard et al., 2016; Essl et al., 2018). After habitat loss and degradation, biological invasions are considered the second leading cause of Earth's declining biodiversity (Glowka et al., 1994; Cronck & Fuller, 2001; Bellard et al., 2016). The strong increase of alien plants, which are among these invasive organisms, is of great concern to the scientific community (Pyšek et al., 2004; Gaertner et al., 2014; Downey & Richardson, 2016). Plant invasions are inextricably linked to human activities

such as livestock farming and agriculture, and have therefore been occurring for a long time. Nevertheless, this phenomenon has accelerated with globalisation, which led to an increase in international and intercontinental trade during the 19th century and more particularly after 1850 (Reichard & White, 2001; Prinzing et al., 2002; Frésard, 2011; Marnot, 2012). Plants that are introduced to a new environment, whether intentionally or unintentionally, often find favourable conditions to propagate. This can be detrimental to native species and, unfortunately, also to those that are endemic or emblematic. The expansion of plant species into new areas can cause significant damage to ecosystem services, leading to health problems for humans and economic losses (Richardson & Pyšek, 2006; Kumschick et al., 2016; Bacher et al., 2018). To effectively manage plant invasions and understand the mechanisms behind them, it is essential to conduct systematic inventories (Verlaque, 1994).

During the 1990s, significant research was conducted on the alien flora of North Africa, as documented by Le Floc'h et al. (1990), Le Houérou (1995) and Vilà et al. (1999). The number of investigations into plant invasions in Algeria has increased significantly since 2020. This increase in research led to the discovery of new non-native plant species, which appeared at varying rates throughout the country. Rebbas et al. (2022), Sakhraoui et al. (2023, 2024a) and Taieb Brahim et al. (2024) have researched the status of invasions in Algeria. In the meantime, the preliminary checklist by Meddour et al. (2020) has offered valuable insights on the subject. Nevertheless, the research carried out so far has primarily focused on the northern region of Algeria, where comprehensive regional floristic lists have been compiled by Kazi-Tani et al. (2012) and Sakhraoui et al. (2019). There is a lack of comparable studies conducted in the arid regions further south. To evaluate the alien flora of these neglected dry Mediterranean ecosystems, we made an inventory of species that could become naturalised in the Naâma region. Additionally, this first checklist also provides information regarding the floristic composition, life form, degree of naturalisation, geographic origin, mode of introduction, and rarity of each inventoried alien species.

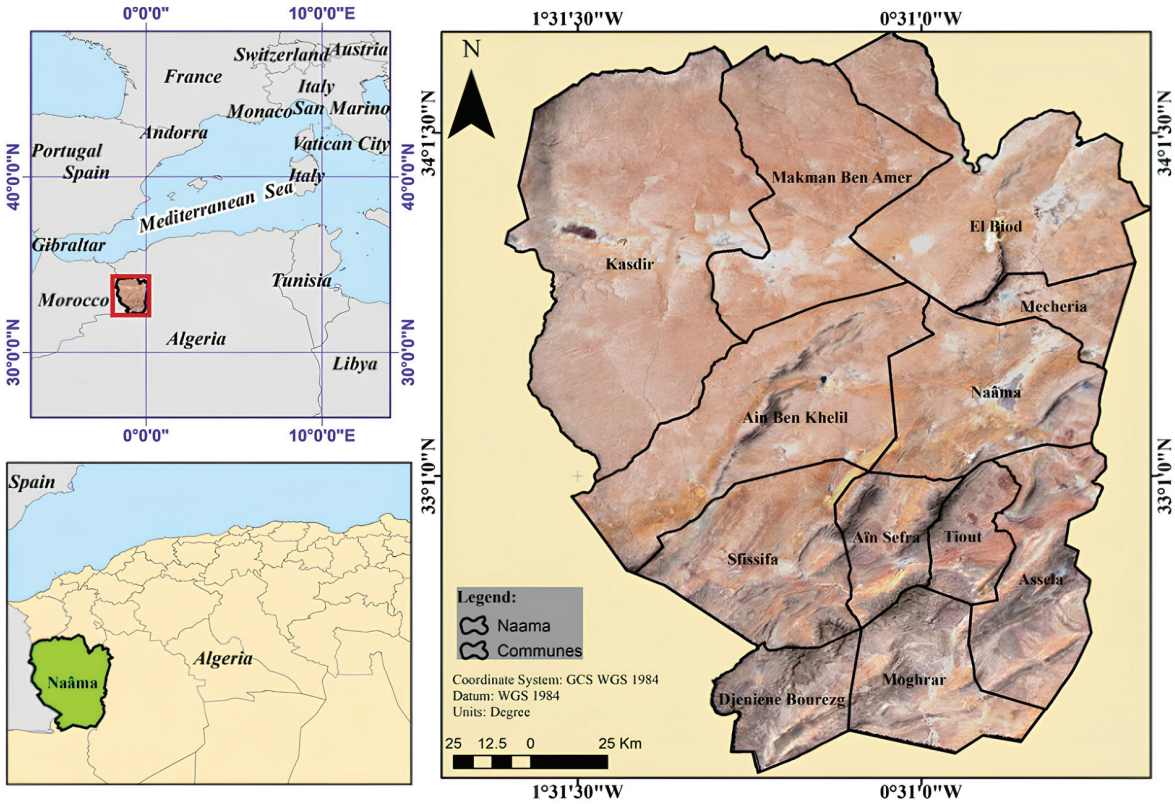

Fig. 1. The geographical position of the Naâma region (study area) in the west of Algeria.

MATERIALS AND METHODS

Study region

The Wilaya of Naâma is an administrative entity located in western Algeria. It comprises 12 municipalities (communes) organised into Daïras (Fig. 1) and covers an area of nearly 30 000 km^2. It shares borders with the Wilaya of Sidi Bel Abbès and Tlemcen to the north, the Wilaya of El Bayadh to the east, the Algerian-Moroccan border to the west, and the Wilaya of Béchar to the south.

The Naâma region is geographically segmented into three distinct biogeographical compartments. The arid and northern steppe zone comprises over 70% of the Wilaya's territory. The elevation gradually increases towards the southern region, reaching its highest point on the peaks of the Western Saharan Atlas, exceeding an altitude of 2 000 meters. The pre-Saharan region extends in a southerly direction, traversing the southern slopes towards the oases of Beni Ounif. The Naâma region exhibits compartmentalisation, with a progressive aridity gradient from north to south, except in the elevated mountainous areas that experience a semiarid bioclimate (Gordo, 2021). This phenomenon gives rise to a botanical convergence point where plant species with Mediterranean and Saharan characteristics intersect and intermingle.

Field surveys and data sources

The current study is based on field trips conducted by the first author since March 2022 at various locations within the study area. For each newly discovered alien species in Algeria, the following data are provided: 1) accepted name; 2) synonym(s); 3) short botanical description; 4) origin and general distribution in the world; 5) distribution and ecology in Algeria; 6) degree of naturalisation; 7) studied specimens. The nomenclature follows the International Plant Names Index (IPNI, 2025). Voucher specimens were deposited in the Herbarium of the University Centre of Naâma (UCN) (not yet listed in index Herbariorum, Thiers, 2025), with duplicates of some of them deposited in the Herbarium of the Meise Botanic Garden, Belgium (BR).

To compile the inventory of the alien flora present in the Naâma region, a comprehensive analysis of the bibliographic data was conducted. This analysis included a review of relevant literature, encompassing both historical and recent floras, checklists and recently published papers (Desfontaines, 1798; Munby, 1847; Battandier & Trabut, 1888, 1902; Hochreutiner, 1904; Maire, 1916; Ducellier & Maire, 1923, 1925; Maire, 1952, 1953, 1962, 1963, 1965, 1967, 1977, 1987; Quézel & Santa, 1962, 1963; Vilà et al., 1999; Dobignard & Chatelain, 2010, 2011, 2012, 2013; EPPO, 2010, 2014; Meddour et al., 2020). Additionally, online databases such as the African Plant Database (APD, 2025), Euro+Med PlantBase (Euro+Med, 2025), Plants of the World Online (POWO, 2025) and World Flora Online (WFO, 2025) were consulted. The biological types in the sense of Raunkiær (1934) of the various alien species were determined from field observations during all seasons of the year.

To assess the degree of naturalisation of the recorded species, we applied the terminology for exotic plants proposed by Richardson et al. (2000) and Pyšek et al. (2004) to our field observations. This allowed us to distinguish between casual, naturalised, invasive, and weedy plants. Regarding the latter, we use the term *naturalised* (weed) to refer to introduced species that tend to proliferate and typically thrive at the expense of crops and vegetable gardens, both within the study area and across the country. Thus, the various databases cited above were consulted to determine the native range of exotic plants. To determine the mode of introduction, we referred to the work of Le Houérou (1995) and data collected from local institutions involved in natural and agricultural heritage management.

Finally, to estimate the frequency of each species, we relied on field observations concerning their geographical distribution and abundance in the Naâma region. The combination of these two criteria formed the basis for a tailored frequency scale: common (abundant species throughout the Naâma region), rare (a few individuals found in two municipalities), very rare (a few individuals found in one municipality) and extremely rare (reported only once).

RESULTS AND DISCUSSION

Newly recorded species

Atriplex suberecta

Atriplex suberecta I. Verd., Bothalia, 6: 418. 1954 (= *Obione suberecta* (I. Verd.) G.L. Chu, Gen. New Evol. System World Chenopod.: 167. 2017).

Description. *Atriplex suberecta* is similar to native *Atriplex rosea* L. from which it differs in its rhomboid fruiting perianths 2.5–3 × 3–3.5 mm, three-nerved and with 1–2 pairs of lateral teeth. According to Cunningham et al. (1992), *Atriplex suberecta* is a monoecious species. The male flowers are arranged in clusters at the top of the branches, and the female flowers are arranged in axillary clusters (Fig. 2). On the other hand, the fruit valves of *Atriplex rosea* are triangular, truncate at the base, and tuberculate on the faces (Quézel & Santa 1962; Castroviejo, 1990).

Origin and general distribution in the world. *Atriplex suberecta* is native to South Australia (POWO, 2025). It has spread all over the world, especially in Africa and Europe. In North Africa, this species is recorded in Egypt, Morocco, and the Canary Islands (Dobignard & Chatelain, 2011); however, there is a lack of documented occurrences in Algeria. In Morocco, the species was first reported in Oujda (which is close to the northwest Algerian border) by Molero & Montserrat (2006), and later mentioned in Agadir by Chambouleyron & Idrissi (2017). In his online Flora Maroccana, Dobignard (2025) has recently referred to specimens of the species found in the southern region of Sidi Ifni and the Anti-Atlas coast. It is noteworthy that Molero & Montserrat (2006) have classified *Atriplex suberecta* as naturalised. Recent observations suggest that this species is undergoing substantial expansion in Morocco, especially in the Sous region and in some areas of the Anti-Atlas Mountains (Chambouleyron & Idrissi, 2017; Fennane, 2021). In Europe, according to Euro+Med (2025), *Atriplex suberecta* has been documented only in Spain and England. Additionally, France is listed by POWO (2025). However, these data provide an inaccurate picture of the real distribution of the species in Europe. As far as is known, it has only genuinely naturalised in Spain (Castroviejo, 1990) and, more recently, also in Cyprus (Hand, 2020). In the past, it has been found in several other countries as well, usually as a wool alien, but these were always ephemeral records (e.g. Belgium, the British Isles, France, Germany, the Netherlands, Switzerland, etc.; Aellen, 1960; van der Meijden, 1968; Verloove, 2006).

Distribution and ecology in Algeria. Based

Fig. 2. *Atriplex suberecta* in Algeria. Plant habit (A). Fruits (B). (26 April 2023, Algeria, Aïn Sefra). Photographs by B. Gordo.

on our field observations, it appears that *Atriplex suberecta* has been inadvertently introduced into the Naâma region. We have observed it in several localities. In the vegetable gardens located in the city of Aïn Sefra, where the soil has a sandy texture, this species exhibits characteristics of a weed, causing inconvenience for the gardeners. As a result, they proceed to gather and incinerate it. The species tends to expand into adjacent areas. Further north, we also observed it in the city of Mécheria, where it behaves like an urban plant. In the different sites explored, *Atriplex suberecta* is commonly found in association with the following species: *Amaranthus blitoides* S. Watson, *Bassia muricata* All., *Calendula arvensis* L., *Carthamus creticus* L., *Centaurea hyalolepis* Boiss., *Cleome arabica* L., *Cynodon dactylon* (L.) Pers., *Hordeum murinum* L., *Onopordum ambiguum* Fresen., *Onopordum arenarium* (Desf.) Pomel, *Salsola tragus* L., *Sisymbrium irio* L., *Tribulus terrestris* L., *Xanthium spinosum* L., and *Xanthium strumarium* L.

Degree of naturalisation. Naturalised.

Specimens examined. Algeria, Naâma (Aïn Sefra city, W Algeria), several mature individuals mingle with weed species colonising soils with a sandy texture, 32.750483°N, 0.586083°E, 1085 m a.s.l., 26 April 2023, B. Gordo s.n. (UCN!, BR); at the edges of the recently opened secondary road which leads to the Ksar of Aïn Sefra, 32.751400°N, 0.582517°E, 1091 m a.s.l., 30 April 2023, B. Gordo s.n. (UCN!); Naâma (Mécheria city, W Algeria), a few mature subjects occupy certain sidewalks in the street, 33.623672°N, 1.274828°E, 1150 m a.s.l., 20 November 2023, B. Gordo s.n. (UCN!).

Euphorbia hypericifolia

Euphorbia hypericifolia L., Sp. Pl.: 454. 1753 (≡ *Anisophyllum hypericifolium* (L.) Haw., Syn. Pl. Succ.: 161. 1812; ≡ *Chamaesyce hypericifolia* (L.) Millsp., Publ. Field Columb. Mus., Bot. Ser., 2: 302. 1909).

Description. Commonly known as golden spurge, graceful spurge, and chicken weed, *Euphorbia hypericifolia* is an annual or short-lived perennial herb, mostly 20–100 cm tall. Stems erect or ascending, glabrous, generally much-branched from upper parts, branches deflexed at apex (Fig. 3). Leaves 8–35 mm long and 4–15 mm wide, simple, opposite; glabrous; blade elliptical-oblong to oblong-oblanceolate, base asymmetric, oblique, apex obtuse or broadly acute, margins serrate or serrulate (or obscurely toothed) toward apex. Stipules triangular or deltate, usually entire, sometimes laciniate-fringed at tip 1.3–1.5 × 1.4–2 mm. Cyathia in dense globose cymes, axillary and terminal, 0.5–1 mm long, glabrous, peduncle 3–12 mm long; involucre obconic, glabrous; glands 4, orbicular to subcircular, white or light brown, appendages almost obsolete to conspicuous, white to pink; each involucre containing one female flower

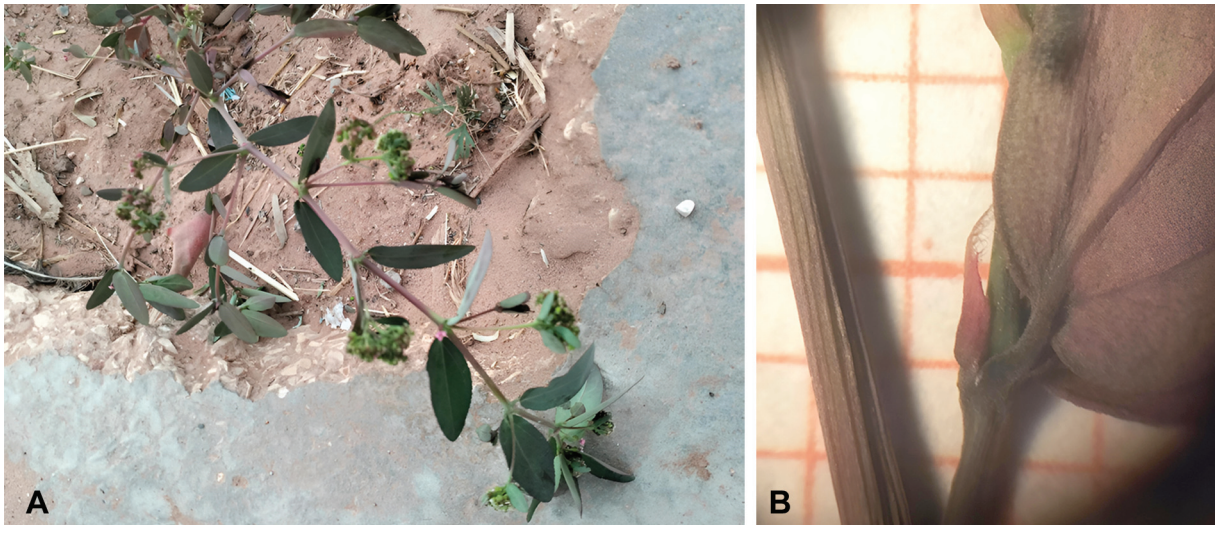

Fig. 3. *Euphorbia hypericifolia* in Algeria. Plant habit (A). Stipule (B). (16 October 2024, Algeria, Aïn Sefra). Photographs by B. Gordo.

that is slightly excerted, surrounded by numerous subsessile male flowers. Ovary green, reddish brown when mature, glabrous, trilobed, with a pedicel 0.5–1 mm long; styles free 3, each 2-fid (stigma) ± 1/2 length. Capsules subglobose, 1–1.5 × 2 mm, glabrous, with one seed per lobe. Seeds 0.8–1.1 × 0.5 mm, brownish, 4-gonous in cross-section, faces slightly wrinkled, caruncle absent (Sciandrello et al., 2016; Steinmann et al., 2016; Mahklouf, 2023; Khamar et al., 2024).

Origin and general distribution in the world. *Euphorbia hypericifolia* is native to tropical and subtropical America (Steinman et al., 2016; POWO, 2025). The alien range of the species encompasses the Mediterranean Basin, tropical Africa, the Mascarene Islands, and various regions of Asia, including Iraq, Oman, Taiwan, China, India, and Pakistan (Sciandrello et al., 2016; Khamar et al., 2024). Within its entire distribution range, *Euphorbia hypericifolia* can be found at altitudes from sea level up to 600 meters, where it grows in many different places (rich soils, old fields, rocky riverbanks, along roads, in ponds, marshes, and near farms) (CABI, 2025). Occasionally, it is cultivated and sold as an ornamental plant (Sciandrello et al., 2016; Khamar et al., 2024).

Distribution and ecology in Algeria. Based on our field observations, it appears that *Euphorbia hypericifolia* has been unintentionally introduced into the Naâma region. Probably, this species is indeed present in northern Algeria, having previously escaped the attention of botanists. The introduction of *Euphorbia hypericifolia* was likely accidental, occurring during reforestation campaigns conducted by forestry services. The plant specimens used in these campaigns are typically sourced from nurseries located in the northern part of the country. Our identification of this species was based on several surveys of urban environments in the cities of Aïn Sefra and Naâma, where we observed its presence. The plant tends to grow in thin layers of moist sand deposited by wind along the edges of roadways. In both localities, *Euphorbia hypericifolia* grows with urban species such as *Chenopodiastrum murale* (L.) S. Fuentes, Uotila & Borsch, *Chenopodium album* L., *Hordeum murinum* L. and *Polygonum aviculare* L.

Degree of naturalisation. Casual.

Specimens examined. Algeria, Naâma (Aïn Sefra city, W Algeria), a few puny flowering plants occupy the thin layers of damp sand, deposited by the wind at the edge of the urban road which crosses the district called Boutma, 32.752075°N, 0.586523°E, 1068 m a.s.l., 16 October 2024, B. Gordo s.n. (UCN!). Naâma (Naâma city, W Algeria), a few flowering plants are growing on a thin layer of sand at the edge of the urban road leading to the University Centre of Naâma, 33.231941° N, 0.337512°E, 1220 m a.s.l., 25 October 2024, B. Gordo s.n. (UCN!).

Checklist of the alien flora of Naâma region, Algeria

The following catalogue compiles the alien vascular plant species recorded in the Naâma region (Algeria), based on our comprehensive field surveys and a review of the relevant literature.

Annotated species list

1. *Ailanthus altissima* (Mill.) Swingle (Simaroubaceae). Phanerophyte. Naturalised. Native to Asia. Introduced deliberately for ornamental purposes. Rare (Sakhraoui et al., 2019; Meddour et al., 2020).
2. *Alcea rosea* L. (Malvaceae). Hemicryptophyte. Casual. Native to the Irano-Turanian region. Introduced deliberately for ornamental purposes. Rare (Ducellier & Maire, 1923; Quézel & Santa, 1963; Meddour et al., 2020).
3. *Amaranthus albus* L. (Amaranthaceae). Therophyte. Naturalised. Native to North America. Introduced unintentionally (with grain). Common (Maire, 1962; Quézel & Santa, 1962; Gleason & Cronquist, 1991).
4. *Amaranthus blitoides* S.Watson (Amaranthaceae). Therophyte. Naturalised. Native to America. Introduced unintentionally (with grain). Common (Taieb Brahim et al., 2024).
5. *Amaranthus muricatus* (Moq.) Hieron. (Amaranthaceae). Hemicryptophyte. Casual. Native to America. Introduced unintentionally (with grain). Rare (Maire, 1962; Meddour et al., 2020).
6. *Amaranthus retroflexus* L. (Amaranthaceae). Therophyte. Naturalised (weed). Native to America. Introduced unintentionally (with grain). Rare (Maire, 1962; Quézel & Santa, 1962; Dobignard & Chatelain, 2011).

7. *Atriplex canescens* var. *gigantea* S.L.Welsh & Stutz (Amaranthaceae). Chamaephyte. Naturalised. Native to America. Introduced as Fodder. Rare. First record by Touati et al. (2020).
8. *Atriplex suberecta* I. Verd. (Amaranthaceae). Therophyte. Naturalised. Native to South Australia. Introduced unintentionally (with grain). Rare. Present study.
9. *Austrocylindropuntia cylindrica* (Lam.) Backeb. (Cactaceae). Succulent. Casual. Native to America. Introduced deliberately for ornamental purposes. Extremely rare. First record by Sakhraoui et al. (2022).
10. *Bassia indica* (Wight) A.J. Scott (Amaranthaceae). Therophyte. Naturalised. Native to Asia. Introduced as Fodder. Common (Quézel & Santa, 1962; Dobignard & Chatelain, 2011; Meddour et al., 2020).
11. *Bassia scoparia* (L.) Voss (Amaranthaceae). Therophyte. Casual. Native to Asia. Introduced deliberately for ornamental purposes. Very rare (Maire, 1962; Quézel & Santa, 1962; Dobignard & Chatelain, 2011; Meddour et al., 2020).
12. *Bidens aurea* (Aiton) Sherff (Asteraceae). Hemicryptophyte. Casual. Native to America. Introduced unintentionally (with grain). Extremely rare. First record by Sakhraoui (2021).
13. *Brassica napus* L. (Brassicaceae). Therophyte. Casual. Native to Eurasia. Introduced deliberately for agricultural purposes. Very rare (Dobignard & Chatelain, 2011).
14. *Bromus catharticus* Vahl (Poaceae). Therophyte. Casual. Native to America. Introduced unintentionally (with grain). Extremely rare (Ducellier & Maire, 1923; Maire, 1953; Meddour et al., 2020).
15. *Centaurea hyalolepis* Boiss. (Asteraceae). Therophyte. Naturalised. Native to the Irano-Turanian region. Introduced unintentionally (with grain). Common. First record by Zater et al. (2019).
16. *Datura ferox* L. (Solanaceae). Therophyte. Naturalised. Native to Mexico. Introduced unintentionally (with grain). Rare. First record by Houmani et al. (1999).
17. *Datura innoxia* Mill. (Solanaceae). Chamaephyte. Naturalised. Native to Mexico and Central America. Introduced unintentionally (with grain). Common (Quézel & Santa, 1963; Dobignard & Chatelain, 2013).
18. *Datura stramonium* L. (Solanaceae). Therophyte. Naturalised. Native to America. Introduced unintentionally (with grain). Common (Quézel & Santa, 1963; Dobignard & Chatelain, 2013).
19. *Dysphania atriplicifolia* (Spreng.) G.Kadereit, Sukhor. & Uotila (Amaranthaceae). Therophyte. Casual. Native to North America. Introduced unintentionally (with grain). Extremely rare. First record by Gordo & Uotila (2024).
20. *Eleusine indica* (L.) Gaertn. (Poaceae). Therophyte. Casual. Native to America. Introduced unintentionally (with grain). Very rare (Maire, 1953; Meddour et al., 2020).
21. *Erigeron canadensis* L. (Asteraceae). Therophyte. Naturalised. Native to America. Introduced unintentionally (with grain). Common (Quézel & Santa, 1963; Dobignard & Chatelain, 2013).
22. *Euphorbia hypericifolia* L. (Euphorbiaceae). Therophyte. Casual. Native to tropical and subtropical America. Introduced unintentionally (with grain). Very rare. Present study.
23. *Galinsoga parviflora* Cav. (Asteraceae). Therophyte. Casual. Native to America. Introduced unintentionally (with grain). Extremely rare. First record by Kazi Tani (2012).
24. *Gazania* × *splendens* Hend. & Andr. Hend. (Asteraceae). Hemicryptophyte. Casual. Native to Africa. Introduced deliberately for ornamental purposes. Very rare. First record by Sakhraoui et al. (2023).
25. *Guizotia abyssinica* (L. f.) Cass. (Asteraceae). Therophyte. Casual. Native to Africa. Introduced unintentionally (with grain). Extremely rare. First record by Rebbas et al. (2022).
26. *Gypsophila pilosa* Huds. (Caryophyllaceae). Therophyte. Naturalised (weed). Native to the Irano-Turanian region. Introduced unintentionally (with grain). Rare. First record by Kazi Tani (2013).
27. *Kalanchoe daigremontiana* Raym.-Hamet & H.Perrier (Crassulaceae). Succulent. Casual. Native to Madagascar. Introduced deliberately for ornamental purposes. Extremely rare. First record by Greuter and Raus (2012).
28. *Lepidium didymum* L. (Brassicaceae). Therophyte. Casual. Native to America. Introduced unintentionally (with grain). Extremely rare (Quézel & Santa, 1962; Maire, 1967; Meddour et al., 2020).

29. *Lepidium sativum* L. (Brassicaceae).Therophyte. Casual. Native to Eurasia. Introduced for food. Extremely rare (Quézel & Santa, 1962; Maire, 1967; Meddour et al., 2020).
30. *Linum usitatissimum* L. (Linaceae). Therophyte. Casual. Native to Eurasia. Introduced for food. Rare (Hochreutiner, 1904; Meddour et al., 2020).
31. *Melia azedarach* L. (Meliaceae). Phanerophyte. Casual. Native to Australasia. Introduced deliberately for ornamental purposes. Extremely rare. First record by Sakhraoui et al. (2019).
32. *Mirabilis jalapa* L. (Nyctaginaceae). Hemicryptophyte. Casual. Native to America. Introduced deliberately for ornamental purposes. Extremely rare (Maire, 1962; Dobignard & Chatelain, 2012; Meddour et al., 2020).
33. *Morus alba* L. (Moraceae). Phanrophyte. Casual. Native to Central China. Introduced deliberately for ornamental purposes. Extremely rare. First record by Sakhraoui et al. (2024b).
34. *Nicotiana glauca* Graham (Solananaceae). Nanophanerophyte. Casual. Native to America. Introduced deliberately for ornamental purposes. Very rare (Quézel & Santa, 1963; Meddour et al., 2020).
35. *Nigella sativa* L. (Ranunculaceae). Therophyte. Casual. Native to Asia. Introduced for food. Extremely rare (Maire, 1965).
36. *Oxalis corniculata* L. (Oxalidaceae). Therophyte. Casual. Native to Asia. Introduced unintentionally (with grain). Extremely rare (Quézel & Santa, 1963).
37. *Oxalis pes-caprae* L. (Oxalidaceae). Hemicryptophyte. Naturalised. Native to Africa. Introduced unintentionally (with bulbils). Common (Ducellier & Maire, 1923; Quézel & Santa, 1963).
38. *Oxybasis glauca* (L.) S. Fuentes, Uotila & Borsch (Amaranthaceae). Therophyte. Casual. Native to Australasia. Introduced unintentionally (with grain). Very rare (Quézel & Santa, 1962; Meddour et al., 2020).
39. *Panicum miliaceum* L. (Poaceae). Therophyte. Casual. Native to Asia. Introduced unintentionally (with grain). Extremely rare (Maire, 1952; Taieb Brahim et al., 2024).
40. *Paspalum dilatatum* Poir. (Poaceae). Hemicryptophyte. Casual. Native to the Old World tropics. Introduced unintentionally (with grain). Very rare (Maire, 1952; Meddour et al., 2020).
41. *Phalaris canariensis* L. (Poaceae). Therophyte. Casual. Native to the Canary Islands and Morocco. Introduced as bird feed. Very rare (Maire, 1953).
42. *Ricinus communis* L. (Euphorbiaceae). Nanophanerophyte. Casual. Native to Africa. Introduced deliberately for ornamental purposes. Rare (Ducellier & Maire, 1923; Meddour et al., 2020).
43. *Robinia pseudoacacia* L.(Fabaceae). Phanerophyte. Casual. Native to America. Introduced deliberately for ornamental purposes. Extremely rare (Quézel & Santa, 1962; Meddour et al., 2020).
44. *Rubia tinctorum* L. (Rubiaceae). Hemicryptophyte. Naturalised (weed). Native to Asia. Introduced deliberately for agricultural purposes. Common (Quézel & Santa, 1963; Meddour et al., 2020).
45. *Sesamum indicum* L. (Pedaliaceae). Therophyte. Casual. Native to Asia. Introduced for food. Extremely rare. First record by Rebbas et al. (2020).
46. *Solanum elaeagnifolium* Cav. (*Solanaceae*). Geophyte. Naturalised. Native to America. Introduced unintentionally (with grain). Common (Véla et al., 2013; Adjim & Kazi Tani, 2018; Meddour et al., 2020).
47. *Solanum bonariense* L. (Solanaceae). Phenorophyte. Casual. Native of South America. Introduced unintentionally (with grain). Extremely rare (Ducellier & Maire, 1923; Meddour et al., 2020).
48. *Solanum rostratum* Dunal (Solanaceae). Therophyte. Casual. Native to America. Introduced unintentionally (with grain). Extremely rare. First record by Chelghoum et al. (2020).
49. *Symphyotrichum squamatum* (Spreng.) G.L. Nesom (Asteraceae). Therophyte. Naturalised. Native to America. Introduced unintentionally (with grain). Common (Quézel & Santa, 1963; Meddour et al., 2020).
50. *Vachellia farnesiana* (L.) Wight & Arn. (Fabaceae). Phanerophyte. Casual. Native to Tropical and Subtropical America. Introduced deliberately for ornamental purposes. Extremely rare (Maire, 1987).

51. *Xanthium spinosum* L. (Asteraceae). Therophyte. Naturalised. Native to America. Introduced unintentionally (with grain). Common (Quézel & Santa, 1963; Meddour et al., 2020).

Analysis of the alien flora

Taxonomic composition

A total of 51 taxa, including one hybrid and one variety, distributed across 40 genera and 20 families, were identified as non-native plant species in the Naâma region. The majority of the recorded taxa belong to the following families: Amaranthaceae (10 species), Asteraceae (8 species), Solanaceae (7 species), Poaceae (5 species), Brassicaceae (3 species), Euphorbiaceae, Fabaceae and Oxalidaceae (2 species) (Table 1). The remaining 12 families are each represented by one species. *Amaranthus* is by far the most species-rich genus, consisting of four species, followed by *Datura* and *Solanum*, each with three species, *Atriplex*, *Bassia*, *Lepidium* and *Oxalis*, each of which has two species.

Table 1. The most represented families in the alien flora of the studied area

Family	Number of species	Percentage
Amaranthaceae	10	20
Asteraceae	8	16
Solanaceae	7	14
Poaceae	5	8
Brassicaceae	3	6
Euphorbiaceae	2	4
Fabaceae	2	4
Oxalidaceae	2	4

Life forms

The 51 exotic species were classified according to their life form, as shown in Table 2. Therophytes (30 species or 59%) account for more than half of the species, followed by hemicryptophytes (8 species or 15%) and phanerophytes (6 species or 12%), chamaephytes, nanophanerophytes and succulents (2 species or 4% each). The geophytes are represented by one species (2%). The climate and habitat greatly determine the abundance of therophytes and hemicryptophytes in this region. With its scorching and arid summers and numerous open habitats, this region provides ideal conditions for the rapid growth and spread of therophytes.

Table 2. Life-form spectrum of the alien flora in the studied area

Life forms	Number of species	Percentage
Therophytes	30	59
Hemicryptophytes	8	15
Phanerophytes	6	12
Chamaephytes	2	4
Nanophanerophytes	2	4
Succulents	2	4
Geophytes	1	2

Degree of naturalisation

According to residence status, 33 species (65%) are categorised as casual, while 18 species (35%) are identified as naturalised, which includes three classified as weeds. The apparent domination of casual aliens (33 species) over naturalised plants (18 species) can be attributed to the challenging dry climatic conditions present within the Naâma region. Some species have only recently been introduced in Algeria (Kazi-Tani, 2012, 2013; Chelghoum et al., 2020; Greuter & Raus, 2012; Rebbas et al., 2020; Touati et al., 2020; Sakhraoui, 2021; Rebbas et al., 2022; Sakhraoui et al., 2022, 2023; 2024b; Gordo & Uotila, 2024), and all of them are new to the Naâma region.

Geographic origin

Table 3 below presents a list of eight geographic origins (native ranges) for the 51 species of aliens reported in the Naâma area. Therefore, more than half of the species (26 taxa) come from the American continent. Asia has the following highest number of species, with a total of nine. Africa comes next with five species. The other regions where alien species originate, namely the Australasian, Eurasian, and

Table 3. Origin of alien species of the Naâma region

Geographic origin	Number of species	Percentage
America	26	51
Asia	9	17
Africa	5	10
Australasia	3	6
Eurasia	3	6
Irano-Turanian	3	6
Madagascar	1	2
Old World tropics	1	2

Irano-Turanian regions, have the lowest numbers of species (3). However, one species is native to Madagascar and another to the Old World tropics. The large proportion of plants originating from the New World is striking (51%). So far, there is a lack of data on the precise timing of the introductions. However, it is possible to analyse the periods of introduction. All of the listed alien plants in our study region can be categorised as neophytes.

Mode of introduction

Twenty-nine species were introduced into the Naâma region unintentionally, and thirteen were imported for ornamental purposes. The remaining species are introduced either for food (4) or for economic purposes: agriculture (2), fodder (2) and birdfeed (1).

Frequency of alien taxa in the Naâma region

Twenty species (39%) are classified as extremely rare, 12 species (23%) as common, 10 species (20%) as rare and nine species (18%) as very rare. The most widespread species in the Naâma region are generally those that are also common throughout Algeria, such as *Erigeron canadensis*, *Oxalis pes-caprae, Symphyotrichum squamatum* and *Xanthium spinosum.*

The current inventory of alien plant species in the Naâma region of Algeria highlights the importance of ongoing botanical investigations in diverse natural habitats within the oasis. Moreover, it is necessary to conduct further research and monitoring to assess the effects of all non-native plant species present in the natural ecosystems of the study region. Moreover, it is crucial also to prioritise the study of disturbed areas, such as urban areas and wadi banks, which typically receive less attention from researchers.

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BG https://orcid.org/ 0000-0002-8407-5266
HK https://orcid.org/0000-0001-6008-3264
EL https://orcid.org/0000-0002-9674-2767
FV https://orcid.org/0000-0003-4144-2422