

Rapid Communication

***Asclepias curassavica* L. (Apocynaceae) a naturalized neophyte threatening the Hyrcanian biodiversity hotspot in North Iran**Mina Khorasani¹, Hamid Gholizadeh², Giuseppe Brundu^{3,4} and Alireza Naqinezhad^{5,6}¹Department of Biology Education, Farhangian University, P.O. Box 14665-889, Tehran, Iran²Department of Life Sciences, University of Siena, Siena, Italy³Department of Agricultural Sciences, University of Sassari, Viale Italia 39/A, 07100 Sassari, Italy⁴National Biodiversity Future Center, Piazza Marina 61, 90133 Palermo, Italy⁵Department of Environmental Sciences, College of Science and Engineering, University of Derby, Kedleston Road, Derby, DE22 1GB, United Kingdom⁶Department of Plant Biology, Faculty of Basic Sciences, University of Mazandaran, P.O. Box 47416-95447, Babolsar, IranCorresponding author: Mina Khorasani (m.khorasani@cfu.ac.ir) and Giuseppe Brundu (gbrundu@uniss.it)

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OPEN ACCESS**Abstract**

This study documents the naturalization of *Asclepias curassavica* (tropical milkweed) as a newly recorded alien species in the Flora of Iran. Native to the tropical Americas, *A. curassavica* has been widely introduced across Africa, Asia, Australia, and Europe – in recent decades, primarily as an ornamental plant. The first established population in Iran was observed in 2002 within the understory of a relict *Populus caspica* forest reserve in the Hyrcanian ecoregion of northern Iran. A second population was identified in 2015 near the initial site, occupying a slightly different habitat. Due to the persistence of these populations, its high reproductive potential and strong ability to spread, tropical milkweed can be classified as a naturalised alien. Its occurrence in a habitat of conservation importance is alarming, as it could have severe negative impacts on the native biodiversity of relict forests. Consequently, we advocate for the prompt eradication of this species and the formulation of a comprehensive management plan to prevent further spread. Additionally, this study provides a detailed morphological and ecological overview of *A. curassavica*, highlighting key distinctions from its closely related congeners within the genus *Asclepias*.

Key words: alien species, Caspian lowlands, Hyrcanian ecoregion, naturalization, plant invasion, taxonomy

Introduction

Apocynaceae Juss. is a relatively large and diverse family of angiosperms, encompassing over 5,000 species and 300 genera (Endress et al. 2014, 2018; El-Gazzar et al. 2018; Rodda et al. 2024). Its members are classified into five subfamilies, 25 tribes and 49 subtribes (Endress and Bruyns 2000; Endress et al. 2014). The family is mainly distributed in the pantropical realm, with a few genera occurring in the temperate regions (Endress et al. 2018). Taxonomically, *Asclepias* L. (milkweeds) is one of the most complicated genera of the subtribe Asclepiadinae Decne. ex Miq., tribe Asclepiadeae Duby, and subfamily Asclepiadoideae R.Br. ex Burnett in

Apocynaceae (Endress et al. 2014). The genus comprises ca. 120–140 species, which are limited to the Americas, particularly to North America. Only segregate genera are considered for African species (Fishbein et al. 2011; Gudžinskas et al. 2019; Stef et al. 2022; Yang 2023). Several species of the genus are found as aliens in many other parts of the globe (Arianoutsou et al. 2010; Gudžinskas et al. 2019; Byalt and Korshunov 2020; Galasso et al. 2024), and some of them are invasive (Sanz-Elorza et al. 2004; Foxcroft et al. 2008; Gazoulis et al. 2022; Galasso et al. 2024).

Asclepias curassavica L. (tropical milkweed) is a perennial herb or subshrub native to Mexico and tropical America (Woodson 1954; Wyatt and Broyles 1997; Goyder 2009; Fishbein et al. 2011; Al-Snafi 2015; Gómez-Bellver et al. 2019; Byalt and Korshunov 2020; Castillo-Campos et al. 2023; POWO 2025; WFO 2025). The species grows in canal banks, coastal dunes, ditches, fields, gardens, marshes, orchards, prairies, sandy soils, streamsides, swamps, wastelands near the road, and moist habitats from 0–100 m a.s.l. (Goyder 2009; Gómez-Bellver et al. 2019; Fishbein et al. 2023), and it is found as an agricultural or ruderal weed (Groves et al. 2003; Randall 2007; Goyder 2009; White et al. 2018; Byalt and Korshunov 2020; Leopardi-Verde et al. 2021) both in its native and alien ranges. Tropical milkweed has been widely moved outside its native range, most likely by cultivation as an ornamental plant (Knees 2000; Babaie et al. 2007; Foxcroft et al. 2008; Goyder 2009; Gómez-Bellver et al. 2019). In recent years, the species is locally naturalized in the Paleotropics: such as in East and South Asia (Byalt and Korshunov 2020; COL 2025; WP 2025), South and Southeast of Africa (Foxcroft et al. 2008; Goyder 2009; Byalt and Korshunov 2020). Moreover, it is considered as an invasive alien in many regions of Europe and Australia (Sanz-Elorza et al. 2004; Foxcroft et al. 2008; Galasso et al. 2024; EPPO 2025).

In Iran, *A. curassavica* was first reported by Parsa (1951) in *Flore de l'Iran* for Bandar-e-Gaz, without citing any geographical reference, habitat for the place of finding, or herbarium voucher. However, its presence was not confirmed in the subsequent floras, such as the Flora Iranica (Rechinger 1970), and the Flora of Iran (Zaeifi 1999). In 2006, one record of *Asclepias* cf. *curassavica* from a black alder forest, in the north of Iran, was reported by Ghahreman et al. (2006). Subsequently, in the latest update of the Iranian alien flora (Sohrabi et al. 2023), this species was classified as a casual alien based on pharmacological literature reporting its use rather than on direct field observations. As a result, the taxonomic position and alien status of this species were both uncertain for Iran.

During extensive field surveys in the Hyrcanian forests of northern Iran, a UNESCO World Heritage site, we observed naturalized populations of *A. curassavica* in lowland habitats. This species was thriving as an understory plant within relict stands of *Populus caspica* (Bornm.) Bornm. forests in the western Hyrcanian ecoregion, posing a potential threat to the natural range

of this endangered sub-endemic tree species, and to the local floristic diversity. It is essential to protect these species and their habitats for preserving the delicate balance of ecosystems (Akhani et al. 2010; Mouillot et al. 2013; Pires et al. 2018; Sękiewicz et al. 2024). Therefore, early detection and eradication of naturalized populations of *A. curassavica* is imperative to prevent its further spread in Iran. In this study, we provide a detailed morphological description of this naturalized alien species, its distribution range, introduction pathways, and discuss its potential ecological threats. The findings aim to support effective management strategies for controlling this invasive species within forest ecosystems.

Materials and methods

The present study is mainly based on intensive fieldwork along the Hyrcanian lowland forests, in the Safrabasteh region in East of Guilan province, North Iran, between 2002 and 2015. The surveyed area, covering 1500 ha, experiences an average annual precipitation and temperature of 1228.5 mm, and 16.1 °C, respectively (Fallahchai et al. 2016). During the field observations, plant samples belonging to the alien species, *Asclepias curassavica* were first detected in December 2002 in a *Populus caspica* forest reserve of the plain area. The area was resurveyed in June 2015, observing dense naturalized populations in moist forest sites, as well as sparse colonies in other places. This alien species was identified according to Woodson, 1954 and Goyder 2009, and the identification was crosschecked considering other reliable literature, such as Gudžinskas et al. (2019), Byalt and Korshunov (2020), and Fishbein et al. (2023). Furthermore, virtual herbarium materials of BM, BR, E, G, K, LINN, M, MA, WU and W herbaria were also examined via JSTOR (JSTOR 2025; <https://plants.jstor.org/>), and JACQ (JACQ 2025; <https://www.jacq.org/>).

The main morphological characters of the collected specimens were examined using a stereomicroscopy (Nikon SMZ645 model), and the voucher samples were deposited at the Herbarium of Tehran University (TUH, 31431). Furthermore, the distribution range of *A. curassavica* was reviewed by integrating different sources, such as the EPPO Global Database (EPPO 2025; <https://gd.eppo.int/taxon/RUMPL>), Euro+Med-Checklist (Euro+Med 2025; <https://europlusmed.org/>), the Global Biodiversity Information Facility (GBIF 2025; <https://www.gbif.org/>), iNaturalist (2025; <https://www.inaturalist.org>), POWO (POWO 2025; <https://powo.science.kew.org/>), and available literature (Goyder 2009; Byalt and Korshunov 2020; Fishbein et al. 2023), along with field observations.

Results and discussion

Asclepias curassavica L., Sp. Pl. 215 (1753) (Figures 1–3).

Type: Curaçao. Anon s.n. (lectotype, designated by Woodson [1954: 59], LINN-HL310-19).

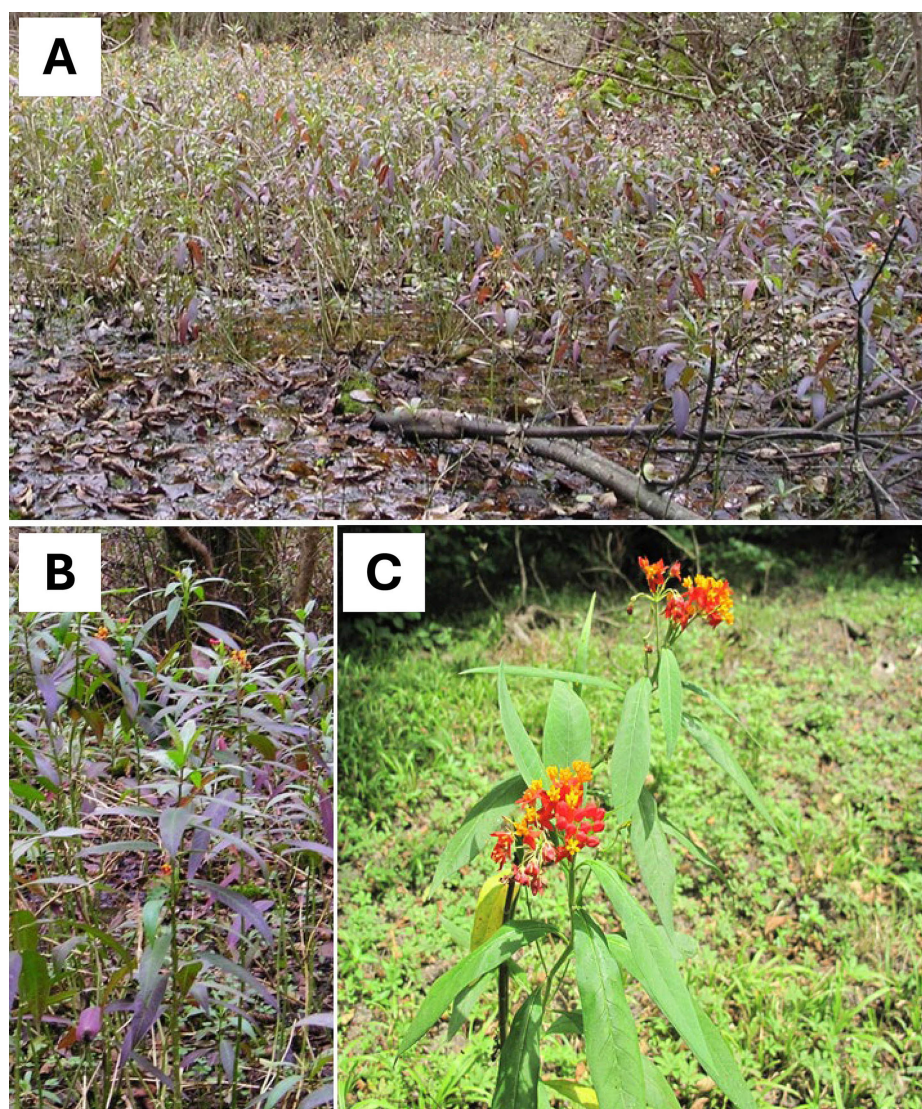


Figure 1. The area invaded by *Asclepias curassavica* L. showing dense populations (A and B); and scattered individuals (C). Photographs A and B by A. Naqinezhad, C by H. Gholizadeh.

Species description and diagnostic traits

Herbaceous annuals or perennials. Stems erect, simple or branched, up to 1.5 m tall. Leaves opposite, petiolate, narrow lanceolate-oblong, acute at both ends, ca. 8–11 × 1–3 cm; petioles 0.5–1 cm, with stipular appendages at the base. Fibrous, non-tuberous rootstock. Inflorescences terminal and/or axillary; cymes on peduncles 3–6 cm long, 4–15-flowered. Flowers erect, bright red-and-yellow; calyx-lobes to 4 mm long; corolla reflexed-rotate, bright red, up to 9 mm long; corona-scales deep yellow, oblong, distinctly stipitate, up to 4 mm long, with prominent tooth arising from the cavity, and arching over style apex; stamen-tube to 3 mm long. Follicles ovoid-oblong (fusiform), erect, 7–8 × 0.5–1.5 cm long, smooth and glabrous. Seeds ovate, margin winged, deep brown, 6–7 mm long, with silky-white tuft of hairs 2–2.7 cm long.

Asclepias curassavica is characterized by having lanceolate leaves, flowers with bright red-orange corolla, orange or yellow corona with prominent tooth

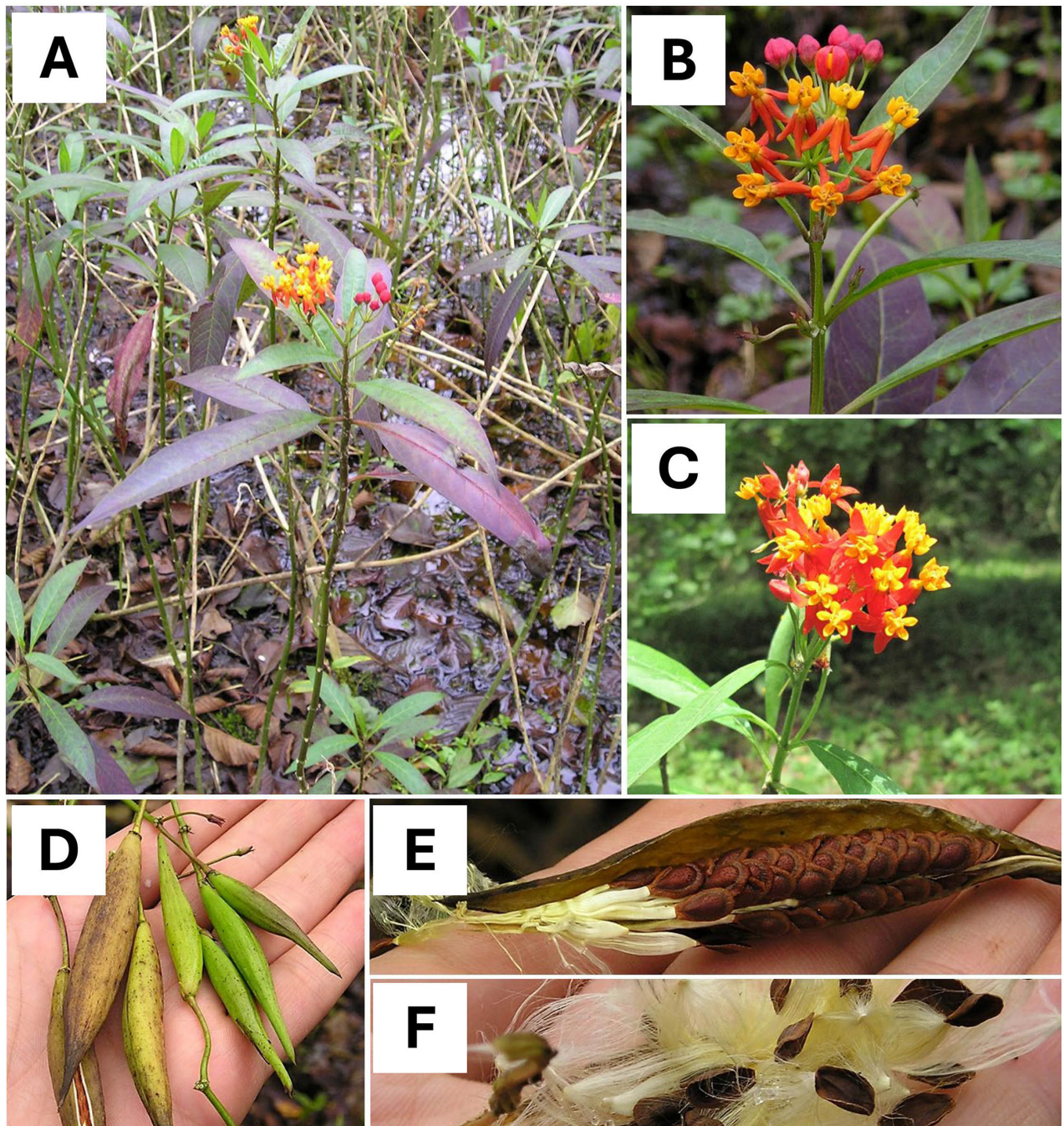


Figure 2. *Asclepias curassavica* L. general habits in the field, along with other growing individuals (A); flowers bearing reflexed corolla, and stipitate corona (B and C); fusiform follicles (D); and winged seeds with silky-white hairs (E and F). Photographs by A. Naqinezhad.

arising from the cavity and arching over the stylar head, as well as fusiform, glabrous follicles (Woodson 1954; Goyder 2009; Gudžinskas et al. 2019; Byalt and Korshunov 2020). It might be confused with three species native to North America: *A. incarnata* L., *A. speciosa* Torr., and *A. syriaca* L. (Woodson 1954), all of which were introduced to many regions of Europe for ornamental and various other purposes (Markgraf 1972; Gudžinskas et al. 2019; Follak et al. 2021), with *A. syriaca* being introduced also to Russia and Georgia (Woodson 1954; POWO 2025). These species can notably be distinguished by their leaf size and morphology, length of peduncle and

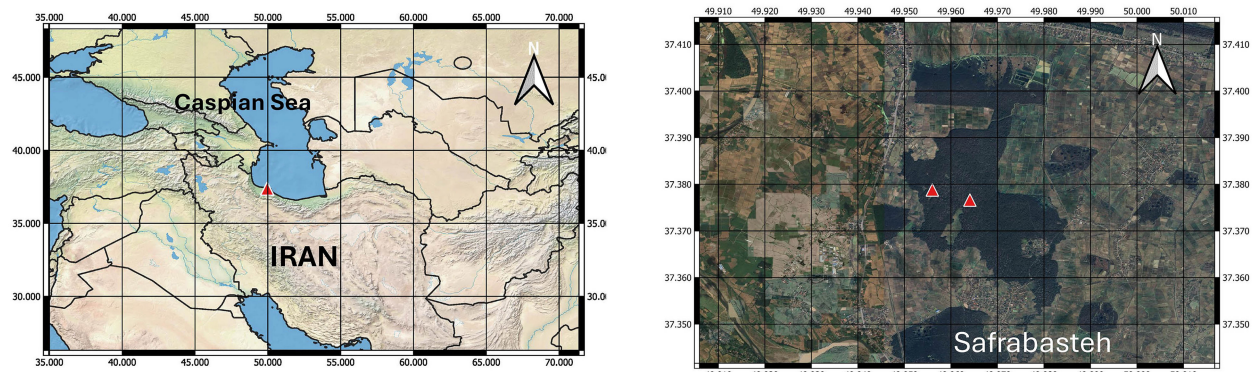


Figure 3. The location (red triangle) of the two sites where *Asclepias curassavica* L. is naturalized in North Iran on a gridded map (on the left) and on Google Earth imagery (on the right). Background map made with Natural Earth, Free vector and raster map data @naturalearthdata.com & earth.google.com/web/.

Table 1. Comparative characters of *Asclepias curassavica*, and its affinities.

Characters	<i>A. curassavica</i> (our record)	<i>A. incarnata</i>	<i>A. speciosa</i>	<i>A. syriaca</i>
Leaf shape	narrow lanceolate-oblong, with a cuneate base	narrow lanceolate-oblong, with a rounded or subcordate base	broadly ovate to elliptic- oblong, with a rounded or shallowly cordate base	ovate to elliptic- oblong with a rounded or slightly cuneate base
Leaf size (cm)	8–11 × 1–3	5–15 × 0.5–4.5	6–20 × 2–14	6–30 × 2.5–11
Number of flowers in the cyme	4–15 (few-flowered)	(10–)20–40 (many-flowered)	3–34 (many-flowered)	24–113 (many-flowered)
Peduncle length (cm)	3–6	1.5–7	1–10	2–12
Pedicle length (cm)	1–2	1–1.5	1.3–3.0	2–6
Corolla length (mm)	up to 9	5–6	9–15	6–9
Corolla color	bright red to orange	bright purple or pink carmine, rarely white	deep purple or pink	green-tinged purple or pink, rarely white
Corona length (mm)	up to 4	2–3	10–15	3.5–5
Corona color	deep yellow	pink or rarely white (variable)	pale pink to nearly cream (variable)	pinkish or purple, rarely white
Follicle size (cm)	7–8 × 0.5–1.5	6–9 × 0.8–1.2	(5–)9–13 × 2–3	7–12 × 2–4
Follicle indumentum	glabrous	glabrous to pilosulous	glabrous or densely spiny, and tomentose-hairy	glabrous, sulcate, or softly spiny, and densely tomentose-hairy

pedicel, details of floral structure (i.e. length and color of corolla and corona), as well as follicle size and texture (cf., Woodson 1954; Gudžinskas et al. 2019; Follak et al. 2021; see Table 1).

Habitat and distribution in Iran

North Iran: Guilan Province: Astaneh, Kiashar, Safrabasteh village, understory of moist lowland forests, 5 m b.s.l., 37°22'35.73", 49°57'50.66", 29.12.2002, Naqinezhad 31431 (TUH); *ibid*, 10 m b.s.l., 37°22'43.6"N, 49°57'21.6"E, 20.06.2015, (H. Gholizadeh, *personal observation*).

Asclepias curassavica grows as an understory species within the forest gaps of the lowland *Populo caspicae-Alnetum barbatae* community (Ghahreman et al. 2006; Hamzeh'ee et al. 2008). The two main populations of the species were surveyed within a radius of approximately 0.5–1 km. One dense population occupies an area of about 1,000 m², consisting of over 200 individuals (Figure 1A, B). In contrast, the second population comprises scattered individuals inhabiting an area of about 5,000 m² under

relatively different habitat conditions in terms of land use, forest canopy, and ecological resources (Figure 1C). The invaded sites are characterized by stabilized sandy loam soils with high sand content (approximately 50%) and silt (approximately 30%), dominated by *Populus caspica* and *Alnus glutinosa* (L.) Gaertn. as primary overstory species. Other co-dominant tree species found in these habitats are *Ulmus minor* Mill., and *Pterocarya fraxinifolia* (Poir.) Spach. Additionally, the most significant understory species include *Smilax excelsa* L., *Oplismenus undulatifolius* (Ard.) P.Beauv., *Carex remota* L., *Carex strigosa* Huds., *Lindelofia kandavanensis* Bornm. & Gauba, *Galium elongatum* C.Presl, *Periploca graeca* L., *Persicaria hydropiper* (L.) Delarber, *Ranunculus repens* L., *Rumex sanguineus* L., and *Viola caspia* (Rupr.) Freyn (see Hamzeh'ee et al. 2008; Gholizadeh et al. 2020).

The two sites where *A. curassavica* is established are located near the forest-village of Safrabasteh, a quite famous tourist destination, near the Caspian Sea coastline. The first introduction of this species is likely to have occurred around 70 years ago, in the mid-twentieth century, as reported by Parsa (1951). Tropical milkweed was likely accidentally introduced by travelers, and through transport networks, possibly as a hitchhiker. It may have also escaped from cultivation (as ornamental plant) into forests near urban and coastal areas, similar to other alien plants in Iran (Khorasani et al. 2024; Sohrabi et al. 2023, 2024). The lightweight seeds can be easily dispersed (Wyatt and Broyles 1997) playing a crucial role in increasing its reproductive potential in the newly occupied sites (Sohrabi et al. 2023, 2024). Moreover, the temperate forest ecosystems of Northern Iran, particularly the lowland plains, provide suitable conditions for its establishment in terms of temperature, humidity, and soil properties (Naqinezhad et al. 2008; Gholizadeh et al. 2020). We highlighted the presence of dense populations of *A. curassavica* in forest gaps where land use and tree cutting provide access to resources, particularly light, which may be another reason for its increased colonization. Therefore, this alien weed has successfully become naturalized in the Hyrcanian lowland forests with a high potential for further spread to higher elevation and other forest communities because of anthropogenic disturbances and climate change. This poses a serious threat and could have significant implications for the local flora, particularly the endangered relict and endemic plant species.

Environmental impacts and management programs

Asclepias curassavica is primarily an agricultural or ruderal weed in both its native and alien range, capable of reducing yields of commercial crops (Groves et al. 2003; Randall 2007; White et al. 2018; Goyder 2009; Byalt and Korshunov 2020; Leopardi-Verde et al. 2021). It can also be an invasive alien plant due to its rapid growth and high reproduction rates (Sanz-Elorza et al. 2004; Foxcroft et al. 2008), causing irreversible environmental

impacts by changing community structure and ecosystem functioning in the invaded sites (Sohrabi et al. 2023; Khorasani et al. 2024). According to our results, tropical milkweed established as an understory plant within relict stands of *Populus caspica* forests in the western Hyrcanian ecoregion, posing a potentially significant ecological threat to the natural range of this endangered sub-endemic tree species and to local biodiversity. These relict *P. caspica* habitats are critically important for conservation, being the only remaining refuges for this sub-endemic tree species in the Hyrcanian region (Akhani et al. 2010; Yousefzadeh et al. 2018; Alipour et al. 2021). The introduced species *A. curassavica* may inhibit the growth of *P. caspica* seedlings hindering forest regeneration. Furthermore, the occupation of large portions of the understory by this alien species could lead to a reduction in space and resources available for native understory plants (see Akhani et al. 2010; Naqinezhad et al. 2021; Sohrabi et al. 2023). With the additional pressures of climate change, submontane and even montane forests in the Hyrcanian region are increasingly vulnerable to invasion by *A. curassavica*. These combined factors highlight the urgency of addressing the invasion to safeguard this highly threatened ecosystem.

The naturalization of *A. curassavica* in the forest habitats represents a significant ecological challenge that warrants further investigations and effective management strategies. Limited information regarding the management and control of *A. curassavica* is available. Hand-pulling and bagging of plant material is generally the recommended method for control. Common herbicides such as glyphosate are reported to have limited effectiveness, although spraying with glyphosate may be a viable option on small areas invaded by tropical milkweed (Ward 2022). Control attempts should be coupled with raising awareness among local communities about the negative impacts of this alien species on the natural ecosystems and encouraging residents to refrain from planting it as an ornamental plant (Sohrabi et al. 2023; Khorasani et al. 2024). Furthermore, environmental organizations should take targeted conservation actions to eradicate tropical milkweed and prevent new introductions toward higher elevations within the Hyrcanian forests which is a unique relict ecosystem, and UNESCO world heritage site (Gholizadeh et al. 2020; Naqinezhad et al. 2021).

Authors' contribution

MKh: has made substantial contributions to research conceptualization, sample design and methodology, investigation and data collection, taxonomic examination and interpretation, and writing the original draft, and editing. HG: has made substantial contributions to data analysis and interpretation, review, and editing. GB: has made substantial contributions to data analysis and interpretation, writing, review, and editing. AN: has made substantial contributions to research conceptualization, data analysis and interpretation, writing, review, and editing. All authors have given final approval for the version to be published.

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