

Rapid Communication***Austrocyllindropuntia subulata* (Muehlenpf.) Backeb. (Cactaceae, Opuntioideae): an invasive new cactus record to the flora of Saudi Arabia**Sami Asir Al-Robai^{1,*}, Abdelazim Ali Ahmed^{1,2}, Haidar Abdalgadir Mohamed^{1,3} and Fatima Omari Alzahrani¹¹Department of Biology, Faculty of Science, Albaha University, Albaha, Saudi Arabia²Department of Botany, Faculty of Science, University of Khartoum, Sudan³Medicinal and Aromatic Plants Research Institute, National Council for Research, Sudan

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OPEN ACCESS**Abstract**

Austrocyllindropuntia subulata is an invasive new opuntoid cactus to the flora of Saudi Arabia collected from Al-Sarah highlands (south-western region). This is the second cylindrical cactus from the Cactus family recorded in the Kingdom after the discovery of *Cylindropuntia rosea* in the same region. It differs from *C. rosea* by lacking of jointed stem and absence of the spines sheath and having long conspicuous leaves. The plant was not widespread in the region. It is only confined to a limited protected area at an elevation of 1630–2160 m above sea level. Taxonomic key, general descriptions, diagnostic features and colored photographs are provided. As *A. subulata* is one of the restricted invasive plants worldwide, actions must be taken by the government to restrict the spreading risks of this taxon into the environment. No records have found regarding the uses of this species by the native people. Eradication steps should be taken to minimize its further distribution in the productive regions of the Kingdom.

Key words: cacti, new record, alien species, invaders, succulent plants**Introduction**

Cactus family (Cactaceae) includes several dangerous invasive species, which have invaded different regions around the world (Novoa et al. 2015). The widespread of these invasive alien species worldwide have threatened natural ecosystems, human health and national economies (Novoa et al. 2016). Most of the cacti invaders have been distributed in the Mediterranean basin, tropical savanna, desert and xeric shrubland biomes (Masocha and Dube 2018).

Austrocyllindropuntia subulata belongs to the family Cactaceae, subfamily Opuntioideae, tribe Tephrocactae and it is known as Eve's pin cactus (Ritz et al. 2012). Cactaceae family comprises 1600 species (Maya-García et al. 2017), 1438 of which are almost restricted to the Americas and distributed throughout Neotropics (Gonzaga et al. 2019). Cacti have diverse structural and ecological features and most of them are characterized by their vestigial leaves. They have inverted flowers with petals above stamens and

clusters of spines developed from axillary buds or bud scales (Mauseth 2006). They occur in arid open habitats and have the ability to invade open Mediterranean scrublands, dry grasslands and rocky habitats (Essl and Kobler 2009). Many factors affecting the growth rate and distribution of cacti are: temperature, latitude, soil properties, perennial companion species as well as water and available nutrients (Godínez-Álvarez et al. 2003).

Four cactus species have been recorded in the southwestern region of Saudi Arabia, three of which belong to the genus *Opuntia* (*Opuntia dillenii*, *O. ficus-indica* and *O. stricta*) (Thomas et al. 2016). The fourth species is *Cylindropuntia rosea* (Al-Robai et al. 2018).

Austrocylindropuntia subulata [basionym: *Pereskia subulata* Muehlenpf.; synonyms: *Cylindropuntia exaltata* (A. Berger) Backeb, *Opuntia exaltata* A. Berger] is native to south Perù (Anderson 2001) and it is characterized by having terete persistent leaves, and areoles with persistent spines, glochids and trichomes (de Arruda and Melo-De-Pinna 2016). It was introduced and naturalized in Australia as well as in some African and European countries and recently reported as a new record in Albania (Nobis et al. 2018) and Tunisia (El Mokni et al. 2020). It has been reported as one of the highly invasive species in the Mediterranean Basin (Celesti-Grapow et al. 2016).

Materials and methods

Field works were made to south-western regions of Saudi Arabia including mountains, valleys, Tihama coastal plain and agricultural lands. Initial data regarding morphological characters, habitat, soil type, and accompanying plants were recorded in the field. After carefully reviewing and checking the published resources regarding the flora of Saudi Arabia (Chaudhary 1999; 2000; 2001); it was clear that *A. subulata* is not recorded in these publications. Current databases (WFO 2021) were conducted to verify and check the recent accepted name of the species. The collected specimens have been deposited at the Biology Department, Faculty of Science, Albaha University.

Results and discussion

Taxon description

A vigorous dense shrub up to 3 meters high with a diameter up to 2 meters. Stem: bright green with purple tinge, cylindrical, not segmented, with tough skin, 40–100 cm in length, 3–5 cm in diameter. Tubercles: up to 3 cm long, irregular in shape, arranged in spiral lines, areole at the tip of each tubercle. Areoles: circular, present on both joints and fruits surface, surrounded with barbed bristles. Leaves: subulate, fleshy green or yellow, persistent when young, deciduous when old, pointed, and up to 7 cm long. Spines: sharp with no papery sheath, yellowish white, 4–7 cm long, 2–5 spines per an areole. Flowers: at the tip of the branch, pink colored, up to



Figure 1. (A) *Austrocyllindropuntia subulata* in its natural habitat; (B) an opening flower; (C) new floral buds from green sterile fruits; (D) stem with conspicuous tubercles, areoles, leaves and spines; (E) large seeds. Photographs by Sami Asir Al-Robai.

11 cm long and 3 cm in diameter, more than 3 rows of tepals. Fruits: green oblong-shaped, sometimes forming chains of sterile fruits. Seeds: large, 30–60 seeds per fruit (Figures 1 and 2). This description was carried out on the collected plant samples from different localities of the study area. Previous study has reported that *A. subulata* has large persistent fleshy leaves up to 12 cm in length and 0.6 cm in diameter which are differed from other leaves of Opuntioideae in their internal structure (Ozerova and Timonin 2020).

Key to genera of Cactaceae in Saudi Arabia

1. Stem with flattened joints, normally not tubercles; spines without a papery sheath.....*Opuntia*
- . Stem segments cylindrical, tubercles distinct..... 2

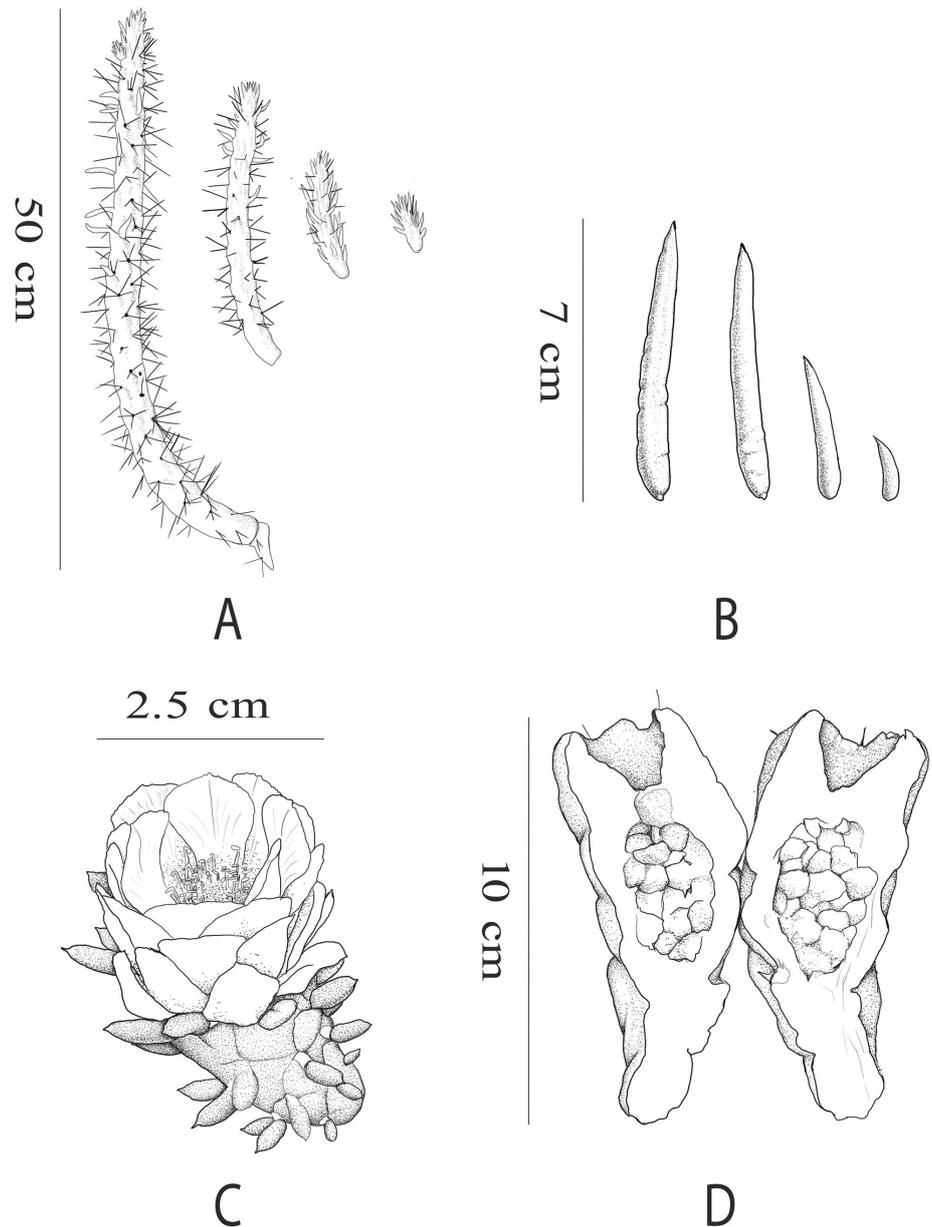


Figure 2. *Austrocylindropuntia subulata*: (A) stems different sizes; (B) Awn-shaped leaves; (C) A flower; (D) longitudinal section in a mature fruit showing the large seeds. Drawings by Sami Asir Al-Robai.

2. Spines lacking papery sheaths, stems jointed *Cylindropuntia*
 -. Spines with detachable papery sheath, stems not jointed
 *Austrocylindropuntia*

Distribution and habitat

The plant showed a casual distribution and is growing in semi dry stony protected places in Al-Sarat highlands (Figure 3). It was found on waste disturbed habitats near the construction areas but far from agricultural lands. The area is within al-Sarawat escarpment of south-western Saudi Arabia (19°51'59"N, 41°33'57"E), a region characterized by scattered steep-sloping mountains separated by small and large valleys (Wadis). The climate

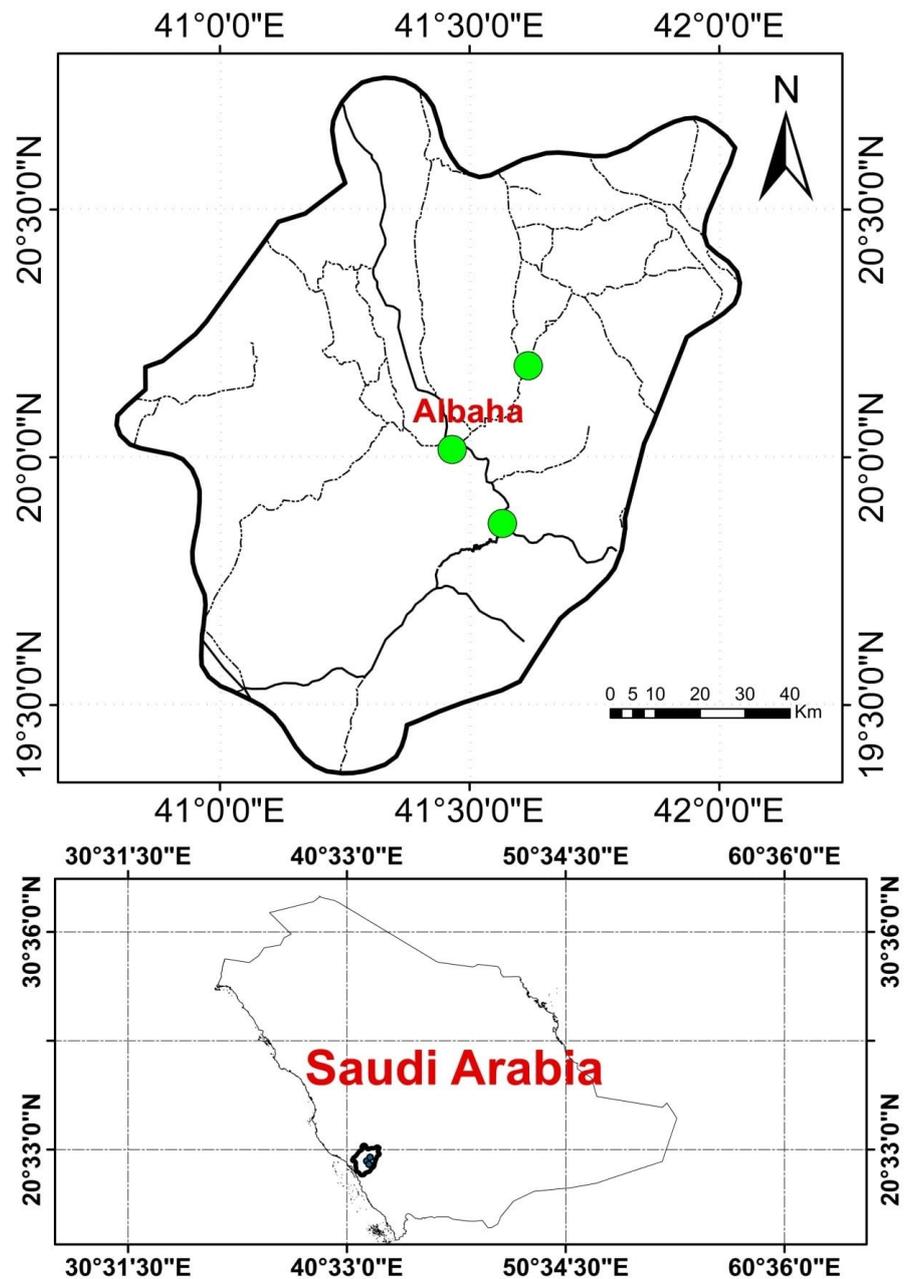


Figure 3. Records of *Austrocyllindropuntia* in Saudi Arabia.

is moderate in summer and cold in winter with an average rainfall of less than 100 mm per year (Ouda 2014). The soil is almost a sandy clay and the ground surface is covered by small rock fragments. More field trips may reveal the presence of *A. subulata* in other regions in the country.

The most common accompanying species growing with *A. subulata* were *Ficus palmata*, *Acacia orginae*, *Viscum schimper* and *Opuntia ficus-indica*. It is possible that these perennial plants have provided a shade habitat for the growing of the taxon. Godínez-Álvarez et al. (2003) have reported that the associated perennial plants provide shade for cacti to grow and favoring their establishing in the area.

The distribution of the plant in south-western regions of the Kingdom could be attributed to many factors such as high humidity, warm weather

in summer and the high altitude that promote the growth and invasion rate of the alien. However, Griffith et al. (2014) revealed that warm and humid areas have positive effects on the growth rate of the invaded aliens. This species is distributed at high altitude (1630–2160 m). This finding was in agreement with the results that reported by Thomas et al. (2016) for the *Opuntia* spp. and Al-Robai et al. (2018) for *Cylindropuntia rosea*.

Austrocyllindropuntia subulata was not previously reported in Saudi Arabia and there is no information about how this cactus was introduced into the Kingdom. It is possible that the plant is an escaped garden cactus that might be probably introduced to the country as an ornamental plant. The high invasive ability of this species (Celesti-Grapow et al. 2016) could possibly enabled it to spread and naturalize in Saudi Arabia. However, the plant has been reported as naturalized alien in Italy, Sardinia, Sicily, Canary Islands (El Mokni et al. 2020) and in Greece (Galanos 2015).

Succulent plants are widely distributed worldwide especially in arid and semi arid ecosystems. They have the ability to adapt to adverse conditions in desert and semi desert habitats by storing water in their stems, leaves and roots. The areoles which are found along the ribs of the plant distinguish Cactus family from the other succulent plant families (El Mokni et al. 2020).

Forty eight species have been reported as exotic plants in the Kingdom; some of these plants have a negative impact on biodiversity and the natural ecosystems in the country. Thirty four of these species (70%) have been detected in the southwestern regions of Saudi Arabia. The species which were recorded in high lands had high diversity as compared with the species that detected at low lands (Thomas et al. 2016). The invasive ability of the succulent plant (Celesti-Grapow et al. 2016) may represent a serious threat for the local habitats by affecting the diversity of native species or altering the natural flora of the region. It is recommended to trace and manage the disruptive effects of this plant on the grazing and agricultural lands in the invaded areas.

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