

**Notes on the Distribution of the Genera
Microparacaryum and *Paracaryum*
(Boraginaceae) in Saudi Arabia**

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ABSTRACT. Collections in the Arabian Peninsula revealed that *Paracaryum rugulosum* and *Microparacaryum intermedium* - outstanding taxa of the Irano-Turanian, polymorphic *Mattiastrum* - *Paracaryum* complex - are able to penetrate southwards into the western part of the Arabian Peninsula. *M. intermedium*, in particular is frequent in the isolated mountains of Hisma Midyan and al-Hijaz. Due to the heteromerocarpy of *M. intermedium* (2-3 winged nutlets and 1 (-2) glochidiate, wingless nutlets) and the differentiation of flat and inflated margins within the winged type (mattiastroid, paracaryoid forms), the species is able to colonize suitable biotopes in the isolated mountains. Within the *M. intermedium* complex a dispersal strategy is realized, combining the Annual shuttle strategy (telechorous strategy) with an Annual stayer strategy (atelechorous strategy).

The recently evolving and closely related taxa of *Paracaryum* (DC.) BOISS., *Mattiastrum* (BOISS.) BRAND and *Microparacaryum* (M. POP. ex H. RIEDL) HILGER & PODLECH (cf. Brand 1915, Johnston 1924, Mill 1977, 1978, Hilger 1981 a,b, Hilger *et al.* 1985) are characteristic species of the Irano-Turanian floristic stock. Their centre of evolution and diversification lies in the mountain ranges and intramontane basins of Turkey, Iran and Afghanistan (Figs. 1,2).

In the Arabian Peninsula, these taxa were known only from three localities.

Saudi Arabia: *Microparacaryum intermedium*, Jabal ash-Shati range, 30 km NE of ash-Sharmah, c. 4000 ft., in pink granite sand; *Paracaryum* cf. *rugulosum*,

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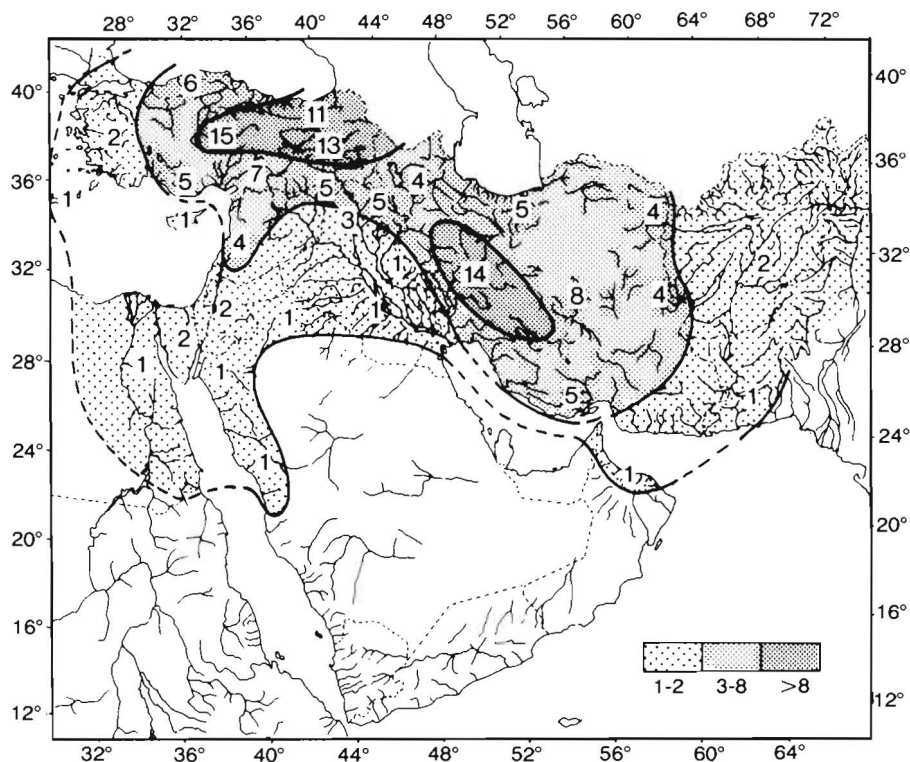


Fig. 1. Species frequency (no. of species) and distribution of *Paracaryum* s. 1. (acc. to Mill 1978, Heller and Heyn 1986, incl. *Mattiastrum*, *Microparacaryum*) in the Middle East (USSR excluded).

30 km W of Turayf camp, c. 2900 ft., in drifted sand and among small shrubs in a runnel on a limestone plateau (Collenette 1985).

Oman: *Microparacaryum intermedium*, Jabal al-Akhdar, Wadi Mistal, c. 1500 m, open stands in *Monothecha buxifolia* woodland, Frey and Kürschner 83-276 (Hilger *et al.* 1985).

Further floristic collections by Collenette, Frey & Kürschner have revealed that *Paracaryum rugulosum* (DC.) BOISS. (Fig. 3) is also frequent in the sand deserts and limestone plateaux north of al-Jawf (Harrat al-Harra). On the other hand, the annual, heteromericarpic *Microparacaryum intermedium* (FRESEN.) HILGER & PODLECH (Hilger *et al.* 1985) (Figs. 4,5) is able to penetrate far into the mountains of the western part of the Arabian Peninsula, which are mainly Saharo-Arabian in character. Therefore, the western part of the area of *Microparacaryum intermedium*, which previously had to be regarded as very

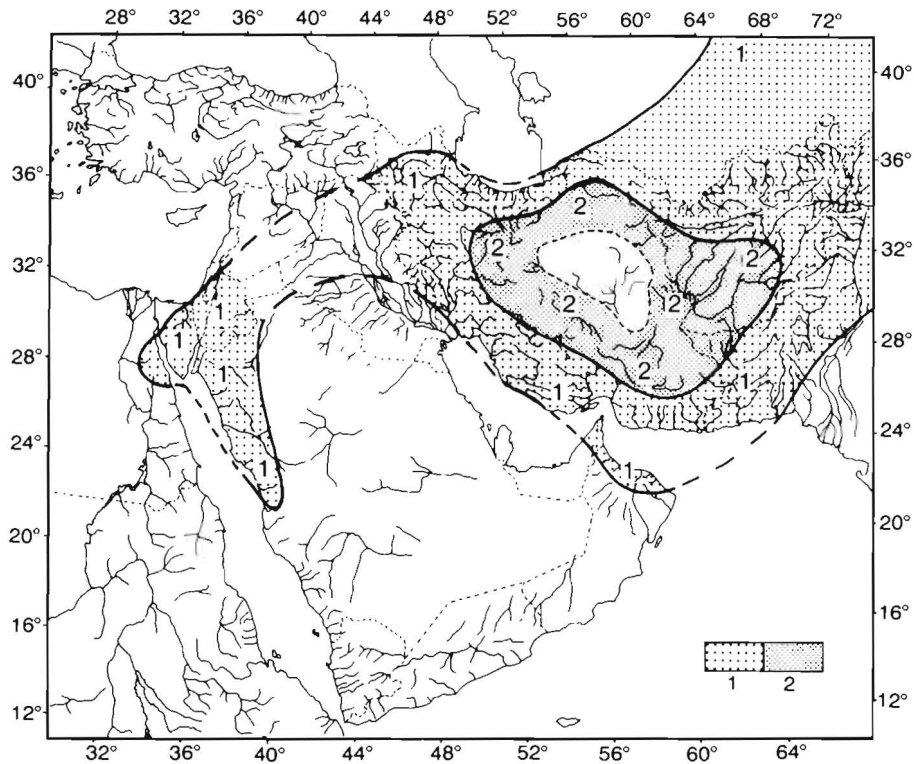
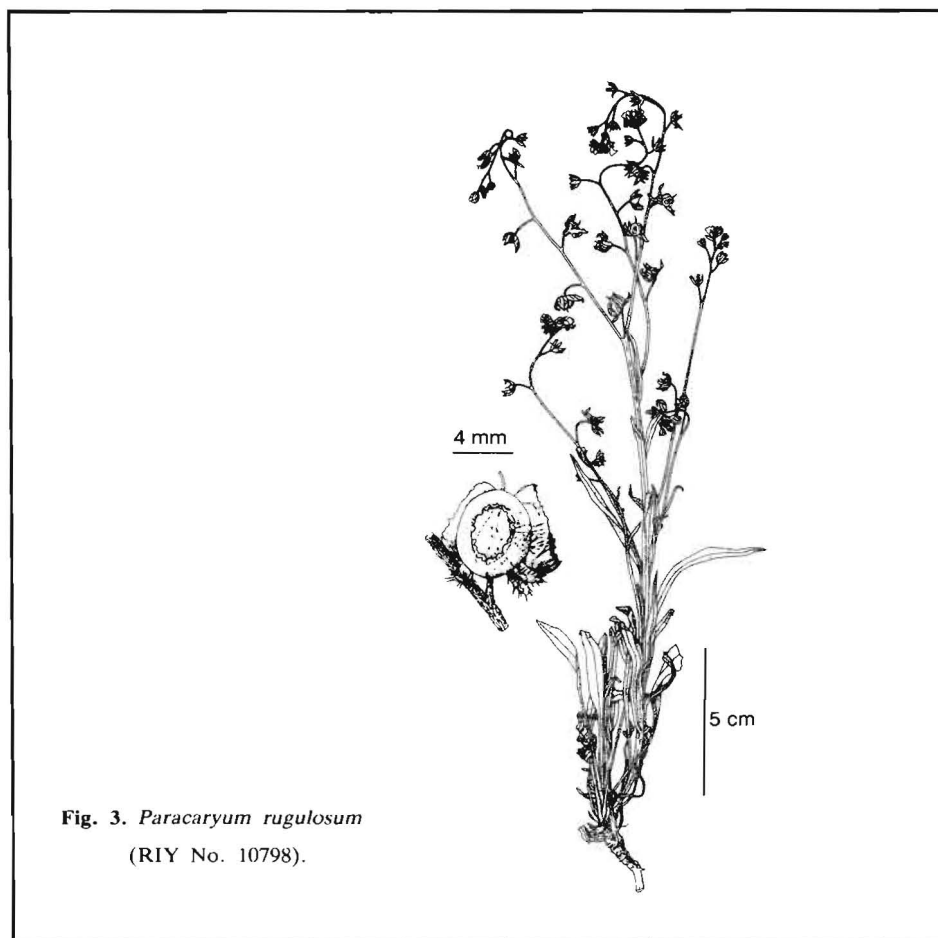


Fig. 2. Species frequency (no. of species) and distribution of *Microparacaryum* in the Middle East.

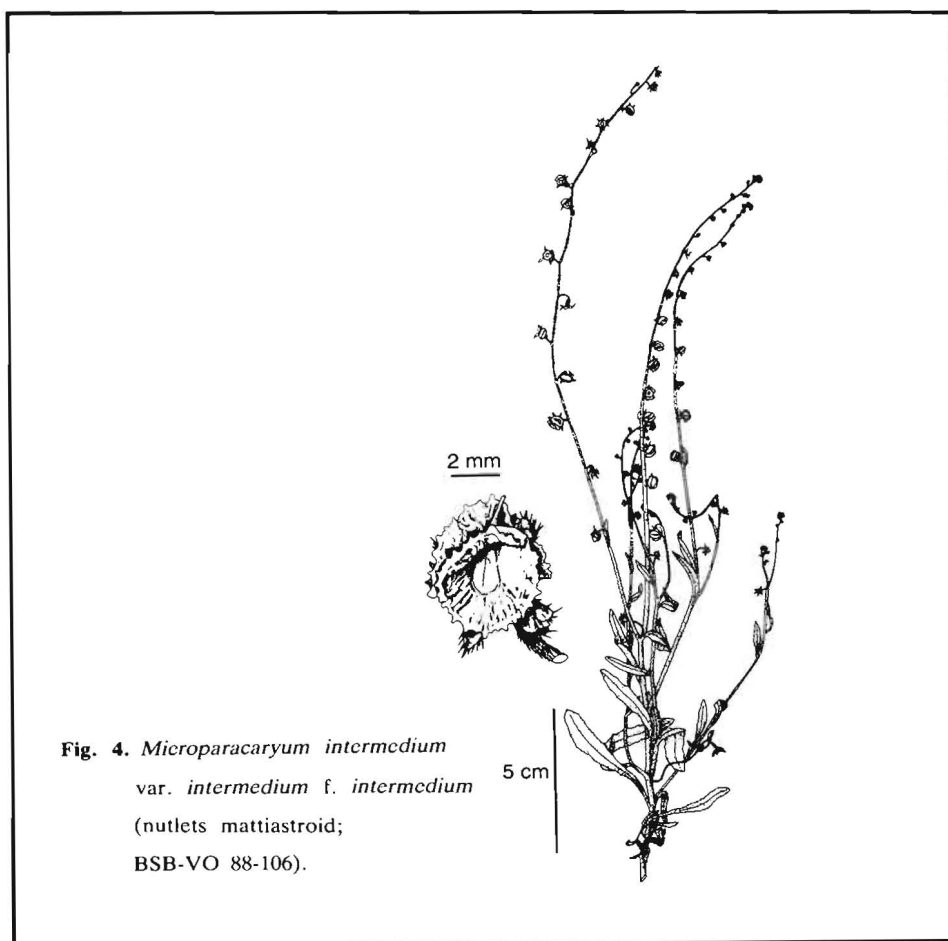
isolated and disjunct, is very much larger than expected on the distribution of the species in Sinai, Palestine and Jordan.

The *Microparacaryum* taxa (*M. intermedium* with two varieties, *M. salsum* (BOISS.) HILGER & PODLECH) are characteristic of semiarid, montane dwarf-shrub communities (700-4000 m) (steppes, *Artemisietea herbae-albae* sensu Zohary 1973) and of rock and gravel deserts. Their centre of distribution is in the Irano-Afghanian highlands (Fig. 2). The western border of the distribution of *Microparacaryum intermedium* is in the southern Sinai and near Mt. Galala in Egypt (Riedl 1967). In the east, the species is penetrating very far into the steppes of Kazakhstan (cf. distribution map in Hilger *et al.* 1985). This southwestern extension to the western disjunct area suggests that there must be a connection between it and the main distribution area in the east through the "Fertile Crescent" but no specimen have so far been collected from the latter region (Fig. 2). This area of distribution is in the western part nearly identical with that one of *Paracaryum rugulosum* but the species is lacking east of the Caspian Sea.



In Saudi Arabia, *Microparacaryum intermedium* is able to penetrate over the isolated mountains of Hisma Midyan and al-Hijaz far into the south (Fig. 2). However, on account of its ecological requirements, the distribution is limited to the mountainous areas which receive sufficient, more or less regular rainfall during spring (up to 150 mm). Only then germination, establishment of seedlings, flowering of plants and the production of fruits are ensured.

The genus *Microparacaryum* is characterized by annual habit, heteromerocarpy (mainly 3 winged mericarps (nutlets), which are anemochorous, and 1 glochidiate mericarp (nutlet) with an atelechorous character; Hilger and Richter 1982, Hilger *et al.* 1985) and show a genetically fixed fruit polymorphism. The basal fruits are long stalked, while the upper ones are sessile (heterocarpy). The different taxonomic treatment of the taxa of *Microparacaryum* mainly is based on



this genetical fruit polymorphism, while the systematically much more important heteromerocarpy has been overlooked.

Within one population there exist plants with flat margins of the nutlets (mattiastroid, f. *intermedium*, Fig. 4) as well as plants with inflated nutlet margins (paracaryoid, f. *paracaryoides*, Fig. 5). In the western part of the area, findings of both morphs together have been known only from Sinai (Shmida 1978), but have now been observed by the authors also in the Hisma Midyan (Jabal Shar) of Saudi Arabia. Most collections, however, show only one morph; mixed populations seem seldom to occur. According to Hilger *et al.* (1985), *Microparacaryum intermedium* is self-fertile. Within smaller populations only one morph exists, while within larger populations both morphs occurs together. The ratio of the two

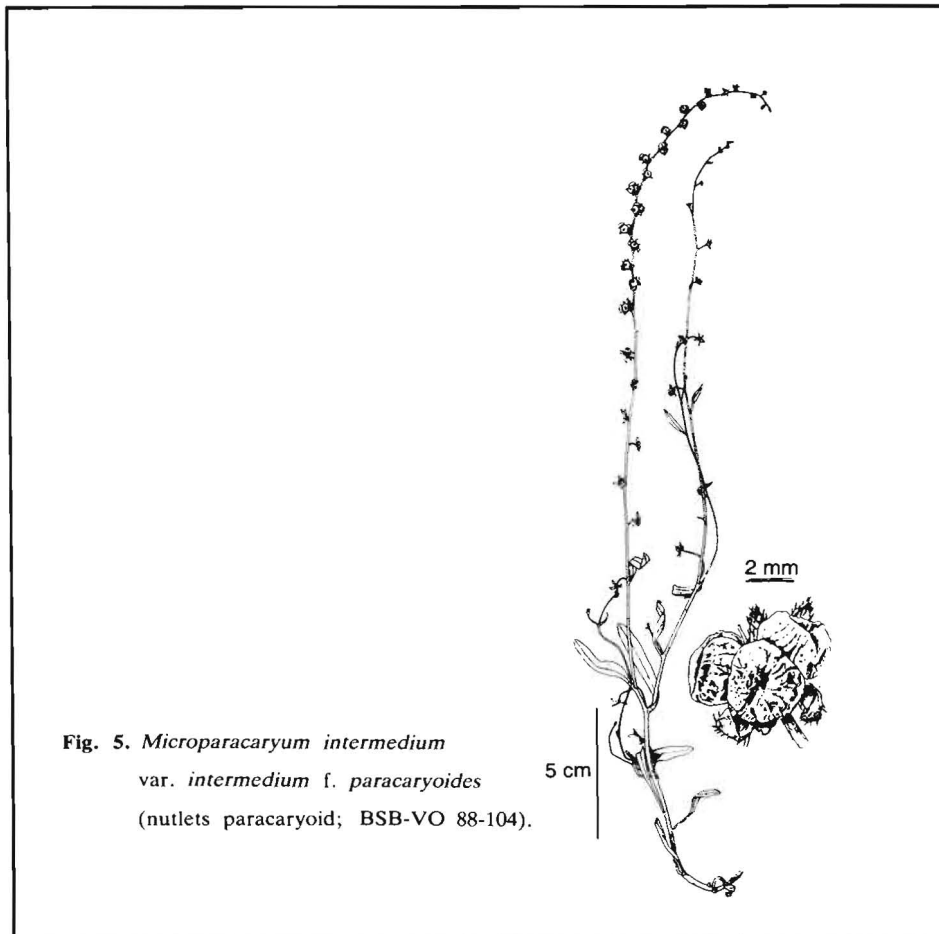
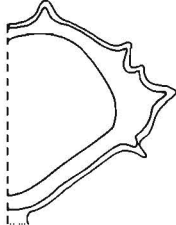




Fig. 5. *Microparacaryum intermedium*
 var. *intermedium* f. *paracaryoides*
 (nutlets paracaryoid; BSB-VO 88-104).

morphs shows considerable variation within the Sinai populations (ratio f. *intermedium* / f. *paracaryoides*: 78/53, 29/3, 12/12, 30/30, 30/6, 29/6, 18/2, Shmida 1978) but usually the mattiastroid form dominates. The ratio within the mixed populations in the Hisma Midyan is 7/1 (mattiastroid/paracaryoid). Shmida (1978) noted that ecological factors are obviously of no importance for the development of the two morphs.

The mattiastroid and the paracaryoid nutlets evolved from cynoglossoid ancestors (Hilger 1981a) (Fig. 7). The cynoglossoid nutlets are (epi) zoochore, while the mattiastroid and paracaryoid nutlets turned to be anemochore ("Flügelflieger" and "Ballonflieger" principle). In addition there are glochidiate, wingless nutlets (ratio usually 1:3, less commonly 2:2 or even 2:3 in rare instances where an extra, fifth mericarp develops). These eventually drop off and allow

Type of nutlets	Dispersal	Life form/habitat
cynoglossoid (<i>Cynoglossum</i> spp.) 	(epi-) zoochore	Chamaephytes, Hemikryptophytes of forests, woodlands and closed vegetation units
mattiastroid (<i>Mattiastrum</i> spp.) 	anemochore ("Flugelflieger")	Hemikryptophytes of open vegetation units (e.g. dwarf-shrublands, semi-deserts, rock deserts)
paracaryoid (<i>Microparacaryum</i> spp.) 	anemochore ("Ballonflieger")	Hemikryptophytes, Therophytes of very open vegetation units (e.g. open dwarf-shrublands, semi-deserts, rock deserts)

> ■ development of a hollow space

Fig. 6. Hypothetical evolution of the anemochore nutlets within the genera *Mattiastrum*, *Paracaryum*, and *Microparacaryum* (nutlets in semi-schematic longitudinal sections, after Hilger 1981a).

survival in niches after colonisation by telechorous nutlets.

Assuming that the mattiastroid nutlets do not have the same long-distance dispersal ability as the paracaryoid nutlets with its ballon-like inflated margin, they can be used to occupy surrounding biotopes. Because distances are very far between the isolated mountain ranges, one has to postulate that they were reached mainly by the anemochorous paracaryoid nutlets dispersed by strong winds. But we have to take into consideration also ecological aspects like seedling establishment which is not investigated until now.

Within the *Microparacaryum intermedium* complex obviously a dispersal strategy is realized, in which the Annual shuttle strategy (telechorous strategy) is combined with the Annual stayer strategy (atelechorous strategy). With this combined dispersal strategy all suitable biotopes in arid regions can be reached.

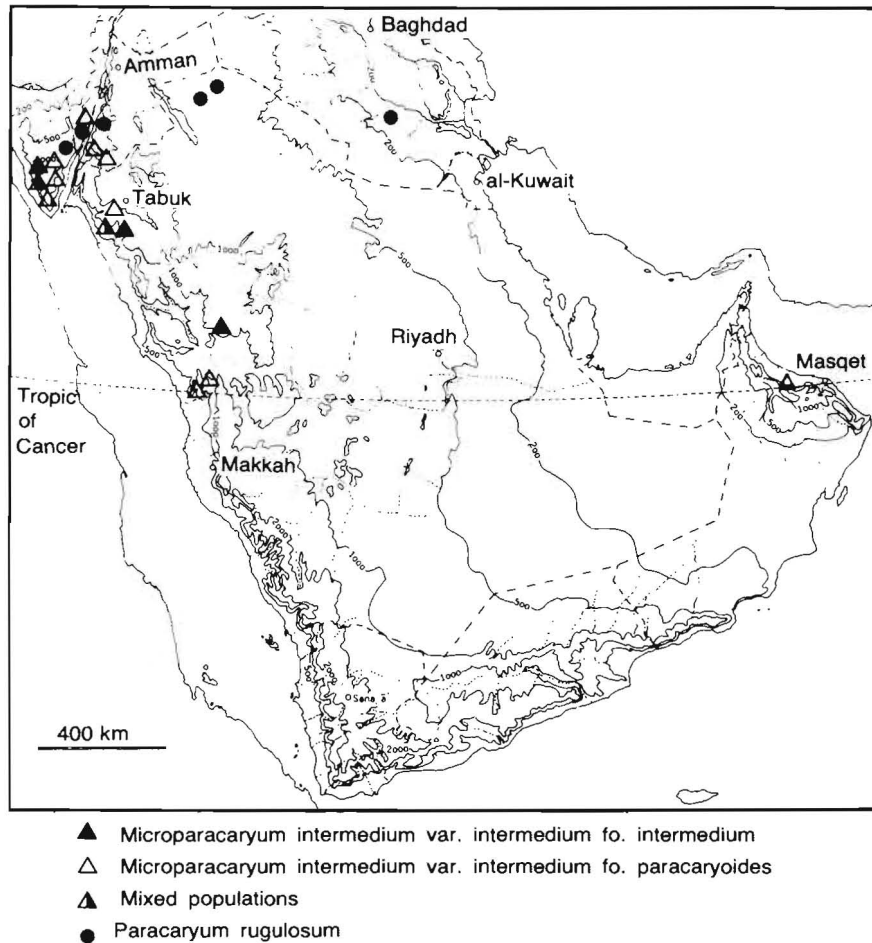


Fig. 7. Distribution of *Microparacaryum intermedium* and *Paracaryum rugulosum* in the Arabian Peninsula, Sinai and Palestine.

Key to the species

- 1 Hemicryptophytes (perennial herbs).
 Corolla 4-6 mm, dark violet to brownish-purple. Nutlets 5-6 mm *Paracaryum rugulosum*
- 1* Therophytes (annuals). Corolla 1.5-3 mm, blue. Nutlets c. 3 mm 2
Microparacaryum intermedium var. *intermedium*)

- 2 Nutlets mattiastroid (wings of the nutlets flat)..... *M. intermedium* var. *intermedium* f. *intermedium*
- 2* Nutlets paracaryoid (wings of the nutlets involute, margin balloon-like inflated) *M. intermedium* var. *intermedium* f. *paracaryoides*

Specimens seen and distribution in Saudi Arabia (Fig. 7).

Paracaryum rugulosum (DC.) BOISS. (Figs. 3,7)

- Harrat al-Harra, N of al-Jawf, lava fields, 13.3.1987, S.A. Chaudhary & A. Al-Jouid (Nat. Herb. of Saudi Arabia, RIY No. 10798).

Microparacaryum intermedium (FRESEN.) HILGER & PODLECH var. *intermedium* f. *intermedium* (Figs. 4,7)

- Wadi Qaraqir, 50 km E of the Dhuba-Tabuk road, turn off 60 km N of Dhuba, 2000 ft., sandstone gravel and red sand in ravine of high sandstone buttes, 14.3.1986, I.S. Collenette No. 5749 (Nat. Herb. of Saudi Arabia, RIY No. 10421).
- Harrat Khaybar, Jabal Abyad complex, 5500 ft., basalt gravel among crag 6.3.1986, I.S. Collenette No. 5677 × (Nat. Herb. of Saudi Arabia, RIY No. 10316).
- Hisma Midyan, Jabal Shar, 30 km E of al-Muelah, 40 km NE of Dhuba, 1200 m, crevices of granite rock, 3.3.1988, W. Frey & H. Kürschner (No. 88-106, BSB-VO).

Microparacaryum intermedium (FRESEN.) HILGER & PODLECH var. *intermedium* f. *paracaryoides* HILGER & PODLECH (Figs. 5, 7).

- Jabal Qals, 100 km SSW of Madinah, 2500 ft., granite cirque, crevices of granite slope near base of mountains, 28.2.1985, I.S. Collenette No. 5099 (Nat. Herb. of Saudi Arabia, RIY No. 5992).
- Jabal Awf, 80 km SSW of Madinah, 3000 ft., crevice of granite spur on northern slope, 24.1.1986, I.S. Collenette No. 5562 (Nat. Herb. of Saudi Arabia, RIY No. 10405).
- N of Shiqri, Tabuk road, 3000 ft., red sandstone, 10.4.1985, I.S. Collenette No. 5250 (Nat. Herb. of Saudi Arabia, RIY No. 9999).
- Hisma Midyan, Jabal Shar, 30 km E of al-Muelah, 40 km NE of Dhuba, 1200 m, crevices of granite rock, 3.3.1988, W. Frey & H. Kürschner (No. 88-104, BSB-VO).

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دراسة عن توزيع أجناس الباراكيوم والميكروباراكيوم (الحمحميات) في المملكة العربية السعودية

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إن الهدف من هذا البحث هو تصنيف نبات الحمحميات الطبي وتحديد أماكن تواجده في المملكة العربية السعودية .

فقد تبين أن أحد أجناس الحمحميات وهو الباراكيوم الخشن وكذلك الميكروباراكيوم الناعم قد نبتا في جنوب الجزيرة العربية علماً أن موطنهما الأصلي كان في الجبال الإيرانية . بشكل خاص ، يتواجد هذين الجنسين في الجبال المعزولة من الجزيرة العربية كجبال الحجاز مثلاً .

لقد وجد أن الميكروباراكيوم الناعم موجود في المملكة العربية السعودية على بعد ٣٠٠ كيلومتر في سلسلة جبال الشاطيء وعلى تلك التي إرتفاعها ٤٠٠٠ قدم . وأما الباراكيوم الخشن فقد وُجد على بعد ٣٠ كيلومتر من طريف في الجبال التي إرتفاعها ٢٩٠٠ قدم وذلك في كتل رملية وبين شجيرات صغيرة وفي قنوات ضمن أرض كلسية . ووجد هذا الجنس أيضاً في بعض الرمال الصحراوية وفي الأراضي الكلسية بالقرب من الجوف .