Genet Resour Crop Evol (2007) 54:1153–1158
DOI 10.1007/s10722-007-9241-6

SHORT COMMUNICATION

First record of *Grewia tenax* (Forssk.) Fiori in northern Oman, a valuable fruit producing shrub

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Received: 14 November 2006 / Accepted: 17 April 2007 / Published online: 23 June 2007

Abstract *Grewia tenax* (Forssk.) Fiori is a wild fruit species with multiple uses in different parts of the Tropics and Subtropics. It is common on the Arabian Peninsula and has also been recorded in southern Oman. To date, no record of the species exists for the northern part of this country. To close this distributional gap, three sites in the al-Hajar mountains of northern Oman were surveyed in summer 2005 and spring 2006. During the botanical fieldwork, several flowering and fruiting plants were found in Wadi Bani Awf and Wadi Muaydin. In the latter area *G. tenax* fruits are eaten by local people. In addition to *G. tenax*, nine woody perennials with edible fruit were recorded. In northern Oman, fruits of *Sideroxylon mascatense* (A. DC.) Penn. and *Ziziphus spina-christi* (L.) Desf. are widely collected and sold on local markets. *G. tena*x shrubs were found to be heavily grazed indicating its high palatability to goats and sheep. The occurrence of *G. tenax* in the al-Hajar mountains is a new record to the flora of northern Oman and calls for further investigation of botanists and germplasm collectors.

Keywords Botanical survey · Flora of Arabia · Genetic resources · Germplasm · Geobotany · *Grewia tenax* · Multipurpose shrub · Perennial species · Vegetation science · Wild fruits

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Introduction

The Sultanate of Oman occupies the south-eastern coast of the Arabian Peninsula between latitudes 16°40′ N and 26°20′ N and longitudes 51°50′ E and 59°40′ E. It is a region of diverse topography. It has rugged mountains, vast sand and rock deserts, dense vegetation, mist-covered escarpment mountains and highly productive areas of ancient agricultural terraces. There are no permanent rivers and only a few permanent streams in the mountains of Oman.

According to Ghazanfar (1992a), Oman consists of four biogeographic regions. The southwest region falls within the Somalia-Masai regional centre of endemism. The central part belongs to the Saharan regional subzone, the western part to the Saharo-Arabian regional subzone and the northern part to the

Nubo-Sindian local centre of endemism. Countrywide so far a total of 1,204 species of vascular plants have been recorded; 3 species of gymnosperms, 19 species of vascular cryptogams and 1,182 species of angiosperms. Among the latter, the families Poaceae (201 spp.), Asteraceae (98 spp.), Fabaceae (81 spp.), Euphorbiaceae (39 spp.) and Scrophulariaceae (38 spp.) have the highest number of species. According to Patzelt (2007) a total of 189 range-restricted species are found in Oman. Seventy-eight species (6.5% of the total flora) are strictly endemic to the country and 48 species (4%) are near-endemics. Sixty-three species (5.3%) are regional endemic to the Arabian Peninsula. The northern mountains of Oman are classified as a local centre of plant endemism (Miller and Nyberg 1991) whereby the flora of the al-Hajar mountains and the foothills in northern Oman also has close links with the mountain flora of southwest Iran, Afghanistan and Baluchistan (south Pakistan) (Ghazanfar 1991).

According to Schwartz (1939) very important tropical genera in Arabia are *Acacia*, *Aristida*, *Barleria*, *Cadaba*, *Caralluma*, *Commiphora*, *Euphorbia*, *Grewia*, *Indigofera*, *Pulicaria*, *Solanum* and *Tephrosia*. About 15 species of the taxonomically difficult genus *Grewia* occur on the Arabian Peninsula (Miller and Morris 1988). *Grewia tenax* (Forssk.) Fiori belongs to the family Tiliaceae and this taxon with edible fruits is found in lowlands and mountains of Arabian countries such as Saudi Arabia (Collenette 1985; Chaudhary 1999), United Arab Emirates (Jongbloed et al. 2003) and Yemen (Al-Hubaishi and Müller-Hohenstein 1984). In Oman *G. tenax* was believed to be restricted to the southern region. From northern Oman only *G. erythraea* Schweinf. and *G. villosa* Willd. were recorded so far (Ghazanfar 1992b, 1997, 2003). It nevertheless seemed likely that *G. tenax* would also occur in the al-Hajar mountains, as the species has been recorded in the adjacent areas from the United Arab Emirates. To close this distributional gap, botanical field surveys were conducted at three representative locations in the al-Hajar mountains of northern Oman.

Methodology and site description

In summer 2005 and spring 2006, comprehensive botanical surveys were conducted in the northern Omani wadis Bani Awf, Khabbah and Muaydin with particular emphasis on plant species of the genera *Grewia*. Plant material was collected and verified with material in the herbarium of Sultan Qaboos University and the National Herbarium at the Oman Natural History Museum in Muscat.

The survey area is situated in the al-Hajar mountains of northern Oman. The mountain range extends some 700 km, reaching its northern end at the tip of the Musandam Peninsula, extending southward and eastward paralleling the coast to the Gulf of Oman, and finally disappearing near the coast at Ra's al-Hadd. The very rocky and stony mountain range rises to an altitude of about 3,000 m a.s.l. The mountains are formed of hard sedimentary rock with extensive areas of crystalline rock in their central part (Guba 2002). Deep and shallow gorges, which form the wadis are very characteristic. These open to broader gravelly or sandy wadis in the foothills and flow through into the coastal, or the inland plains. Due to the availability of water, the vegetation of the wadis is generally richer than that of the surrounding slopes (Miller and Cope 1996). The climate of the mountains is hot and arid to semi-arid. Rainfall patterns are erratic, but generally rain occurs between December and February and ranges from 100–340 mm (Gebauer et al. 2007a). The annual mean temperature varies between 19°C in the mountains and 30°C in the plains. Typically temperatures are highest during June and July and lowest in December and January. Local reports indicate that even frost and occasional snow are known in the highest parts of the mountain range (Mandaville 1977).

Results and discussion

During the field survey, several individual plants of *G. tenax* were identified in Wadi Bani Awf and Wadi Muaydin, being a new record to the flora of northern Oman (Fig. 1). However, in Wadi Khabbah no specimen could be identified.

According to the available literature, *G. tenax* is generally restricted to the lowlands and lower mountains up to a maximum altitude of 1,250 m a.s.l. (Collenette 1985; König 1986). In our survey, however, *G. tenax* shrubs were found growing up to an elevation of 1,850 m a.s.l. at the upper edge of Wadi Muaydin (Fig. 2). *Grewia erythraea* and *G. villosa* were also found.

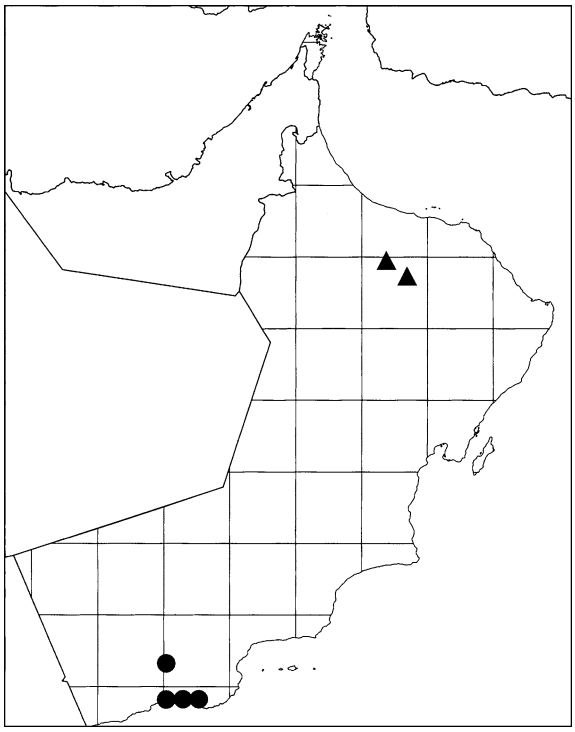

Fig. 1 Distribution map of *Grewia tenax* in Oman (altered from Ghazanfar 2003). The black triangles (▲) indicate the new records of this species

Fig. 2 *Grewia tenax* shrub growing at an elevation of 1,850 m a.s.l. at the upper edge of Wadi Muaydin, Oman

Fig. 3 Flowering branch of *Grewia tenax*

The up to 3 m high, deciduous and thornless *G. tenax* shrubs flowered in March and April and fruited in August and September. The insect pollinated white flowers (Fig. 3) appear with new developing leaves. The lifespan of a single flower is only one day. According to Ghazanfar (1992b), in the mountains of northern Oman wild perennial species generally flower in the cooler winter months from February to early June. In Wadi Muaydin people are used to eat the (1–)2–4 paired orange-coloured fruits (Fig. 4) and consider them delicious. According to Miller and Morris (1988) the fruits of *G. tenax* also were a popular food in Dhofar (southern Oman).

Within the oasis Balad Seet (23.19° N, 57.39° E, 985 m a.s.l.) located at the upper end of Wadi Bani Awf, seven shrubs were recorded along field borders and in ruderal parts of the oasis. According to Torquebiau 1992 and Kehlenbeck et al. 2007 multicropping small scale agriculture can promote a favourable microclimate and often offers a habitat to wild plants and animals. The threatened orchid *Epipactis veratrifolia* Boiss. et Hohen. ex Boiss., for example, has recently been recorded from oasis settlements in northern Oman (Gebauer et al. 2007a; Patzelt 2007). *Grewia tenax* shrubs in Balad

Fig. 4 Fruits and seeds of *Grewia tenax* collected in northern Oman

Seet were not cultivated, and the fruits known as *kalkal* (Arabic name) were not used by local people.

Only limited information is available about *G. tenax* as an edible fruit species. A recent article about *G. tenax* in Sudan (Gebauer et al. 2007b) highlights multipurpose uses and indicates the potential of the species as a fruit crop for the horticultural sector. In Sudan, the tasteful fruits are intensively collected from the wild, which leads to overexploitation of natural stands and recently to losses of genetic resources. The fruits are also considered to have medicinal value which is reflected by the high prices at local markets (Gebauer et al. 2007b). Despite this, *G. tenax* has been largely neglected with respect to both research and development.

Among the wild plants of the mountains of northern Oman, several species are of economic (Ghazanfar 1998b) and medicinal (Ghazanfar 1994) value. In addition to *G. tenax*, nine woody perennials with edible fruits were found during the botanical survey and listed in Table 1. Fruits of *Sideroxylon mascatense* (A. DC.) Penn. and *Ziziphus spina-christi* (L.) Desf. are still collected by the people and sold on local markets.

A considerably high variation in certain fruit traits such as size, shape, colour and taste, was observed among trees. The most impressive variation was obvious in *Ziziphus spina-christi*. However, no scientific information about infraspecific diversity of wild fruit trees and shrubs in northern Oman is available. Detailed studies are needed in quantifying the extent of tree-to-tree variation to select ideotypes as a worthwhile approach to the domestication and cultivation of these species.

Grewia tenax was found to be heavily grazed by the high number of free roaming domestic animals indicating its palatability. Leaves and young twigs of the species have been reported to be very palatable to goats and sheep (Miller and Morris 1988; Von Maydell 1990). Only some plants in the oasis Balad Seet and a few plants in steep cliffs were less heavily grazed. During the field survey in 2005 and 2006, intensive grazing by goats and sheep was apparent all around the survey areas. This seems to present a serious threat to plant diversity and vegetation cover within the country (Fisher et al. 1998; Patzelt 2004). Environmental pressure such as heavy grazing due to increased stocking rates has led to severe environmental degradation and in some areas to a sharp decline in populations of palatable species. This includes genetic erosion and perhaps local extinctions (Ghazanfar 1998a; Guarino 1990). Over the whole Arabian Peninsula, overgrazing is the greatest threat to plant diversity and vegetation cover (Fisher et al. 1998).

The occurrence of *G. tenax* in the al-Hajar mountains is a new record to its flora and calls for further research. However, the very scarce occurrence of *G. tenax* combined with its high palatability can lead to the local extinction of the species and to the loss of this genetic resource in northern Oman. It is therefore recommended that seeds should be collected and safeguarded in gene banks of wild plants.

The new record of *G. tenax* in northern Oman extends its known distribution and represents its easternmost occurrence. The results of the survey are therefore an important contribution for the species distribution in the forthcoming Volume of the ‘‘Flora of the Arabian Peninsula and Socotra’’.

Table 1 Wild trees and shrubs with edible fruits found during the botanical survey in northern Oman (2005/2006)

Number	Species	Family	Characteristics
1	*Grewia erythraea* Schweinf.	Tiliaceae	• deciduous thorn less shrub, up to 2 m high, fruits (1–)2–4 paired, orange, hairy and clusters 1–1.5 cm across
2	*Grewia tenax* (Forssk.) Fiori	Tiliaceae	• deciduous thorn less shrub, up to 3 m high, fruits (1–)2–4 paired, orange, glabrous and clusters 1–1.5 cm across
3	*Grewia villosa* Willd.	Tiliaceae	• deciduous thorn less shrub, up to 3 m high, fruits (1–)2–4 paired, subglobose, red to brown, tomentose and 0.5–1.5 cm in diameter
4	*Ficus palmata* Forssk.	Moraceae	• evergreen thorn less tree up to 4 m high, fruits globose or pyriform, red to violet, pubescent and 1.5–2.5 cm in diameter
5	*Ficus sycomorus* L.	Moraceae	• evergreen thorn less tree up to 15 m high, fruits globose or pyriform, yellow to red, pubescent and 2–4 cm in diameter
6	*Sageretia thea* (Osb.) M.C. Johnst.	Rhamnaceae	• evergreen thorny shrub, up to 2 m high, fruits oblong, red to purple, glabrous and 0.4–0.8 cm long
7	*Salvadora persica* L.	Salvadoraceae	• evergreen thorn less shrub, up to 3 m high, fruits globose, red glabrous and 0.4–0.6 cm in diameter
8	*Sideroxylon mascatense* (A. DC.) Penn.	Sapotaceae	• deciduous thorny shrub, up to 4 m high, fruits globose, purple-black, glabrous and 1–1.5 cm in diameter
9	*Ziziphus hajarensis* Duling, Ghaz. et Prendergast	Rhamnaceae	• deciduous thorny tree, up to 5 m high, fruits globose, orange to yellow, glabrous and 1–2 cm in diameter
10	*Ziziphus spina-christi* (L.) Desf.	Rhamnaceae	• evergreen thorny tree, up to 12 m high, fruits globose, orange to yellow, glabrous and 1–2 cm in diameter

Acknowledgements We are grateful to the curator Sadiqa Ramdan of the National Herbarium, Ministry of National Heritage and Culture, Oman, for allowing us to use the herbarium facilities. We thankfully acknowledge the help of the Extension Center Al Jabal al Akhdar of the Ministry of Agriculture and Fisheries of Oman, the infrastructural support of the College of Agriculture and Marine Sciences, Sultan Qaboos University, Muscat and the hospitality of the Omanis in the survey areas. The authors are also indebted to the Deutsche Forschungsgemeinschaft (DFG) for funding (BU1308/2-4).

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