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Source: Willdenowia, 52(1) : 75-81

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: <https://doi.org/10.3372/wi.52.52104>

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## *Chenopodium hoggarens* (Amaranthaceae), a new species from Algeria and Chad

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Version of record first published online on 14 March 2022 ahead of inclusion in April 2022 issue.

**Abstract:** *Chenopodium hoggarens* Uotila & C. Chatel., a new species of the family *Amaranthaceae* s.l. (*Chenopodiaceae* s.str.) from the Hoggar and Tibesti mountains of the Sahara, in Algeria and Chad, is described and illustrated. The species was found in quantities from the Hoggar (Ahaggar) mountains in 2019. It had been observed there earlier several times, but it was confused with *C. vulvaria* L. because of its similar smell and dense cover of vesicular hairs. However, it differs from *C. vulvaria* in growth habit, leaf shape and flower characters. Its relationships to and the identity of *C. vulvaria* var. *incisum* Maire are discussed and var. *incisum* is lectotypified. *Chenopodium hoggarens* is known only from the isolated Hoggar and Tibesti mountains.

**Keywords:** Africa, Algeria, *Amaranthaceae*, Chad, *Chenopodiaceae*, *Chenopodium*, Hoggar, new species, Sahara, taxonomy, Tibesti

**Article history:** Received 2 February 2022; peer-review completed 16 February 2022; received in revised form 21 February 2022; accepted for publication 24 February 2022.

**Citation:** Chatelain C., Uotila P., Benhouhou S., Mombrial F., Mesbah M., Baa S. & Benghanem A. N. 2022: *Chenopodium hoggarens* (Amaranthaceae), a new species from Algeria and Chad. – Willdenowia 52: 75–81. <https://doi.org/10.3372/wi.52.52104>

### Introduction

During an excursion to the Hoggar (Ahaggar) mountains in the central Sahara in October 2019, attention was paid to a small, whitish *Chenopodium* L., which grew in quantities on rocks. It had a very strong smell, as in the well-known species *C. vulvaria* L., which is widespread from Mediterranean Europe, North Africa, Turkey and Near East to Iraq, Iran and Afghanistan (Jalas & Suominen 1980; Meusel & Weinert 1992; Uotila 1997; Groom 2015; Sukhorukov & al. 2016; Lomonosova & Uotila in press). However, morphological characters of the plants match neither *C. vulvaria* nor any other species of *Chenopodium*, and it proved to be a previously undescribed species of the genus.

***Chenopodium hoggarens*** Uotila & C. Chatel., **sp. nov.** – Fig. 1, 2, 3(A–D).

Holotype: Algeria, Assekrem, pente Sud menant à l’hermitage (Hoggar) pt 7, 23°15'37"N, 05°38'02"E, 2700 m, 24 Oct 2019, Chatelain, Benhouhou, Mombrial, Mesbah, Baa & Benghanem CM874 (G [G00408262]! [Fig. 1]; isotypes: ENSA!, G [G00408265]!, H [H1777033]!).

**Diagnosis** — Small annuals, strongly smelling like rotting fish (trimethylamine) and densely covered with vesicular hairs as in *Chenopodium vulvaria* L., but differing from that species by red colour sometimes present on stem and leaves, erect stem with short branches, leaves much longer than broad and often mucronate to cuspidate at apex, inflorescence mostly leafless in upper 1/3 of stem and branches, paniculate, of mostly well-spaced, dense glomerules, perianth deeply split into lobes, lobes apically winged abaxially and truncate at apex.

**Description** — Small annuals, strongly smelling like rotting fish (trimethylamine), whitish because of dense indumentum of vesicular hairs, especially in young parts, sometimes with red colour on stems, leaf margins and perianth segments. *Stem* erect, green with red longitudinal stripes, 10–16(–18) cm tall, hard, branched in lower half; branches spreading to erectopate, straight, short, usually without secondary branches. *Leaves* erectopate to erect; petiole 3–5 mm long; blade trullate to ovate to elliptic-ovate, entire or very slightly 3-lobed, 9–11 × 6–7 mm, becoming ± glabrescent on upper surface and often red at least on margin when old, base obtuse, mar-

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Fig. 1. Holotype of *Chenopodium hoggarens* (G [G00408262]).

gin entire or with a few obscure teeth, apex acute to mucronate to cuspidate; upper leaves narrowly elliptic to lanceolate (Fig. 3A). *Inflorescence* occupying most of plant height, composed of paniculately arranged, mostly well-spaced, dense glomerules, mostly leafless in upper 1/3 of stem and branch length, in leaf axils in lower parts. *Perianth lobes* 5, basally united for 1/4–2/5 of their length,

0.7–1 mm long, densely farinose, free parts spreading in fruit, abaxially with a narrow, wing-like keel in apical part, midrib strong, visible adaxially, margin broad, membranous, minutely ciliate, apex truncate, sometimes red; receptacle cupuliform to obconic (Fig. 3B–D). *Stamens* 5; anthers 0.3–0.4 mm long. *Stigmas* 2, very short, c. 0.2 mm long. *Fruits* mostly falling without perianth;





Fig. 2. *Chenopodium hoggarens*, flowering and fruiting branches. – Algeria, rocky plateau of Assekrem, 2700 m, 24 Oct 2019, photograph by S. Benhouhou.

pericarp fairly thin, quite easily scraped off. *Seeds* lenticular with weakly acute margin, 1.2–1.3 × 1.1–1.2 mm, 0.4–0.5 mm thick, testa finely radially rugose to almost smooth.

*Distribution and habitat* — *Chenopodium hoggarens* is known from Algeria, the Hoggar mountains, and Chad, the Tibesti mountains (Fig. 4). In 2019 it grew as a very large population in the Hoggar Assekrem plateau at altitudes of 2000–2700 m; occasionally it was also seen on rocky slopes of the plateau covered by bushes of *Pentzia monodi-ana* Maire, *Crambe kralikii* Coss. subsp. *kralikii* and occasionally *Senecio hoggariensis* Batt. & Trab. Habitats were barren rocky, sandy soil (Fig. 5), practically without other vegetation except for scattered *Euphorbia dracunculoides* Lam., *Rumex vesicarius* L. and *Stipa parviflora* Desf. Earlier finds are from the same area and mostly from similar habitats and altitudes, but also from cultivated places and lower altitude (1060 m, 1928, *Maire 1062*, MPU). The

find from Tibesti, Toussidié, is from 2000 m.

*Chenopodium hoggarens* could be an endemic species for the isolated mountains of the Sahara. Maire (1933) described 58 new taxa from the Hoggar, but they did not all prove to be endemic. It is difficult to estimate the number of taxa endemic to the Hoggar even now, but it probably does not exceed 20 among the total of 350–399 species reported from the area (Lebrun 1981; Chenoune 2005; Médail & Quézel 2018: 108). Also, *C. hoggarens* is probably endemic to a wider area, at least for the Hoggar and Tibesti mountains.

*Etymology* — the specific epithet refers to the Hoggar mountains,

the core area and locality of the type collection of the species.

*Remarks* — *Chenopodium hoggarens* shares some common features with *C. vulvaria*, such as the smell of trimethylamine and dense cover of vesicular hairs. However, it differs from *C. vulvaria* in many taxonomically essential morphological features, among others in its growth habit, presence of red colour, leaf shape, inflorescence and perianth characters (Table 1; Fig. 3). The red colour detected in 2019 on the plants of *C. hoggarens* may be a stress response to the extreme circumstances in the high altitude; it was not seen in the other specimens studied. Despite its smell, *C. hoggarens* is not necessarily closely related to *C. vulvaria*, which is an isolated species and phylogenetically sister to the other species of *Chenopodium* s.str. (Fuentes-Bazan & al. 2012; Mandák & al. 2018). A similar smell has also been reported from some other, unrelated and geographically separated

Table 1. Main morphological differences between *Chenopodium hoggarens* and *C. vulvaria*.

Characters	<i>Chenopodium hoggarens</i>	<i>Chenopodium vulvaria</i>
Colour and habit	often red on stems and leaves; stem erect; branches spreading to erectopatent, straight, short	rarely reddish; stem procumbent to ascending to erect; branches procumbent to ascending, long
Middle leaves	trullate to ovate to elliptic-ovate, entire or very slightly 3-lobed, much longer than broad, margin entire to obscurely dentate, apex acute to mucronate to cuspidate	broadly trullate to rhombic-ovate, entire, slightly longer than broad, margin entire, apex obtuse to subacute, not mucronate to cuspidate
Inflorescence	mostly leafless in upper 1/3 of stem and branches, paniculate, of mostly well-spaced, dense glomerules	leafy, in apical parts of stem and branches, paniculate, of loose thyrses
Perianth	divided more than halfway, lobes apically winged abaxially, margin broad, membranous, apex truncate	divided less than halfway, lobes slightly rounded abaxially, margin narrow, membranous, apex obtuse
Seeds	1.2–1.3 × 1.1–1.2 mm	(0.9–)1–1.2 × (0.9–)1–1.2 mm

*Chenopodium* species, such as *C. hircinum* Schrad. (South America), *C. frutescens* C. A. Mey. (Siberia and Central Asia), *C. sosnowskyi* Kapeller (E Turkey, Caucasus and Iran), *C. detestans* Kirk (New Zealand) and some other taxa (see Mosyakin & Iamonico 2017; Lomonosova & Uotila in press; and references therein). However, in *C. vulvaria* and *C. hoggarens* the smell is probably stronger than in other species and, at least in *C. vulvaria*, can still be detected from herbarium specimens that are several years old. The specimens of *C. hoggarens* collected in 2019 still had a very strong smell in the autumn of 2020, but by the autumn of 2021 the smell was only weakly detected by moistening and rubbing the leaves of the specimens.

*Chenopodium hoggarens* could resemble small plants with  $\pm$  entire leaves of some members of the polymorphic species aggregate *C. album* L. (sensu lato) but differs from them in the smell (not known, or at least not evidently perceptible, in *C. album*), dense cover of vesicular hairs (usually sparser in *C. album*), leaf shape with mucronate to cuspidate apex (mostly acute in *C. album*) and perianth characters.

In the Hoggar in 1928, R. Maire collected plants that he identified as *Chenopodium vulvaria*. He also determined specimens collected by Th. Monod from the same area during “Mission Saharienne Augiéras-Draper 1927–1928” as the same species. On the basis of these specimens, Maire (1933: 80) reported *C. vulvaria* from the summit of Atakor and several other places in the Hoggar at altitudes of 1060–3000 m. He recorded it as very abundant on slopes and rocky plateaux of the high mountains in the upper and lower Mediterranean levels, from which it descended along wadis to the tropical level, particularly in cultivated places.

Maire (1933) also noted morphological differences of the Hoggar plants from the Mediterranean *Chenopodium vulvaria* and even provided a description of the former

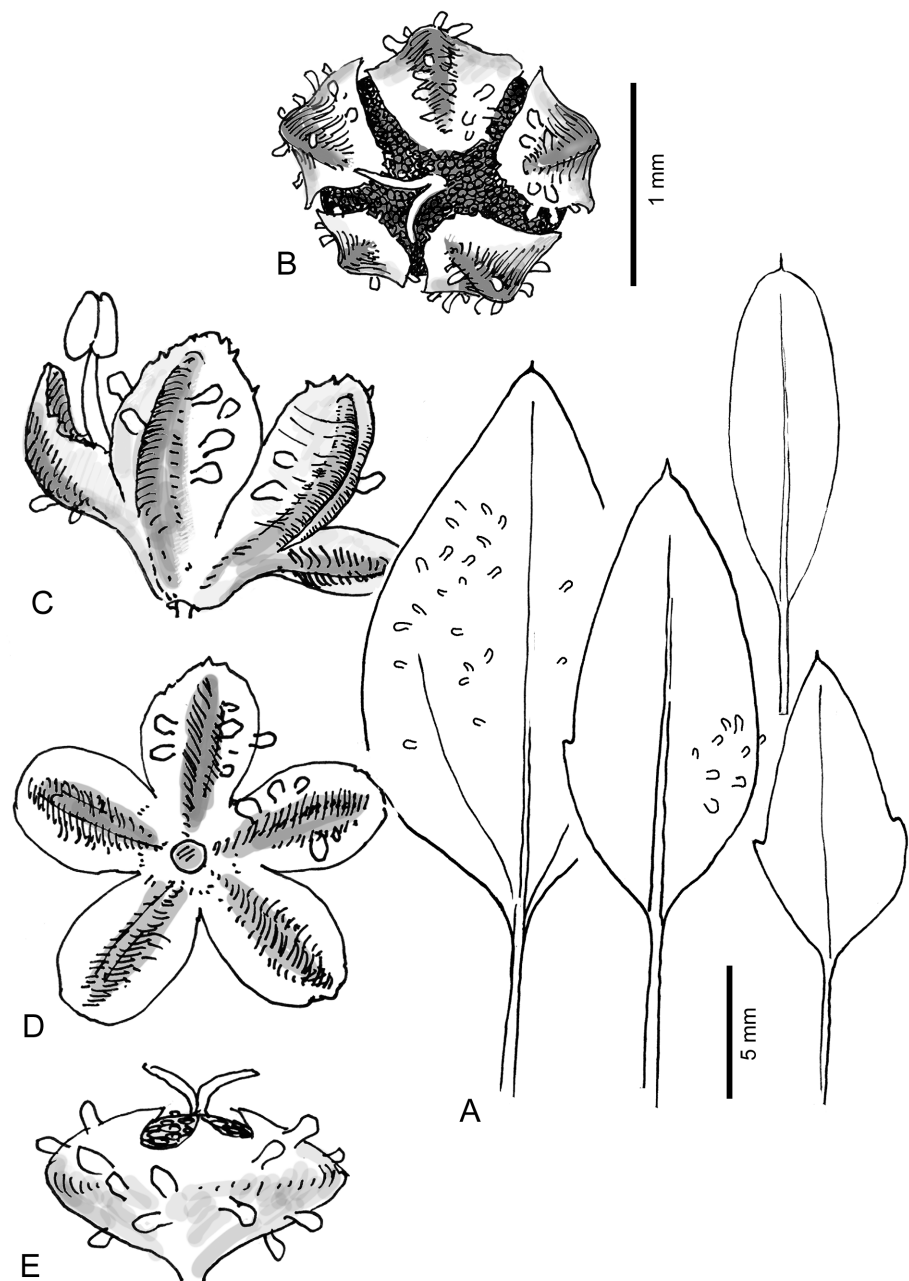


Fig. 3. A–D: *Chenopodium hoggarens*; A: leaves; B: perianth, apical view; C: perianth, lateral view; D: perianth, basal view. – E: *Chenopodium vulvaria*, young perianth, lateral view. – Scale bars: A = 5 mm; B–E = 1 mm. – Based on the holotype. – Drawings by C. Chatelain.

(“40–60 cm tall, rather short and ascending branches, elongated inflorescence, leaves often lobed, resembling *C. opulifolium* Schrad.”), but he neither named the taxon nor discussed the importance of this observation. The description “leaves often lobed” corresponds to only two of his specimens (*Maire 1067* from Hoggar and *Maire 1063* from Tefedest), but the others have typical,  $\pm$  entire leaves of *C. hoggarens*. Laperrine’s specimen (MPU276164) may indicate that also *C. opulifolium* Schrad. ex W. D. J. Koch & Ziz could have grown in the area: it was named by the collector as “Aggaouit” (the Tuareg name for *C. opulifolium*). However, Maire corrected the identification to *C. vulvaria*, with an addition “Taouit (non Aggaouit)”.



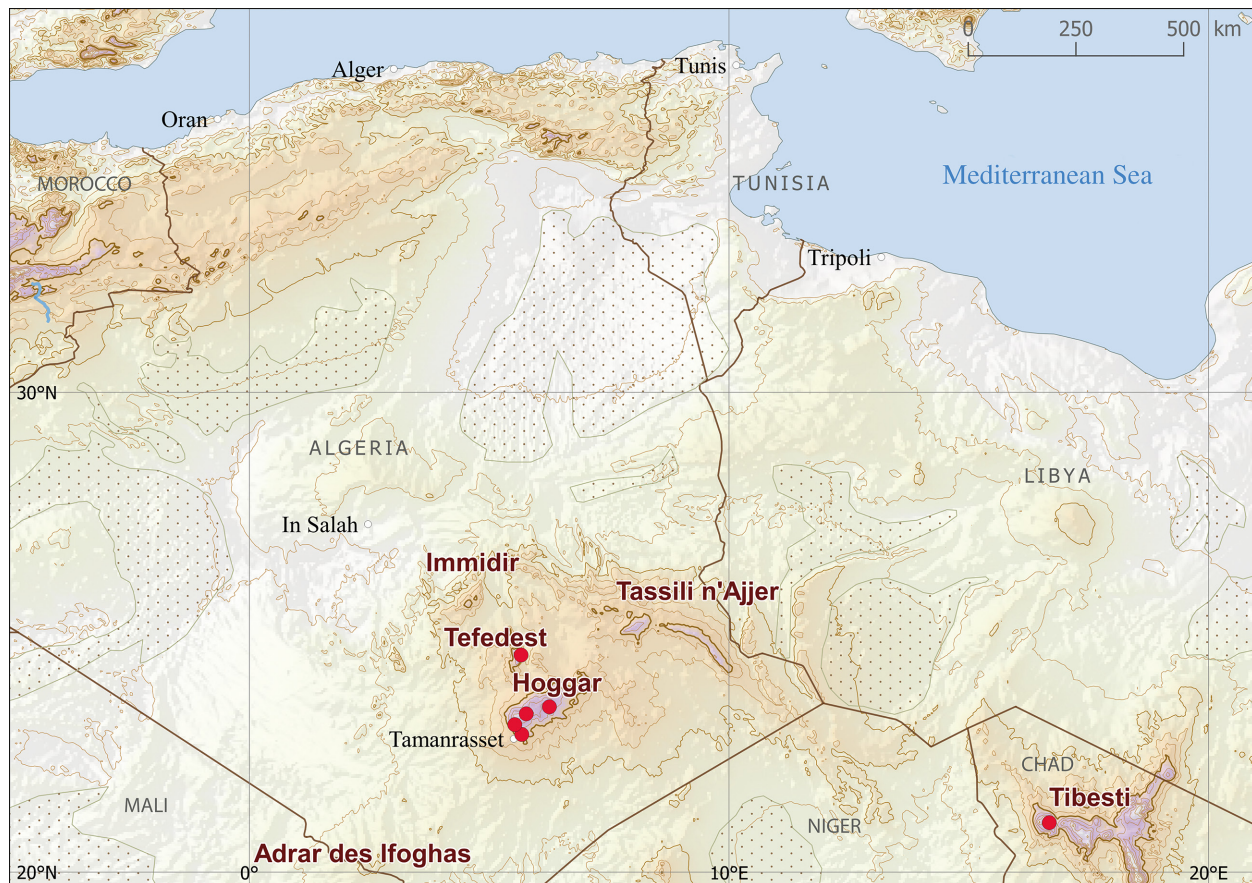


Fig. 4. Distribution map of *Chenopodium hoggarense* (red dots) in North Africa.

Ozenda (2004: 225) mentioned *Chenopodium vulvaria* as an alien plant from the central Sahara; the drawing included in his flora corresponds rather well to *C. hoggarense* by its leaf shape and deeply lobed perianth, but the habit is not so typical, possibly due to damage from grazing animals.

#### Additional specimens examined

**ALGERIA:** Wilaya de Tamanrasset: Coudia du Hoggar, 1927, *Monod* 144 (P [P04940923]), *Monod* 151 (P [P04940920]), *Monod* 153 (P [P04940921]); Hoggar, *Laperrine s.n.*, in herb. Maire (MPU [MPU276163]); Atakor-n-Ahaggar, 19 Mar 1928, *Maire* 1061 (MPU [MPU276161]); Montibus Ahaggar, im-Amgel in cultis, 1060 m, 4 Apr 1928, *Maire* 1062 (MPU [MPU276167]); Montibus Ahaggar, Issekka-ressem, in lapidosis basalticis 2070 m, 22 Mar 1928, *Maire* 1068 (P [P04940924]); Hoggar-Massif, Umgebung des guelta Afilal, 2050 m, Felsen, Sand und Sumpf, 24 Mar 1980, *Podlech* 33352 (G); Hoggar-Massif, Assekrem Südhänge, 2520 m, 25 Mar 1980, *Podlech* 33397 (G); Assekrem, Nov 1953, *Quézel s.n.* (MPU [MPU276159]); Hoggar au-dessus de 2000 m, s.d., *Lhote s.n.* (MPU [MPU276162]). — **CHAD:** Tibesti, Toussidé, 2000 m, in lapidosis basalticis, Mar 1931 *Dalloni s.n.* (P [P04940922]) [image seen]; Tibesti, 12 Nov 1940, *Monod* 7829 (IFAN [IFAN26382]) [image

seen]; both specimens from Chad represent basal parts of injured plants only.

### Identity of *Chenopodium vulvaria* var. *incisum*

*Chenopodium vulvaria* var. *incisum* Maire in Bull. Soc. Hist. Nat. Afrique N. 34: 184. 1943. – **Lectotype (designated here):** Algeria, in montibus Ahaggar Tazerouk, in alveo arenoso aminis, 1900–1950 m, 20 Mar 1928, *Maire* 1067 (P [P04940937]!), islectotype: MPU [MPU005496]!).

**Remarks** — Maire (1943) described *Chenopodium vulvaria* var. *incisum* from Hoggar and Tefedest with the description given in Maire (1933), but without the reference to *C. opulifolium*. Further, he did not mention anything of the smell, but the placement of the variety under *C. vulvaria* might at least suggest the presence of a similar smell. He also noted that this plant was mentioned unnamed in his study from the central Sahara in 1933 and that it grows also in Tibesti. He reproduced the same description and geographical information in his *Flore de l'Afrique du Nord* (Maire 1962), in which he accepted var. *incisum* as the only lower taxon of *C. vulvaria* from the central Sahara. However, neither the type material of var. *incisum* nor the specimens determined by Maire as



var. *incisum* belong to *C. vulvaria* s.lat.

The specimens collected or determined by Maire seem to represent two kinds of plants, one with almost entire leaves (typical *Chenopodium hoggarens*) and another with three-lobed leaves (typical var. *incisum*). In growth habit and type of inflorescence, var. *incisum* resembles *C. hoggarens*, which is also the case if they both have a similar smell. But the distinctly three-lobed leaves of var. *incisum* do not match the plants of *C. hoggarens* seen in 2019 or many other specimens, all with fully or almost entire leaves. However, such leaf dimorphism is not completely unknown in *Chenopodium*, e.g. seen at least in Asiatic *C. novopokrovskyanum* (Aellen) Uotila and North American *C. pratericola* Rydb.

*Chenopodium opulifolium* and *C. vulvaria* var. *incisum* resemble each other because they can both be strongly farinose and may have three-lobed leaves with acute or even mucronate apices. But the leaves of *C. opulifolium* are as broad as long, sometimes even broader, and the margins are more distinctly dentate, whereas leaves of var. *incisum* are only narrowly three-lobed, otherwise weakly dentate if at all. Furthermore, the growth habit of *C. opulifolium* is usually strongly branched, the branches long and fairly spreading, also in the inflorescence, whereas var. *incisum* has only short branches from basal parts of the stem and the branches of the inflorescence are short and erectopatent. Maire (1962) reported *C. opulifolium* only from the N part of North Africa. However, the variation in characters of *C. opulifolium* in North Africa seems to be different and wider than is typically reported from Europe. Even *C. album* occurs in North Africa. It is variable and the growth habit may resemble that of var. *incisum*. But its leaves are larger, with variable shape and dentation, but never in the combination seen in var. *incisum*.

Because there are some doubts about the identity of *Chenopodium vulvaria* var. *incisum*, its position is left open here.



Fig. 5. A: Algeria, rocky plateau of Assekrem, 2700 m, view to south, 24 Oct 2019; B: same locality, habitat of *Chenopodium hoggarens*, 24 Oct 2019. – Photographs by S. Benhouhou.

**Uses** — Gast & al. (1972) and Gast (2000) reported that *Chenopodium vulvaria* (under the name of Taouit, in Tamasheq), which grew on the slopes of the Atakor and of the Adrar des Ifoghas between 1000 and 2700 m, could be very abundant there in rainy years. Then seeds were collected in quantities by the Tuaregs of the Ahaggar and they ground flour from them to be used in pancakes or porridge-like cereal or to “bulk out” cereal dishes, e.g. mixed with wheat or millet. Gast (2000) also noted that flour/seeds lacked the smell, so unmistakably present in the leaves. Spare seeds were even sown deliberately for future crops. Seeds were also considered good against tropical fever, which is why people travelling by caravans to Sudan carried them as a medicinal plant. Obviously this plant is *C. hoggarens*, no other *Chenopodium* has been observed at this altitude in such quantities. The use and even sowing by Tuaregs may explain the occurrence

of *C. hoggarensis* in cultivated places, as reported by Maire (1933, as *C. vulvaria*), and intentional carrying by caravans might have caused spreading along their routes.

*Additional specimens examined* — Algeria, Wilaya de Tamanrasset, Hoggar (without precise locality), *Laperrine s.n.* (MPU [MPU276164]); Montis Tefedest amnem Agelil in humidis, 1200 m, 11 Apr 1928, *Maire 1063* (MPU [MPU276166] mixed with *Chenopodium murale* (L.) S. Fuentes & al.).

## Author contributions

P.U. and C.C. described the new species and carried out the herbarium research, field collections were made by C.C., F.M., M.M., S.Ba., S.Be. and A.N.B. All authors contributed to the text and approved the final version of the manuscript.

## Acknowledgements

Our warmest thanks go to Mrs. Zahra Khodja, Saharan guide at Nomadict, for her generosity, kindness and availability with regard to the administrative requirements that the excursion in 2019 entailed. Our cordial thanks also go to the institutions Ecole Nationale Supérieure Agronomique and Conservatoire et Jardin botaniques de la Ville de Genève for their logistical support, to Caroline Loup from the herbarium MPU for her help in checking collections and to Sergei Mosyakin (KW) and Alexander P. Sukhorukov (MWG) for their comments on an earlier version of this paper.

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## Willdenowia

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Online ISSN 1868-6397 · Print ISSN 0511-9618 · 2020 Journal Impact Factor 0.985

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

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