Taxonomic notes on Dysphania and Atriplex (Chenopodiaceae)

Author: Sukhorukov, Alexander P.

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ALEXANDER P. SUKHORUKOV[1]

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Abstract

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Some taxonomic amendments for the genera *Dysphania* and *Atriplex* are given. Three species of *Dysphania* are recognised in the central and eastern Himalaya and on the southern Tibetan plateau: two native species, *D. nepalensis* and *D. bhutanica,* the latter here described as new to science, and one introduced species, *D. ambroisioides,* whereas the presence of *D. botrys* and *D. schraderiana,* formerly reported from the area, is not confirmed. Features relevant for the delimitation of these taxa are discussed. The combination *D. bonariensis* is published. A new species, *Atriplex brenanii,* formerly misidentified with *A. halimus* var. *granulata,* is described from East Tropical Africa, while the occurrence of *A. halimus* in this region is not confirmed. *A. asphaltitis,* an enigmatic taxon described from the Dead Sea area, is synonymised with the Australian *A. nummularia,* which is spreading as an alien in the S Mediterranean.

Additional key words: *Dysphania bhutanica, Atriplex brenanii,* taxonomy, E Africa, E Mediterranean, Himalaya, Bhutan, China, Nepal

Introduction

The present study provides scattered taxonomic notes on the *Chenopodiaceae* genera *Dysphania* R. Br. (tribe *Dysphanieae*) and *Atriplex* L. (tribe *Atripliceae;* for the most recent tribal rearrangement of subfamily *Chenopodioideae* see Fuentes-Bazan & al. 2012b). The treatment of both genera in regional floras holds the greatest misconceptions within the entire family *Chenopodiaceae.* The present notes include (1) a revision of the genus *Dysphania* in the central and eastern Himalaya and on the southern Tibetan plateau, (2) the new combination *D. bonariensis,* (3) the description of *Atriplex brenanii* from East Tropical Africa, a new species formerly misidentified with *A. halimus* var. *granulata,* and (4) the identification of the enigmatic *A. asphaltitis* as conspecific with the Australian *A. nummularia*.

Material and methods

Field studies were carried out by the author in Sikkim (India) and many provinces of Nepal. The specimens of *Dysphania* collected from that area have been deposited mainly in the herbaria E and MW (herbarium abbreviations according to Thiers 2008+). Further material of *Dysphania* and the relevant material of *Atriplex* was revised in the herbaria B, BM, CAL, E, G, H, HUJ, K, LE, MHA, MW, KATH, TUCH and W.

Cross sections of fruits and seeds were made by hand. Fruits and seeds of *Dysphania* and *Atriplex* were studied by scanning electron microscopy (SEM). Prior to the microscopy, the material (parts of inflorescences, perianth and fruits) was dehydrated in aqueous ethyl alcohol solutions of increasing concentration, then in alcohol-acetone solutions and finally in pure acetone. SEM observations

1 Dr Alexander P. Sukhorukov, Dept. Higher Plants, Biological Faculty, Moscow, Lomonosov State University, 119234 Vorobyovy Gory, Moscow Russia, e-mail: suchor@mail.ru; ryba4@yandex.ru.

were made with a JSM-6380 (JEOL Ltd., Japan) at 15 kV after critical point drying and sputtercoating with gold-palladium. A list of the specimens included in the carpological analysis and SEM investigations is given in the Appendix.

Results and Discussion

1. *Dysphania* in the central and eastern Himalaya and on the southern Tibetan plateau

Dysphania, formerly for the major part included in *Chenopodium,* comprises in its recent circumscription c. 40 species in Australia, Eurasia and America (Mosyakin & Clemants 2002, 2008; Kadereit & al. 2003, 2010; Fuentes-Bazan & al. 2012a, b). In the central and eastern Himalaya and on the southern Tibetan plateau, including Nepal, Bhutan, Sikkim state of India and parts of the Chinese provinces Sichuan, Xizang and Yunnan, only a few members of the genus have been reported, but they were often misunderstood or misidentified. An overview of the current distribution and taxonomy of *Dysphania* in this region is given in Table 1. *D. aristata* (L.) Mosyakin & Clemants is excluded, because according to the molecular results (Kadereit & al. 2003; Fuentes-Bazan & al. 2012a) it belongs to the genus *Teloxys* (*T. aristata* (L.) Moq.).

Dysphania nepalensis

Dysphania botrys (L.) Mosyakin & Clemants and *D. nepalensis* (Colla) Mosyakin & Clemants show close morphological affinity, but they are separated by the pubescence of stem and perianth and the prominence of the midrib keel of the perianth segments (Uotila 1997, 2001, under *Chenopodium*), as well as by the length of the blades of the middle leaves (Yonekura 2008). However, analysis of numerous specimens shows that features such as leaf length or the presence of a perianth keel do not reliably separate them. *D. nepalensis,* e.g., is often characterised by a "weak keel" near the top of the perianth segments. The perianth indumentum, however, is diagnostically valuable: in *D. nepalensis* it is of simple hairs and small subsessile glandular hairs with spherical terminal cells visually resembling sessile glands (Fig. 1A). The perianth of *D. botrys,* in contrast, bears two forms of stalked (glandular) hairs, such with rook-shaped terminal cells (Fig. 1B) and such with spherical terminal cells; besides it has few simple hairs (Fig. 1B). An additional important difference between *D. botrys* and *D. nepalensis* is that fresh plants of the latter have a stronger scent than plants of *D. botrys* (pers. obs., see also Moquin-Tandon 1849, sub *Chenopodium multiflorum*). The distribution ranges of both species overlap only in the Pamir Mts

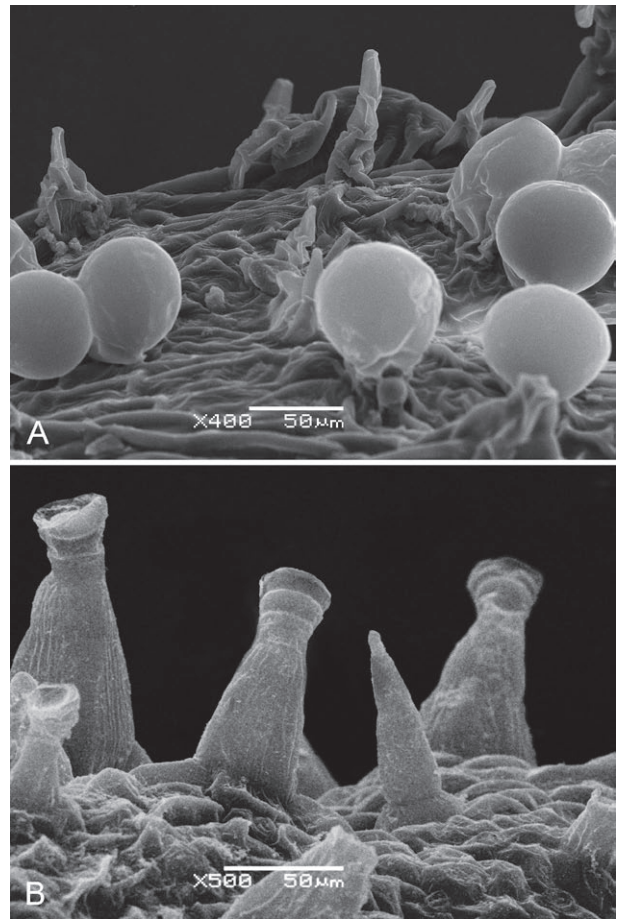

Fig. 1. Indumentum on the perianth segments in *Dysphania* – A: *D. nepalensis,* from *A. Sukhorukov s.n.,* MW; B: *D. botrys,* from *S. E. Kucherovskaya s.n.,* MW.

Table 1. Presence of the species of *Dysphania* (as *Chenopodium*) in the central and eastern Himalaya and on the southern Tibetan plateau according to the most important recent floras.

Species	China: Sichuan, Yunnan and Xizang provinces (Zhu & al. 2003)	Nepal (Press & al. 2003)	Bhutan and Indian state of Sikkim (Long 1984)
D. nepalensis	status and distribution unclear, included in *D. schraderiana*	not mentioned	not mentioned
D. botrys	absent	present	present
D. schraderiana	present	not mentioned	not mentioned
D. ambrosioides	present (Yunnan)	present	present

(incl. Hindu Kush), Karakoram and the NW Himalayas from N Pakistan (Uotila 2001) to Himachal Pradesh, Lahul. In contrast to *D. nepalensis,* which is widespread in the monsoon areas of the Himalayas and Tibet, *D. botrys* clearly prefers the (semi)arid regions of Eurasia including Central Asia, Caucasus, Asia Minor, Arabia and S Europe, whereas it seems to be absent from the flora of the central and eastern Himalayas and southern Tibet.

In agreement with Yonekura (2008), also all existing records of *Dysphania schraderiana* (Schult.) Mosyakin & Clemants from the above-mentioned area should be referred to *D. nepalensis*. *D. schraderiana* is native to E Africa and the Arabian Peninsula, and reported also from N Pakistan (Uotila 1997, under *Chenopodium*). *D. schraderiana* is easy to recognise by its cristate perianth lobes without long-stalked glandular hairs.

The taxonomy and selected records of *Dysphania nepalensis* from the territory investigated are listed below.

Dysphania nepalensis (Colla) Mosyakin & Clemants in J. Bot. Res. Inst. Texas 2(1): 428. 2008 ≡ *Chenopodium nepalense* Colla, Herb. Pedemont. 5: 25. 1836. – Holotype: [Nepal], ex. Herb. Berol[inense] (TO 5972 [photo]!) – Fig. 2.

= *Chenopodium multiflorum* Moq. in Candolle, Prodr. 13(2): 75. 1849. – Lectotype (designated here): [India, Uttarakhand state], Ind. Orient., Garhwal, 4.1845, *T. Thomson 1324* (K!; isolectotype: BM 00629118!).

– *Chenopodium botrys* sensu auct. fl. himal., p.p.

– *Dysphania schraderiana* sensu Zhu & al. (2003)

The specimens named as *Chenopodium multiflorum* differ only in a throughout leafy inflorescence. During my expedition 2010 in W Nepal, both forms with leafy and leafless inflorescences were found growing together, e.g., in the surroundings of Jumla village. The latter form was rather infrequent.

Specimens investigated — China: Xizang prov.: Kham, Basin of Golubaya [Yangtze] river, Nru-Chu natural boundary, gravelly substrate, 25.7.1900, *V. Ladygin s.n.* (MW); Gyangtse, 7.–9.1904, *H. J. Walton s.n.* (CAL); vicinity of Lhasa, 7.1939, *H. E. Richardson 308* (BM). — Sichuan prov.: Kangding county, 2200 m, 4.8.1981, *Z. Zhao 115341* (K); Muli, Guhtzun, 3100 m, 4.7.1937, *T. T. Yъ 14827* (BM). — Yunnan prov.: Dechin prefecture, W of Dechin near Marbating, 28°33'3"N, 98°47'4"E, 2230 m, 16.9.1995, *D. Chamberlain & al. 275* (H 1684317); NE of Zhongdian (Chungtien), Nada village, near hot springs, 3360 m, 27.9.1990, *without collector 324* (K).
Nepal [selected specimens]: [Seti zone, Bajura distr.], Kolti [vill.], 5000 ft, 9.1963, *S. B. Raj Bhandary 1222* (CAL); [Mugu prov., surroundings of Rara Lake], Gum Garhi, 2400 m, 5.7.1977, *B. Shrestha & N. P. Nanandhar 241* (E 00214393); Mustang prov., Annapurna Conservation area, trekking route Jomosom–Nayapul, valley of Kali Gandaki river, 2500 m, in the private kitchen garden, 25.9.2008, *A. Sukhorukov 219* (MW); [Jumla prov.] Jumla village, 29°17'N 82°05'E, 2400 m, roadside, common, 3.10.2010, *A. Sukhorukov 464* (MW, W 2011-0006543).
Bhutan: [Thimphu & Paro districts], Thimphu & Paro rivers, 2400 m, 14.8.1963, *N. P. Balakrishnan 1195* (CAL); [Haa distr.], Ha, 2797 m, 18.6.1971, *R. Bedi 162* (K); Upper Mo Chu distr., Gangyvel Chu below Gangyvel, grassy hillside, c. 3820 m, 27.9.1984, *I. W. J. Sinclair & D. G. Long 5364* (E 00151629); Bumthang distr., Bumthang, 2600 m, 6.6.1992, *C. Parker 7176* (E 00051985); Ohra, 11000 ft, 28.8.1915, *R. E. Cooper 4733* (E 00151614).

General distribution — Pamir (Uotila 1997), Hindu Kush and the Himalayas (Afghanistan, Pakistan, India, Nepal, Bhutan), southern part of the Tibetan plateau (Xizang, Yunnan and Sichuan provinces of China). Occurring on hill slopes and disturbed grounds at altitudes from 1700 to 4000 m. It is a common weed in some areas of Mustang and Jumla provinces of Nepal.

Dysphania bhutanica Sukhor., **sp. nov.**
Holotype: Bhutan, Thimphu distr., Lango, near Paro, frequent weed in apple and other crops; to 30 cm [tall], leaves glabrous, not glandular, less bad smelling than *C. nepalense*, 2300 m, 29.6.1992, *C. Parker 7263* (E 00051983).
– *Dysphania botrys* sensu auct. fl. himal. ≡ *Chenopodium botrys* sensu auct. fl. himal.

Ic. — Fig. 3; Parker (1992: sub *Chenopodium botrys*).

Annual to 20–100 cm tall. *Stem* covered with simple hairs and subsessile intermixed orange and yellow-orange glands. *Leaves* pinnatisect, 2–2.5 × 6–9 cm, long-petiolate, their segments oblong or lanceolate, sinuous to lobed. *Inflorescence* to 20 cm long, leafy at least in its basal and medium parts. *Perianth segments* almost free, oblong, 0.6–0.7 × 0.35 mm, horizontally spreading at fruiting stage, dorsally with simple conical hairs and orange subsessile glands. *Fruit* subglobose, 0.6–0.7 × 0.5 mm in diameter, with small keel. *Pericarp* entirely papillate. *Seeds* blackish. Flowering June to July; fruiting July to October.

Other specimens seen — Bhutan: Thimphu distr.: Thimphu, 8000 ft, 9.8.1914, *R. E. Cooper 3376* (E 00151685); Thimphu, 2408 m, 10.8.1971, *R. Bedi 657* (CAL, K); Thimphu Chu, below Taba, 27°30'N, 89°38'E, c. 2300 m, 22.7.1979, *A. J. C. Grierson & D. G. Long 2828* (E 00151632, K); Chapcha, 2200–2400 m, 1.7.1992, *C. Parker 7270 & 7271* (E 00051982, E 00051981).
China: Xizang: Gyangtse, 7.–9.1904, *H. J. Walton s.n.* (CAL); Tsangpo valley, 10–11000 ft, 5.9.1935, *F. Kingdon-Ward 12308a* (BM); Tsangpo valley, Tse, 9800 ft, weed of cultivation, 31.5.1938, *F. Ludlow & al. 4585* (BM).

General distribution — E Himalayas. The species occurs on hill slopes or disturbed areas at 2000–3500 m.

Fig. 2. Holotype specimen of *Chenopodium nepalense* (≡ *Dysphania nepalensis*) at TO.

Fig. 3. Holotype specimen of *Dysphania bhutanica* at E.

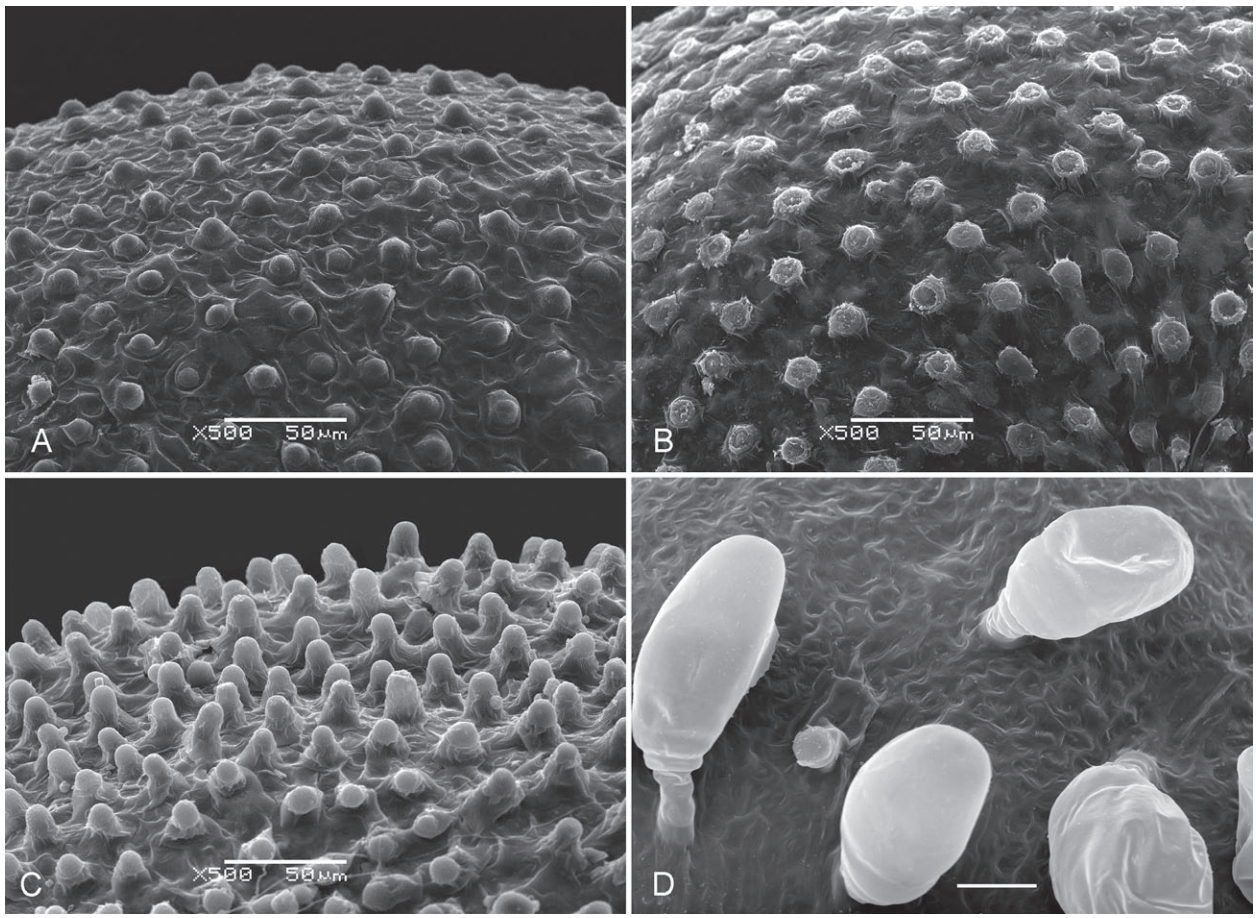

Fig. 4. Papillae (A–C) and glandular hairs (D) on the pericarp surface of *Dysphania* – A: *D. bhutanica,* from *C. Parker 7263,* E; B: *D. botrys,* from *S. E. Kucherovskaya s.n.,* MW; C: *D. nepalensis,* from *A. Sukhorukov s.n.,* MW; D: *D. ambrosioides*, from *A. Sukhorukov s.n.,* MW, scale bar = 30 µm.

Delimitation — Dysphania bhutanica is morphologically close to but clearly distinguished from *D. nepalensis* by its longer and pinnatisect (not lobate or pinnatifid) lower and middle leaves with narrower segments and the orange or yellow-orange (not pure yellow) subsessile glandular hairs. The gland shape resembles that in *D. nepalensis* but the colour is different. Orange or red subsessile glands seem to be rare in *Dysphania.* Investigation of the fruit and seed anatomy (Sukhorukov & al., in prep.) did not reveal differences between *D. bhutanica, D. botrys* and *D. nepalensis* in thickness or number of pericarp layers and seed coat, but there is a difference in the shape of the papillae on the pericarp surface, *D. nepalensis* having longer papillae than the other two species (Fig. 4A–C).

Dysphania ambrosioides

Dysphania ambrosioides (L.) Mosyakin & Clemants is a North American species, which is widely introduced in tropical and subtropical areas. It is distributed throughout the area considered here, although reported in China only from Yunnan (Table 1), according to specimens seen by the author from Xizang and Sichuan (K, BM). At least in central and eastern Nepal and Sikkim, especially in the lowland plains (the so-called Terai region), it is quite common in ruderal habitats and disturbed river bed sites. It often grows together with other American aliens such as *Bidens pilosa* L., *Parthenium hysterophorus* L., *Galinsoga parviflora* Cav., *G. ciliata* S. F Blake, *Ageratum conyzoides* L., *Conyza* sp., *Solanum viarum* Dunal, etc. The upper altitudinal limit of *D. ambrosioides* seems to be at about 1700 m.

Dysphania ambrosioides differs from the native species by having entire or sinuate-dentate leaves, spike-like inflorescences, perianth segments fused for half of their length and closed in fruit, larger fruits (0.8–1 mm in diameter) and a pericarp with stalked (100–130 µm) glandular hairs (Fig 4D) in its upper part. The native species have lobed, pinnatifid or pinnatisect leaves, thyrsoid, branched inflorescences, basally fused perianth segments spread in fruit, fruits of 0.6–0.8 mm in diameter and a pericarp entirely covered with tiny conical papillae up to 25 µm long (Fig. 4A–C). *D. ambrosioides* is usually a short-lived perennial, whereas the native species are annuals. The closely related *D. anthelmintica* (L.) Mosyakin & Clemants has not yet been found in the area investigated but is widespread in the (sub)tropics. For its differences from *D. ambrosioides* see Iamonico (2011).

2. The new combination *Dysphania bonariensis*

By an oversight, the publication date was omitted by Mosyakin & Clemants (2008) in the basionym citation for their new combination *Dysphania bonariensis*. This omission is corrected here in accordance with Art. 46.4 of the Code (McNeill & al. 2006): *Dysphania bonariensis* (Hook. f.) Mosyakin & Clemants ex Sukhor., **comb. nov.** ≡ *Roubieva bonariensis* Hook. f. in Bentham & Hooker, Gen. Pl. 3: 52. 1880.

3. A new species from Tropical East Africa previously misidentified as *Atriplex halimus*

Atriplex halimus L. is a shrubby species with farinose indumentum and a typical member of the Mediterranean vegetation (Browicz 1991). It colonises river beds, shorelines and brackish ruderal habitats; it is also sometimes used for landscaping purposes (pers. obs. in Israel). The species is quite heteromorphic in its phenotypical and biochemical characteristics as well as in its ploidy level (e.g. Pau 1903; Andueza & al. 2005; Ouarda & al. 2006; Kheria & al. 2007; Lomonosova & al. 2010). Three taxonomic units of *A. halimus* are recognised: (1) the nominal variety from S Europe. (2) *A. halimus* var. *schweinfurthii* Boiss. (Boissier 1879 as β *schweinfurthii*) from the E Mediterranean region and N Africa. These two varieties are geographically distinct from each other (Ortíz-Dorda & al. 2005; Walker & al. 2005). (3) A third variety, *A. halimus* var. *granulata* L. Chevall., was described from the surroundings of Biskra (N Algeria). According to the protologue (Chevallier 1905), it is distinguished by "bracteis ovato-reniformibus denticulatis, disco tuberculatis; foliis glauco-argenteis" [bracts ovate or reniform, toothed; its back with outgrowths; leaves silvery glaucous]. Flores Olvera & al. (2011) state that "bracts" or "bracteoles" subtending each female flower, are actually two accrescent lobes of tepals (perianth). Due to the similarity of this structure with the foliar structure enveloping the fruit, the term "bract-like cover" with two accrescent tepals is used here. The type material of var. *granulata* located at G(!), as well as one sheet at K (!, probably originating from Chevallier's collection but with printed label) match with *A. halimus* s.str. in all features, except for the tuberculate back of the bract-like cover, which in *A. halimus* is an unique feature of this variety. The identity of this N African variety requires further investigations.

Brenan (1954) recorded *Atriplex halimus* var. *granulata* from East Tropical Africa. However, morphological differences of the E African populations from *A. halimus* s.str. are much greater than previously considered (Table 2). Moreover, the East Tropical African populations are disjunct from all varieties of *A. halimus,* which does not exceed Egypt southwards (Friis & Gilbert 1993, 2000). The E African populations are recognised here at species level and described as the new species *A. brenanii.*

Atriplex brenanii Sukhor., **sp. nov.**
Holotype: [Tanzania, Mara region], Flora of Musoma distr., Naabi Hill, entrance to the Serengeti, c. 5700 ft, 11.4. 1961, *P. J. Greenway & M. Turner 10020* (K) – Fig. 5.
– *Atriplex halimus* var. *granulata* sensu Brenan, non L. Chevall.

Subshrub up to 1 m, branching at base with procumbent or ascending stems. *Leaves* semisucculent, short-petiolate; blade oblong or narrowly ovoid, 2.5–6 × 0.8–1.7 cm, entire, with slightly undulate or sinuate margins, sometimes with two small lobes, mostly rounded at the apex, greyish green on both sides, with Kranz anatomy. *Inflorescence* in the basal and median parts leafy and composed of female flowers aggregated in small clusters, in the apical part leafless and with intermixed male and female flowers. *Bract-like covers* at fruiting stage connate halfway, segments isodiametric and 5–10 mm, or broadly rhombic and shorter than wide, 5–7 × 8–10 mm, sclerified almost of their whole length and especially hardened and spongy in the basal part, back smooth or tuberculate, margins den-

Table 2. Differences between *Atriplex halimus* and *A. brenanii.*

Characters	***A. halimus,* incl. var. *halimus*, var. *granulata* and var. *schweinfurthii***	***A. brenanii***
Life form	shrub up to 3 m with straight stems	subshrub up to 1 m with ascending or procumbent stems
Leaves	rhombic, entire	ovate or oblong, toothed
Inflorescence	leafless	at least partially leafy
Bract-like cover	round, not spongy (Fig. 6A, B), segments basally fused	broadly rhombic or rhombic, basally spongy (Fig. 7), segments fused for about half of their length
Pericarp surface	without mamillae in upper part of the fruit, but sometimes with scattered hairs (Fig. 8A, B)	mamillate in upper part of the fruit, but without hairs (Fig. 8C)
Seed diameter [mm]	1.5–1.7	1.6–2.2

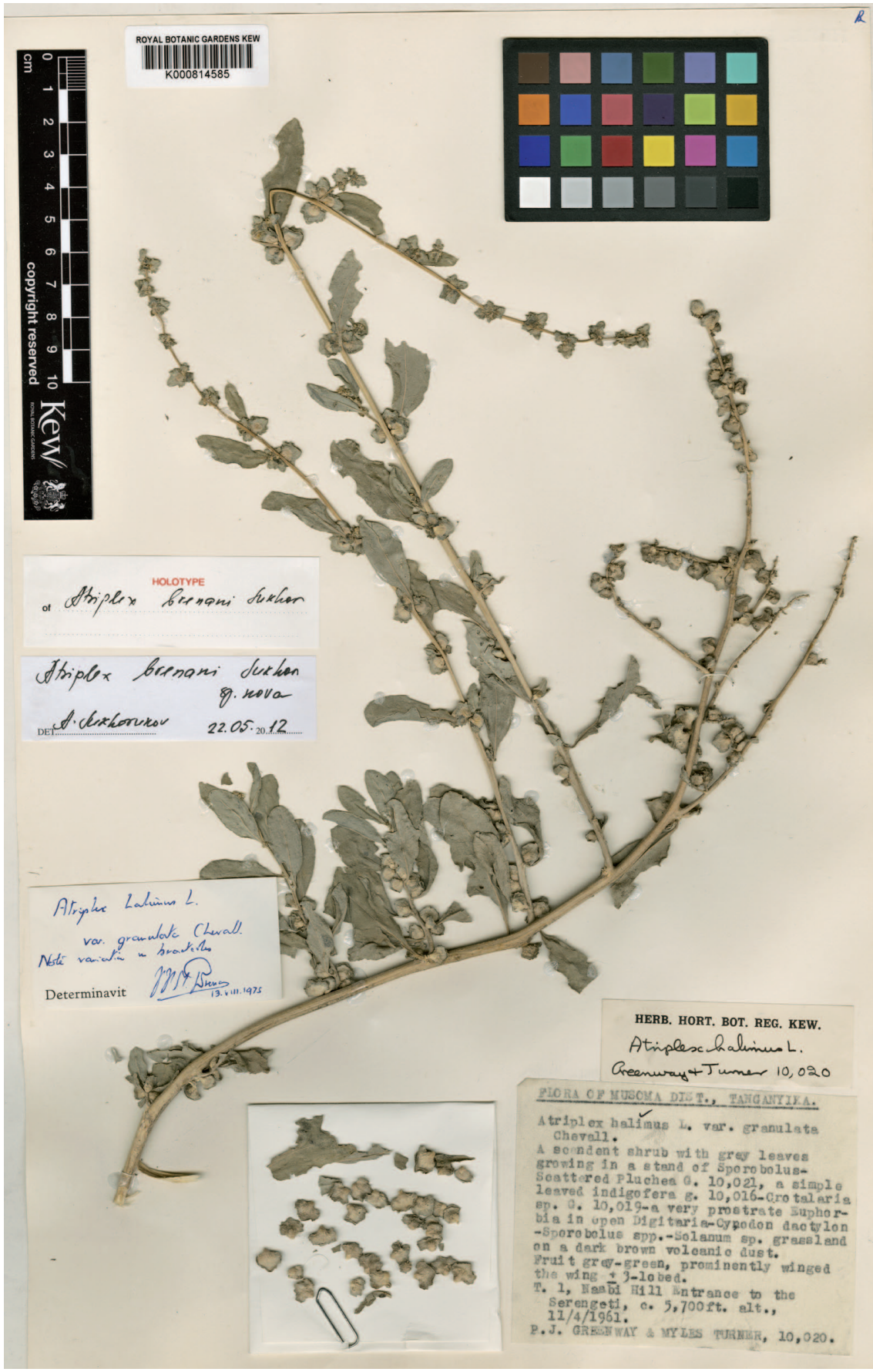

Fig. 5. Holotype specimen of *Atriplex brenanii* at K.

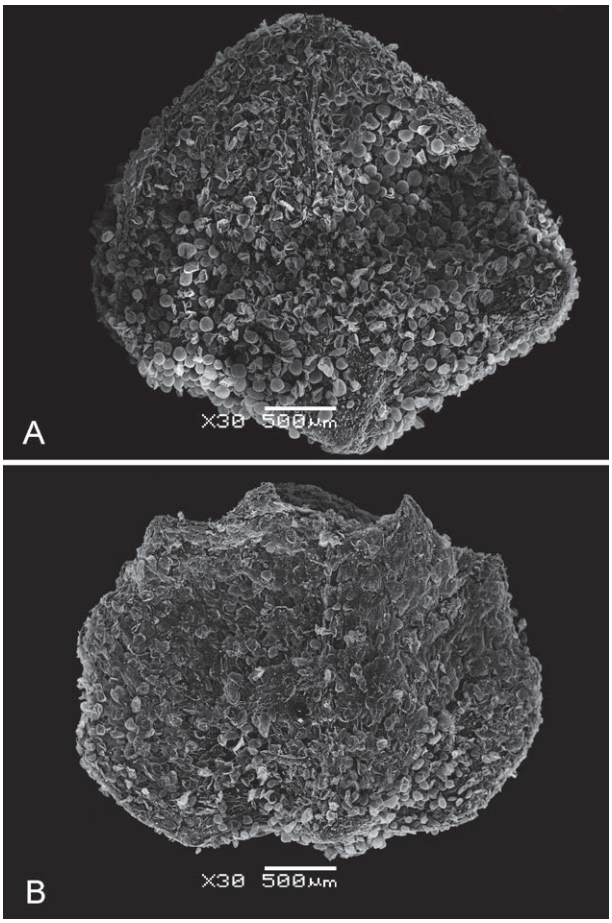

Fig. 6. Shape variation of the bract-like covers in a single individual of *Atriplex halimus* var. *schweinfurthii,* from *Khaittab s.n.,* K – A: bract-like cover with entire margin; B: bract-like cover with dentate margin.

tate or lobate. *Fruit* not fused with the covers, 2–2.2 mm in diameter; pericarp scraped off the seed coat, hyaline, reticulate, mamillate in the upper part. *Seed* reddish.

Eponymy. — The new species is dedicated to Dr J. P. M. Brenan (1917–1985, director of the Royal Botanic Gardens, Kew), an expert in the eastern African *Chenopodiaceae*.

Additional specimens seen. — Tanzania: [Manyara region, Mbulu distr.], Mbugwe, 3000 ft, 18.6.1941, *Mr & Mrs Hornby 2137* (K); [Mara region], Musoma distr., near Engari Nanyuki, N Serengeti, 20.11.1956, *P. J. Greenway 9041* (B 100448367, K); Masai distr., Soitayai, 6200 ft, 29.11.1956, *P. J. Greenway 9084* (B 100448368, K); [Manyara region], Mbulu distr., 19.1.1959, *H. S. Mahinda 448* (K); [Arusha region, Ngorongoro distr.], Serengeti, Kakessio, 5000 ft, 2.8.1962, *J. B. Newbould & E. W. Russell 6258* (K); [Arusha region, Ngorongoro distr.], E Serengeti, Ang'ata Kiti, 5600 ft, 11.1962, *J. Oteke 237* (K); [Arusha, Ngorongoro distr.], Masek, near head of Olduvai gorge, 5500 ft, 22.12.1962, *J. B. Newbould 6418* (K).
Kenya: [Rift Valley prov.], Kajiado distr., Amboseli Game Reserve, 40 km NE of Amboseli lodge, 1500 m, 17.1.1978, *F. Msafiri 80* (K).

Fig. 7. Shape of the bract-like cover of *Atriplex brenanii*. – Scale bar = 1 mm; drawn by E. Makarov from the loose diaspore of the type specimen.

Distribution and ecology. — *Atriplex brenanii* is known from Tanzania and Kenya, but its occurrence is expected also in the neighbouring countries, e.g. Burundi and Uganda. It grows in river beds, salty grasslands and margins of salty lakes at altitudes of 1000–2000 m. The collectors of the holotype stated on the label "Ascendent shrub with grey leaves growing in a stand of *Sporobolus,* scattered *Pluchea* [...], a simple leaved *Indigofera* [...], *Crotalaria* sp. [...], a very prostrate *Euphorbia* in open *Digitaria-Cynodon dactylon-Sporobolus* spp.*-Solanum* sp. grassland on a dark brown volcanic dust". Greenway (in sched. *9084*) also indicates some ecological characteristics of the taxon: "Very local on the banks of a dried up stream in a brown calcareous clay overlying granite in open *Acacia xanthophloea, A. drepanolobium* fringe with *Commiphora* in *Digitaria-Cynodon dactylon-C. plectostachyus* grassland on a grey volcanic ash".

Affinity. — *Atriplex brenanii* is morphologically related to *A. amboensis* Schinz described from N Namibia and also encountered in Zambia according to material seen by the author at K. In contrast to the new species, *A. amboensis* seems to be an annual or short-lived perennial subshrub up to 50 cm tall (Schinz 1890) without procumbent or ascending stems and its bract-like covers have large (to 2 mm) dorsal finger-like outgrowths (Aellen 1940, 1967). Its pericarp is mamillate in the upper part of the fruit (Fig. 8D) similar as in *A. brenanii.*

4. The identity of the enigmatic *Atriplex asphaltitis*

Atriplex asphaltitis Kasapligil (1966) was described from the surroundings of Jericho city, Palestine/Israel, as possibly related to *A. griffithii* Moq. The name has never been used in the literature and own investigations reveal that the species matches in all characters the Australian *A. nummularia* Lindl., which is a spreading alien in the

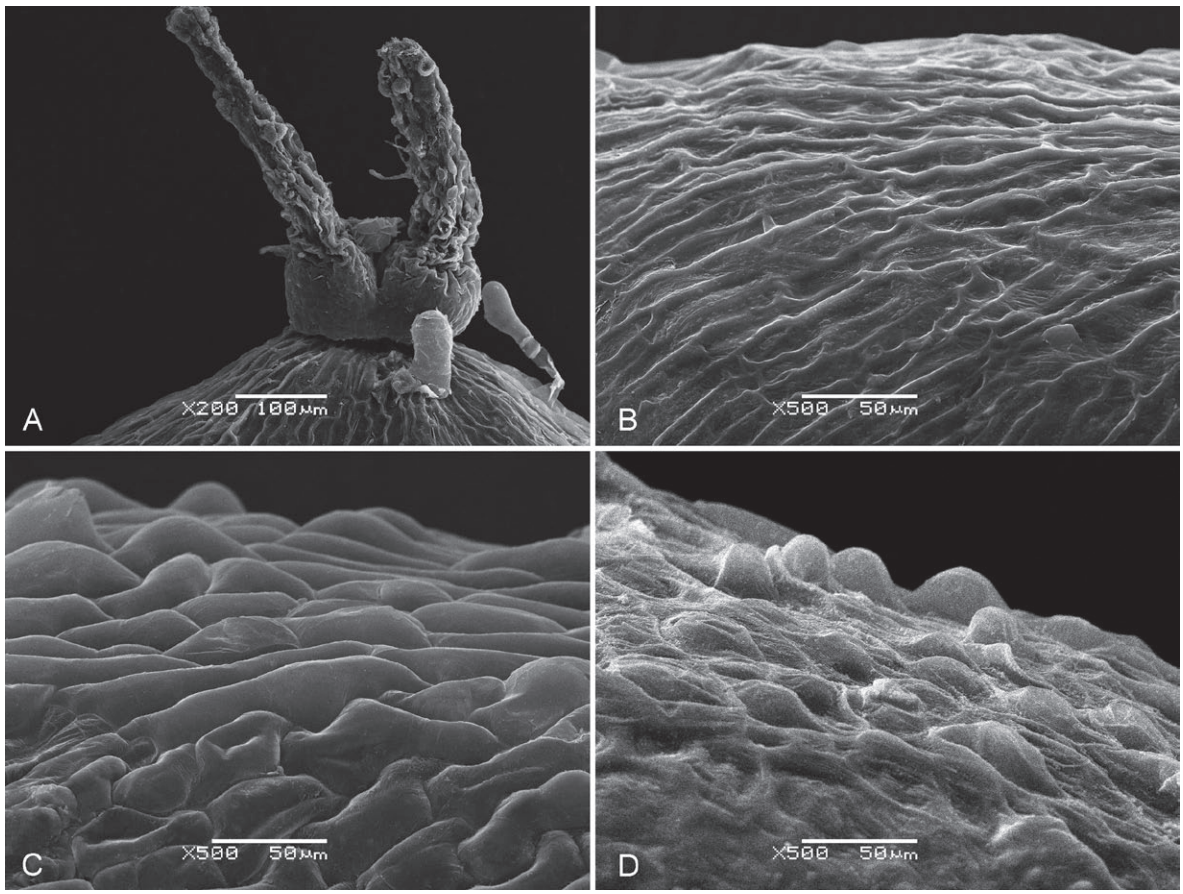

Fig. 8. Details of the pericarp surface of *Atriplex* – A: top of the fruit of *A. halimus* (var. *schweinfurthii*), with two free stylodia and scattered simple hairs, from *Khaittab s.n.,* K; B–D: close ups of the pericarp surface in the upper fruit part of *A. halimus* var. *schweinfurthii* (B), from *Khaittab s.n.,* K; *A. brenanii* (C), from *J. Oteke 237,* K and *A. amboensis* (D), from *H. Schinz,* K.

desert vegetation in some parts of the E Mediterranean and N Africa (Greuter & al. 1984; Danin 2000; Sukhorukov, pers. obs. in Egypt). In this region, *A. nummularia* in its vegetative stage can be easily confused with the native *A. halimus*. Both species have ovoid or rhombic leaves and a dense whitish indumentum consisting of persistent bladder hairs. At anthesis, *A. nummularia* differs from *A. halimus* by its dioecy and bracteose inflorescences. Due to identity in all traits, *A. asphaltitis* is here sunk in the synonymy of *A. nummularia*.

Atriplex nummularia Lindl. in Mitchell, J. Exped. Trop. Australia: 64. 1848. – Holotype: Australia, Subtropical New Holland, 1846, *T. L. Mitchell 19* (MEL 607106 [photo!]).

= *Atriplex asphaltitis* Kasapligil in J. Arnold Arbor. 47: 160, 1966, **syn. nov.** – Holotype: [Israel], Kale, south of Jericho and at the north end of the Dead Sea, on dry calcareous salines, c. 390 m below the sea level, 8.12.1954, *B. Kasapligil 1656* (UC 1083535 [photo!]).

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References

Aellen P. 1940: *Atriplex* und *Blackiella* in Südafrika. – Bot. Jahrb. Syst. **70:** 383–401.

Aellen P. 1967: *Chenopodiaceae*. – Pp. 1–22 in Merxmüller H. (ed.), Prodromus einer Flora von Südwestafrika. *Tetragoniaceae-Chenopodiaceae*. – München: Cramer.

Andueza D., Muñoz F., Delgado I. & Correal E. 2005: Intraspecific variation in *Atriplex halimus:* chemical composition of edible biomass. – Options Médit., ser. A, **67:** 377–381.

Boissier E. 1879: Flora orientalis **4.** – Geneve & Basileae: H. Georg.

Brenan J. P. M. 1954: *Chenopodiaceae*. – Pp. 1–25 in:

Turrill W. B. & Milne-Redhead E. (ed.), Flora of Tropical East Africa. – London: Crown Agents.

Browicz K. 1991: Chorology of trees and shrubs in South-West Asia and adjacent regions **8.** – Warszawa & Poznan: Polish Science Publishers.

Chevallier L. 1905: Troisième note sur la flore du Sahara. – Bull. Herb. Boissier, ser. 2, **5:** 440–444.

Danin A. 2000: The nomenclature news of Flora Palaestina. – Fl. Medit. **10:** 109–172.

Flores Olvera H., Vrijdaghs A., Ochoterena H. & Smets E. 2011: The need to re-investigate the nature of homoplastic characters: an ontogenetic case study of the 'bracteoles' of *Atripliceae (Chenopodiaceae)*. – Ann. Bot. **108:** 847–865.

Friis I. & Gilbert M. G. 1993: *Chenopodiaceae*. – Pp. 127–140 in: Thulin M. (ed.), Flora of Somalia **1.** – Kew: Royal Botanic Gardens.

Friis I. & Gilbert M. G. 2000: *Chenopodiaceae*. – Pp. 277–298 in: Edwards S., Tadesse M., Demissen S. & Hedberg I. (ed.), Flora of Ethiopia & Eritrea **2(1).** – Addis Ababa: University of Addis Ababa & Uppsala: University of Uppsala.

Fuentes-Bazan S., Mansion G. & Borsch T. 2012a: Towards a species level tree of the globally diverse genus *Chenopodium (Chenopodiaceae)*. – Molec. Phylogen. Evol. **62:** 359–374.

Fuentes-Bazan S., Uotila P. & Borsch T. 2012b: A novel phylogeny-based generic classification for *Chenopodium* sensu lato, and a tribal rearrangement of *Chenopodioideae (Chenopodiaceae)*. – Willdenowia **42:** 5–24.

Greuter W., Burdet H.-M. & Long G. 1984: Med-Checklist **1.** – Genève: Conservatoire et Jardin botanique & Berlin: Botanischer Garten und Botanisches Museum.

Iamonico D. 2011: *Dysphania anthelmintica (Amaranthaceae)*, new to the non-native flora of Italy, and taxonomic considerations on the related species. – Hacquetia **10:** 41–48.

Kadereit G., Borsch T., Weising K. & Freitag H. 2003: Phylogeny of *Amaranthaceae* and *Chenopodiaceae* and the evolution of C4 photosynthesis. – Int. J. Pl. Sci. **164:** 959–986.

Kadereit G., Mavrodiev E., Zacharias E. & Sukhorukov A. P. 2010: Molecular phylogeny of *Atripliceae (Chenopodioideae, Chenopodiaceae)*: implications for systematics, biogeography, flower and fruit evolution, and the origin of C4 photosynthesis. – Amer. J. Bot. **97:** 1664–1687.

Kasapligil B. 1966: Additamenta ad floram Jordanicae. – J. Arnold Arbor. **47:** 160–170.

Kheria H., Ouerda H. F. & Bouzid S. 2007: Morphological variability of fruit and chromosome numbers in Tunesian populations of *Atriplex halimus* L. *(Chenopodiaceae)*. – Caryologia **60:** 203–211.

Lomonosova M. N., Sinelnikova N. V. & Sukhorukov A. P. 2010: Karyology of some species of the *Chenopodiaceae* family from Israel and Jordan. – Bot. Zhurn. **95:** 270–272.

Long D. G. 1984: *Chenopodiaceae*. – Pp. 216–219 in: Grierson A. J. C. & Long D. G. (ed.), Flora of Bhutan **1(2).** – Edinburgh: Royal Botanic Garden.

McNeill J., Barrie F. R., Burdet H.-M. & al. 2006: International Code of Botanical Nomenclature (Vienna Code). Adopted by Seventeenth International Botanical Congress Vienna, Austria, July 2005. – Regnum Veg. **146**; online at http://www.ibot.sav.sk/icbn/main.htm.

Moquin-Tandon A. 1849: *Salsolaceae* [*Chenopodiaceae*]. – Pp. 41–219 in: Candolle A. de (ed.), Prodromus systematis naturalis regni vegetabilis **13(2).** – Paris: V. Masson.

Mosyakin S. L. & Clemants S. E. 2002: New nomenclatural combinations in *Dysphania* R. Br. *(Chenopodiaceae)*: taxa occurring in North America. – Ukrayins'kyi Bot. Zhurn. **59:** 380–385.

Mosyakin S. L. & Clemants S. E. 2008: Further transfers of glandular-pubescent species from *Chenopodium* subgen. *Ambrosia* to *Dysphania (Chenopodiaceae)*. – J. Bot. Res. Inst. Texas **2:** 425–431.

Ortíz-Dorda J., Martínez-Mora C., Correal E., Simyn B. & Cenis J. L. 2005: Genetic structure of *Atriplex halimus* populations in the Mediterranean Basin. – Ann. Bot. **95:** 827–834.

Ouarda H. E. F., H'cini K. & Bouzial S. 2006: Chromosome numbers in Tunisian populations of *Atriplex halimus* L. *(Chenopodiaceae)*. – African J. Biotechnol. **5:** 1190–1193.

Parker C. 1992: Weeds of Bhutan. – Bhutan: National Plant Protection Center.

Pau C. 1903: Plantas nuevas para la flora Española procedentes de Cartagena. – Bol. Soc. Aragonesa Ci. Nat. **2:** 65–73.

Press J. R., Shrestha K. K. & Sutton D. A. 2003: Annotated checklist of the flowering plants of Nepal. – London: Natural History Museum.

Schinz H. 1890: Beiträge zur Kenntnis der Flora von Deutsch-Südwest-Afrika und der angrenzenden Gebiete. – Verh. Bot. Vereins Prov. Brandenburg **31:** 179–230.

Thiers B. 2008+ [continuously updated]: Index herbariorum: A global directory of public herbaria and associated staff. – New York Botanical Garden: http://sweetgum.nybg.org/ih/.

Uotila P. 1997: *Chenopodium*. – Pp. 24–59 in: Rechinger K. H. (ed.), Flora iranica **172.** – Graz: Akademische Druck- u. Verlagsanstalt.

Uotila P. 2001: *Chenopodium*. – Pp. 13–52 in: Ali S. I. & Qaiser M. (ed.), Flora of Pakistan **204.** – Karachi: Dep. of Botany, University of Karachi & Missouri: Missouri Botanical Garden.

Walker D. J., Moñino I, González E., Frayssinet N. & Correal E. 2005: Determination of ploidy and nuclear DNA content in populations of *Atriplex*

halimus (Chenopodiaceae). – Bot. J. Linn. Soc. **147:** 441–448.

Yonekura K. 2008: *Chenopodiaceae*. – Pp. 53–61 in: Ohba H., Iokawa Y. & Sharma & L. R. (ed.), Flora of Mustang, Nepal. – Tokyo: Kodansha Scientific.

Zhu G.-L., Mosyakin S. L. & Clemants S. E. 2003: *Chenopodiaceae*. – Pp. 351–414 in: Wu Z. & Raven P. H. (ed.), Flora of China **5.** – Bejing: Science Press & Oxford: University Press.

Appendix: Specimens investigated in the fruit anatomical and SEM studies

Atriplex amboensis Schinz – SEM: [Namibia], Amboland, *H. Schinz* (K).

Atriplex brenanii Sukhor. – SEM: [Tanzania], Tanganyika, Angata Kiti, 11.1962, *J. Oteke 237* (K).

Atriplex halimus L. [var. *schweinfurthii* Boiss.] – SEM: Egypt, El Buseili, 9.1962, *Khaittab s.n.* (K).

Dyshania ambrosioides (L.) Mosyakin & Clemants – SEM: Nepal, Kathmandu valley, 11.2005, *A. Sukhorukov s.n.* (MW).

Dysphania bhutanica Sukhor. – SEM: Thimphu, 9000 ft, 8.1914, *E. Cooper s.n.* (E 001516). – Fruit anatomy: Bhutan, Thimphu distr., Lango, near Paro, 6.1992, *C. Parker 7263* (E).

Dysphania botrys (L.) Mosyakin & Clemants – SEM: Kazakhstan, Karkaralinsk distr., 8.1910, *S. E. Kucherovskaya s.n.* (MW); 2) [Volgograd prov.] Sirotinskaya, 8.1938, *P. A. Smirnov s.n.* (MW). – Fruit anatomy: [China, Xinjang] Kuldsha, 1875, *Larionov s.n.* (MW); 2) Moldavia, Dubossary, 8.1947, *V. N. Andreev 91* (MW).

Dysphania nepalensis (Colla) Mosyakin & Clemants – SEM: Gum Garhi, 7.1977, *B. Shrestha & N. P. Nanandhar 241* (E 00214393); West Nepal, 15 km NE from Jumla village, 9.2010, *A. Sukhorukov s.n.* (MW). – Fruit anatomy: Nepal, Marpha vill., 9.2009, *A. Sukhorukov* (MW); Nepal, Jumla vill., 10.2010, *A. Sukhorukov 464* (MW).