

**94. NEOTORULARIA** Hedge & J. Léonard, Bull. Jard. Bot. Belg. 56: 393. 1986.

念珠芥属 nian zhu jie shu

*Torularia* (Cosson) O. E. Schulz in Engler, Pflanzenr. 86(IV. 105): 213. 1924, not Bonnemaïson (1828); based on *Sisymbrium* Linnaeus sect. *Torularia* Cosson, Comp. Fl. Atlant. 2: 136. 1887.

Herbs annual, biennial, or perennial with a woody caudex. Trichomes stalked or sessile, 1- or 2-forked sometimes also simple. Stems erect or prostrate, usually several from base. Basal leaves petiolate or sessile, rosulate or not, entire, dentate, or pinnatisect. Cauline leaves often similar to basal ones, rarely absent. Racemes few to several flowered, ebracteate or rarely bracteate. Fruiting pedicels erect, ascending, or divaricate. Sepals ovate or oblong, erect or spreading, rarely reflexed, glabrous or pubescent, base of lateral pair not saccate. Petals white or pink, sometimes yellowish, longer or rarely shorter than sepals; blade obovate, spatulate, or oblanceolate, apex obtuse or retuse; claw distinct or not. Stamens 6, tetradynamous; filaments rarely dilated at base; anthers ovate or narrowly oblong, apex apiculate or obtuse. Median glands absent; lateral ones semilunar or 1 on each side of lateral stamen. Ovules (8–)16–36(–44) per ovary. Fruit dehiscent siliques, linear or rarely linear-oblong, terete or 4-angled, sessile; valves with branched trichomes sometimes mixed with simple ones, rarely glabrescent, torulose; replum rounded; septum complete; style obsolete or to 1 mm; stigma capitate, entire or 2-lobed. Seeds uniseriate, wingless, oblong or ovate, plump; seed coat reticulate, not mucilaginous when wetted; cotyledons incumbent.

About 14 species: C and SW Asia, one species extending into North America and another into N Africa and Europe; six species (one endemic) in China.

1a. Perennials, at least lowermost portion of raceme bracteate.

2a. Fruit (9–)12–25(–32) × 0.5–0.9(–1) mm, uniform in width; petals 3–5(–8) mm; seeds uniseriate; racemes

bracteate along lowermost portion, rarely throughout ..... 1. *N. humilis*

2b. Fruit 3–10(–15) × 1–1.3 mm, widest near or at base; petals 1–2.5(–3) mm; seeds often subbiseriate at basal portion of fruit; racemes bracteate throughout or rarely only along proximal half .. 2. *N. brachycarpa*

1b. Annuals or biennials, if perennial then style more than 1 mm; racemes ebracteate.

3a. Racemes rachis flexuous; fruit straight; Nei Mongol ..... 6. *N. qingshuiheense*

3b. Racemes rachis straight; fruit twisted or curved apically; elsewhere.

4a. Stem leafless; petals less than 2 mm; basal leaves including petiole less than 1 cm ..... 5. *N. brevipes*

4b. Stem leafy; petals more than 2 mm; basal leaves including petiole more than 1 cm.

5a. Fruiting pedicels narrower than fruit, (3–)4–6(–8) mm; petals 5–7 mm ..... 3. *N. korolkowii*

5b. Fruiting pedicels as thick as fruit, 0.3–1(–2) mm; petals (2–)2.5–3.5(–4) mm ..... 4. *N. torulosa*

**1. Neotorularia humilis** (C. A. Meyer) Hedge & J. Léonard, Bull. Jard. Bot. Belg. 56: 394. 1986.

蜆果芥 ying guo jie

*Sisymbrium humile* C. A. Meyer in Ledebour, Icon. Pl. Fl. Ross. 2: 16. 1830; *Arabidopsis trichocarpa* R. F. Huang; *A. tuemurnica* K. C. Kuan & Z. X. An; *Arabis axillaris* Komarov; *A. piasezkii* Maximowicz; *Braya humilis* (C. A. Meyer) B. L. Robinson; *Dichasianthus humilis* (C. A. Meyer) Soják; *Erysimum alyssoides* Franchet; *E. stigmatosum* Franchet; *Hesperis hygrophila* Kuntze; *H. piasezkii* (Maximowicz) Kuntze; *Malcolmia perennans* Maximowicz; *Neotorularia humilis* f. *angustifolia* (Z. X. An) Z. X. An; *N. humilis* f. *glabrata* (Z. X. An) Z. X. An; *N. humilis* f. *grandiflora* (O. E. Schulz) Z. X. An; *N. humilis* f. *hygrophila* (Fournier) Z. X. An; *N. maximowiczii* (Botschantzev) Botschantzev; *N. piasezkii* (Maximowicz) Botschantzev; *Sisymbrium humile* var. *hygrophilum* Fournier; *S. humile* var. *piasezkii* (Maximowicz) Maximowicz; *S. nanum* Bunge; *S. piasezkii* Maximowicz; *Torularia humilis* (C. A. Meyer) O. E. Schulz; *T. humilis* var. *maximowiczii* (Botschantzev) H. L. Yang; *T. humilis* var. *piasezkii* (Maximowicz) Jafri; *T. humilis* var.

*ventosa* O. E. Schulz; *T. humilis* f. *angustifolia* Z. X.

An; *T. humilis* f. *glabrata* Z. X. An; *T. humilis* f. *grandiflora* O. E. Schulz; *T. humilis* f. *hygrophila* (Fournier) O. E. Schulz; *T. maximowiczii* Botschantzev; *T. piasezkii* (Maximowicz) Botschantzev.

Herbs perennial, (4–)8–25(–35) cm tall, sparsely to densely covered with short-stalked or sessile, submalpighiaceus or rarely 2-forked trichomes often mixed along petioles and stem base with simple trichomes, rarely glabrescent. Stems usually few to many from base, rarely simple, ascending or erect, rarely subdecumbent. Basal leaves rosulate; petiole 2–16(–35) mm; leaf blade obovate, spatulate, oblanceolate, oblong, or sublinear, (0.3–)0.5–2(–3.5) cm × 1–8(–10) mm, sparsely to densely pubescent or rarely glabrous, base attenuate or cuneate, margin entire, repand, dentate, or pinnatifid, apex acute or obtuse. Cauline leaves similar to basal leaves but progressively smaller upward, uppermost sessile to sessile. Racemes bracteate along lowermost part, very rarely throughout. Fruiting pedicels erect and subappressed to rachis, ascending, or divaricate, slender, much narrower than fruit, (2.5–)3–8(–12) mm. Sepals oblong, 2–3 × 0.8–1.2 mm, slightly

saccate or not saccate at base. Petals white, pink, or purple, broadly obovate or spatulate, 3–5(–8) × (1–)1.5–2.5(–4) mm, apex rounded. Filaments 2–3(–4) mm; anthers oblong, 0.4–0.7 mm, apex apiculate. Ovules 20–44 per ovary. Fruit linear, uniform in width, (0.9–)1.2–2.5(–3.2) cm × 0.5–0.9(–1) mm, mostly straight, terete, torulose, pubescent with submalpighiaceus trichomes rarely mixed with fewer straight ones, rarely glabrescent; style 0.3–0.8(–1) mm; stigma entire or strongly 2-lobed. Seeds oblong, uniseriate, 0.6–0.9 × 0.4–0.5 mm. Fl. May–Aug, fr. Jun–Aug.  $2n = 28, 40, 42, 50, 56, 64, 70$ .

Sandy areas, river terraces, open stony slopes, scree, dolomite cliffs and slopes, degraded loess slopes, limestone ledges; 1000–5300. Gansu, Hebei, Henan, Nei Mongol, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, Xinjiang, Xizang, Yunnan [Afghanistan, Bhutan, India, Kashmir, Kazakstan, Korea, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan; North America].

A highly variable species in pubescence, leaf shape and margin, flower color and size, length of the bracteate portion of the raceme, fruit orientation and length, cotyledonary position, and chromosome number. Numerous taxa have been described from China, Russia, and North America, but the variation is continuous and does not support the recognition of infraspecific taxa. Fully bracteate racemes, though very rare, appear sporadically in populations that otherwise have racemes only basally bracteate. The above synonymy pertains only to China, and it represents about half of the total synonymy of the species.

**2. *Neotorularia brachycarpa*** (Vassilczenko) Hedge & J. Léonard, Bull. Jard. Bot. Belg. 56: 393. 1986.

短果念珠芥 *duan guo nian zhu jie*

*Torularia brachycarpa* Vassilczenko, Fl. URSS 8: 635.

1939; *Dichasianthus brachycarpus* (Vassilczenko)

Soják; *Neotorularia bracteata* (S. L. Yang) Z. X. An; *N.*

*conferta* R. F. Huang; *N. parvia* (Z. X. An) Z. X. An;

*N. tibetica* (Z. X. An) Z. X. An; *Torularia bracteata* S.

L. Yang; *T. conferta* R. F. Huang; *T. parvia* Z. X. An;

*T. tibetica* Z. X. An.

Herbs perennial, (1–)3–10(–2) cm tall, sparsely to densely covered with short-stalked or sessile, submalpighiaceus or rarely 2-forked trichomes. Stems several to numerous from base, procumbent or decumbent. Basal leaves rosulate; petiole 1–6(–12) mm; leaf blade oblanceolate or oblong, (2–)3–15 × 1–3 mm, sparsely to densely pubescent, base attenuate or cuneate, margin dentate or pinnatifid, apex acute or obtuse. Cauline leaves similar to basal ones but progressively smaller upward, uppermost sessile to sessile.

Racemes bracteate throughout, rarely only along proximal half; bracts attached to rachis or pedicel. Fruiting pedicels subappressed to rachis, slender, much narrower than fruit, 0.5–2.5(–5) mm. Sepals oblong, 0.7–1.5 × 0.5–0.8 mm, not saccate at base. Petals white, spatulate, 1–2.5 (–3) × 0.5–0.9(–1.1) mm, apex rounded. Filaments 1–1.5 mm; anthers ovate, 0.3–0.5 mm, apex apiculate. Ovules 20–40 per ovary. Fruit oblong, linear-lanceolate, or linear, widest at or near base, 3–

10(–15) × 1–1.3 mm, often basally appressed or subappressed to rachis and distally curved away from it, terete, torulose, pubescent with submalpighiaceus trichomes; style 0.1–0.5 mm; stigma entire. Seeds oblong, subseriate at least on proximal half of fruit, 0.5–0.8 × 0.3–0.4 mm. Fl. Jun–Aug, fr. Jul–Sep.

Gravelly slopes, sandy areas. Gansu, Qinghai, Xinjiang, Xizang [Tajikistan].

The alleged differences between *Neotorularia bracteata*, *N. conferta*, *N. parvia*, and *N. tibetica* in fruit length and bract position on the pedicel or rachis are artificial, and the four taxa easily fall within the general range of variation of *N. brachycarpa*.

**3. *Neotorularia korolkowii*** (Regel & Schmalhausen) Hedge & J. Léonard, Bull. Jard. Bot. Belg. 56: 394. 1986.

甘新念珠芥 *gan xin nian zhu jie*

*Sisymbrium korolkowii* Regel & Schmalhausen, Trudy

Imp. S.-Peterburgsk. Bot. Sada 5: 240. 1877;

*Dichasianthus korolkowii* (Regel & Schmalhausen)

Soják; *Malcolmia mongolica* Maximowicz;

*Neotorularia korolkowii* var. *longicarpa* (Z. X. An) Z.

X. An; *N. rosulifolia* (K. C. Kuan & Z. X. An) Z. X. An;

*N. sulphurea* (Korshinsky) Ikonnikov; *Sisymbrium*

*mongolicum* (Maximowicz) Maximowicz; *S.*

*sulphureum* Korshinsky; *Torularia korolkowii* (Regel &

Schmalhausen) O. E. Schulz; *T. korolkowii* var.

*longicarpa* Z. X. An; *T. korolkowii* var. *longistyla*

Vassilczenko; *T. rosulifolia* K. C. Kuan & Z. X. An; *T.*

*sulphurea* (Korshinsky) O. E. Schulz.

Herbs annual or biennial, rarely perennial, (1.5–)8–45(–60) cm tall, sparsely to densely covered with short- to long-stalked, 1- or rarely 2-forked trichomes sometimes mixed basally with simple ones. Stems usually few to several from base, rarely simple, ascending or erect. Basal leaves rosulate; petiole 3–15(–30) mm; leaf blade oblong to lanceolate or spatulate-oblong, (0.8–)1–5(–7.5) cm × (1–)2–10(–15) mm, sparsely to densely pubescent primarily with forked stalked trichomes, base attenuate or cuneate, margin entire, repand, or dentate, apex acute or obtuse. Cauline leaves similar to basal leaves but progressively smaller upward, sessile to sessile. Racemes ebracteate. Fruiting pedicels erect or ascending, slender or stout, narrower than fruit, (3–)4–6(–8) mm. Sepals oblong, 2–2.5 × 1–1.3 mm, not saccate. Petals white, sometimes with yellowish center, broadly obovate, 5–7 × 2–3.5 mm, apex retuse. Filaments 2–2.5 mm; anthers oblong, 0.6–0.8 mm, apex apiculate. Ovules 15–25 per ovary. Fruit cylindrical, (0.7–)1.2–2.2(–3.3) cm × 0.9–1 mm, mostly arcuate, sometimes straight or coiled into a loop, terete, strongly torulose, pubescent with sessile or short-stalked, forked, slender trichomes; style 1–1.5 mm; stigma slightly 2-lobed. Seeds oblong, 0.9–1.1 × 0.5–0.6 mm. Fl. and fr. May–Aug.

Mountain slopes, river banks, sandy beaches, grasslands, fields, roadsides; 500–3000 m. Gansu, Qinghai, Xinjiang, Xizang [Afghanistan, Kazakstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan].

*Neotorularia rosulifolia* is indistinguishable from *N. korolkowii* in every aspect of leaf morphology, trichomes, flower size, pedicel length, and fruit shape and size. The only feature in which the former taxon is said to differ from *N. korolkowii* is in its having only basal leaves. However, this character varies within a given population and throughout the range of the species.

Some forms of *Neotorularia dentata* (Freyn & Sintenis) Hedge & J. Léonard (from Afghanistan, Iran, Pakistan, Tajikistan, and Turkmenistan) approach *N. korolkowii* in petal, pedicel, and fruit size, but the most reliable distinguishing feature is the trichomes on the leaves and fruit. In *N. korolkowii* they are exclusively Y-shaped, whereas in *N. dentata* they are several forked to subdendritic.

**4. *Neotorularia torulosa*** (Desfontaines) Hedge & J. Léonard, Bull. Jard. Bot. Belg. 56: 395. 1986.

念珠芥 nian zhu jie

*Sisymbrium torulosum* Desfontaines, Fl. Atlant. 2: 84. 1798; *Dichasianthus torulosus* (Desfontaines) Soják; *Malcolmia torulosa* (Desfontaines) Boissier; *Neotorularia torulosa* var. *scorpiuroides* (Boissier) Hedge & J. Léonard; *Sisymbrium rigidum* Marschall von Bieberstein; *S. scorpiuroides* Boissier; *Torularia torulosa* (Desfontaines) O. E. Schulz; *T. torulosa* var. *scorpiuroides* (Boissier) O. E. Schulz.

Herbs annual, (1.5–)7–25(–35) cm tall, sparsely to densely covered with rigid, straight, simple trichomes to 1 mm, these mixed with much smaller, short-stalked or sessile, forked trichomes, rarely glabrescent above. Stems usually few to several from the base, rarely simple, ascending to erect. Basal leaves rosulate; petiole 0.3–2(–4) cm; leaf blade oblong, lanceolate, or linear-oblong, (1.5–)2.5–6.5(–12) cm × (1–)3–13(–20) mm, sparsely to densely pubescent, rarely subglabrous, base attenuate, margin dentate or sinuate, rarely pinnatisect or subentire, apex acute or obtuse. Cauline leaves similar to basal leaves but progressively smaller upward, sessile to subsessile. Racemes ebracteate. Fruiting pedicels divaricate or ascending, stout, as thick as fruit, 0.3–1(–2) mm. Sepals oblong, (1–)1.5–2 × 0.4–0.8 mm, not saccate. Petals white, oblanceolate, (2.2–)2.5–3.5(–4) × (0.3–)0.5–1 mm, apex obtuse. Filaments (1–)1.5–2.5 mm; anthers ovate, 0.3–0.5 mm, apex apiculate. Ovules 14–40 per ovary. Fruit cylindrical, (0.8–)1.5–2.8(–3.7) cm × 0.8–1 mm, straight, arcuate, or spirally inrolled up to 3 turns, terete, strongly torulose, glabrous or pubescent with forked and/or simple subsetose trichomes; style 0.3–1 mm; stigma entire or slightly 2-lobed. Seeds oblong, (0.6–)0.8–1.2 × 0.4–0.6 mm. Fl. and fr. Feb–Jun.  $2n = 14$ .

Deserts, steppe, hillsides, rocky areas; near sea level to 1500 m. Xinjiang [Afghanistan, Kazakstan, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan [N Africa, SW Asia, SE Europe]].

This is a highly variable species, especially in leaf morphology and pubescence. Forms with glabrous fruit are recognized by some botanists as var. *scorpiuroides*, but these do not merit recognition because both glabrous and pubescent plants can be found in the same population. The species is often confused with some species of *Malcolmia*, but the latter genus has a conical stigma with decurrent lobes,

whereas *Neotorularia* has a flat, entire to slightly lobed stigma with nondecurent lobes.

**5. *Neotorularia brevipes*** (Karelin & Kirilov) Hedge & J. Léonard, Bull. Jard. Bot. Belg. 56: 393. 1986.

短梗念珠芥 duan geng nian zhu jie

*Sisymbrium brevipes* Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscou 15: 154. 1942; *Dichasianthus brevipes* (Karelin & Kirilov) Soják; *Fedtschenkoa brevipes* (Karelin & Kirilov) Dvorák; *Hesperis brevipes* (Karelin & Kirilov) Kuntze; *Malcolmia brevipes* (Karelin & Kirilov) Boissier; *Torularia brevipes* (Karelin & Kirilov) O. E. Schulz; *T. brevipes* var. *leiocarpa* O. E. Schulz.

Herbs annual, (2–)4–11(–15) cm tall, sparsely covered with minute, short-stalked trichomes, often glabrescent above. Stems 1 or few from the base, erect. Basal leaves rosulate, sessile or petiole 0.5–1(–2) mm; leaf blade obovate or oblanceolate, (1–)3–10 × 0.5–1.5(–3) mm, sparsely pubescent, rarely subglabrous, base cuneate, margin entire, apex obtuse or rounded. Cauline leaves absent. Racemes ebracteate. Fruiting pedicels ascending, stout and slightly narrower than fruit, 0.1–2(–5) mm. Sepals oblong, 0.9–1.2 × 0.4–0.5 mm, not saccate. Petals white or lavender, oblanceolate, 1.1–1.7 × 0.3–0.4 mm, apex obtuse. Filaments 0.8–1.5 mm; anthers ovate, 0.1–0.2 mm, apex apiculate. Ovules 14–32 per ovary. Fruit cylindrical, (0.6–)1–1.8(–2.2) cm × 0.5–0.8 mm, straight, terete, torulose, glabrous or pubescent with minute forked trichomes; style 0.2–0.7 mm; stigma slightly 2-lobed. Seeds oblong, 0.6–0.8(–1) × 0.2–0.4(–0.5) mm. Fl. and fr. Apr–Jun.

Xinjiang [Afghanistan, Kazakstan, Kyrgyzstan, Pakistan, Turkmenistan].

The above first records of *Neotorularia brevipes* from China and Afghanistan are based on *Przewalski s.n.*, 2–14 May 1879 (LE) and *Podlech 31387* (M), respectively. The latter is a mixed collection of *N. brevipes* and *N. torulosa*.

**6. *Neotorularia qingshuiheense*** (Ma & Zong Y. Zhu) Al-Shehbaz et al. in Al-Shehbaz & O’Kane, Edinburgh J. Bot. 56: 326. 1999.

青水河念珠芥 qing shui he nian zhu jie

*Microsisymbrium qingshuiheense* Ma & Zong Y. Zhu, Acta Sci. Natur. Univ. Intramongol. 20: 538. 1989.

Herbs annual, 8–13 cm tall, densely covered with short-stalked, forked or 3-rayed trichomes, these mixed with simple ones at least on petioles. Stems usually few from base, ascending or erect. Basal leaves rosulate; petiole 1–1.5 cm; leaf oblanceolate, 1–1.5 cm × 2–2.5 mm, base cuneate, margin coarsely dentate or pinnatifid, apex acute; terminal lobe 2.5–3 mm. Cauline leaves few, similar to basal leaves but smaller and with a shorter petiole. Racemes ebracteate; rachis distinctly flexuous in fruit. Fruiting pedicels ascending or divaricate, slender, narrower than fruit, 3–4 mm. Sepals oblong, 2–2.5

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× 1–1.3 mm, not saccate. Petals white or pink, broadly obovate, ca. 5 × 2.5 mm, apex retuse. Ovules 20–22 per ovary. Fruit cylindric, 0.8–2 cm × ca. 1 mm, straight, terete, strongly torulose, pubescent with short-stalked, forked or 3-rayed trichomes; style ca. 1 mm; stigma slightly 2-lobed. Seeds oblong, ca. 1 × 0.5–0.6 mm. Fl. and fr. Jul.

• Rocky areas. Nei Mongol.

The present authors have seen no material of this species, and the above description was taken from the protologue.

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