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Taxonomy, Cultivation, Phytochemistry and Traditional Use of *Grewia* L. (Tiliaceae)

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Abstract The paper presents taxonomy, cultivation, phytochemical and traditional use, phenology and ecology of *Grewia* L. (Phalsa) plant. The plant *Grewia* is a largest genus of family Tiliaceae and grows mostly in tropical climate. About 15 species were discussed in this paper but *G. asiatica* is the only species which is cultivated in India in large scale. It is used as food, medicine, fiber, fuel, fodder, timber and every part of this plant is very useful. It mainly contains phytochemicals alkaloids, tannins, anthraquinones, glycosides, saponins, flavonoids, steroids, phenol and resins.

Keywords *Grewia*, Tiliaceae, Phytochemistry, Traditional use.

Introduction

It is an exotic plant and has been mentioned in vedic literature as having many medicinal properties. At of the early part of the 20th century, the fruit was introduced to Indonesia and Philippines, where it has since naturalized. This deciduous shrub commonly grows in the Himalayan region of India, at elevation up to 900 meter. *Grewia*, the largest genera of family Tiliaceae having 150 species in the tropics and subtropics rare in temperate region while 31 species in India. *Grewia* have a large number of economic and medicinal importance as edible fruits, timber, fiber, fuel by most of the peoples, tribes and nomads, *Grewia* is a deciduous in North India but evergreen in South as a bush and small tree in mixed forest. The stem is hard and brittle. Leaves are broad rough and light green with stellate hairs on both side. Flowers small, yellow in clusters of cymose appear in April and fruit is small berry like drupe that appear in June with one or sometime two hard seeds. Larger fruits have two seeds, whereas the smaller fruits have only one. Plant can tolerate drought condition, fruiting occurs mainly in summer season, fruit persisting throughout the year in few species like– *G. abutilifolia*.

India grows several species of *Grewia* for fruits but is not common as *Grewia asiatica*. It is small fruit and is being cultivated on very small scale in each state ; however in Punjab, Haryana and Uttar Pradesh it is cultivated near cities commercially. Punjab covers only 30 hectares area with annual production of 196 tons approximately. Generally Phalsa is cross pollinated fruit crop and pollination is completed by the insects such as honey bee, wasp, beetle however some flowers are self-pollinated. The yield of fruit per plant is roughly 3-5 kg per plant or 4.5–6 t/ha.

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Enumeration

Grewia asiatica L., Mant. 1:122. 1767 ; DC., Prodr. 1:511. 1824 ; Roxb., Fl. Ind. 2. 586, 1832 ; Boiss., Fl. Orient. 1 : 844. 1867 ; Stewart and Brandis, For. Fl. 40.

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Grewia asiatic L.

Grewia hirsuta Vahl.

Fig. 1. *Grewia asiatica* L. *Grewia hirsuta* Vahl.

1874 ; Mast. In Hook. f., Fl. Brit. India 1 : 386, 1874 ; Watt., Diet. Econ. Prod. Ind. 4 : 184. 1890 ; Duthie, Fl. Gangetic Plain 1 : 113. 1903 ; Talbot, For. Fl. Bomb. Pres. and Sind 1 : 162. 1911 ; Bamber, Punj. Pl. 9. 1916 ; Cooke, Fl. Bomb. Pres. (reprint. ed.) 1 : 150. 1958 ; Maheshwari, Fl. Delhi 87. 1963 ; Jafri, Fl. Kar. 212. 1966 (Fig. 1).

Bangla: Phalsa, Shukri; Gujrati: Phalsa; Hindi: Dhamin, Kara, Purusha, Phalsa, Pharsa, Sukri; Kannad: Buttiyudippe, Jana, Thadasal; Marathi: Phalsi; Orria: Pharosakoli; Sanskrit: Alpasthi, Dhanvanchhada, Giripilu, Nilacharma, Purushaka; Tamil: Palicca, Tadachi, Unnu; Telgu: Nalajana, Peddajana, Phutiki.

Small trees or shrubs. Leaves 5–19 × 4–15 cm, broadly ovate, rounded at base, acute or acuminate at apex, crenate, scabrous above, tomentose beneath, 5–7-nerved; petioles up to 1.8 cm long. Flowers in axillary, umbellate cymes; peduncles up to 3.5 cm long ; buds 6–11 × 4–5 mm, oblong-obovoid, ribbed, tomentose; pedicels up to 1 cm long. Sepals 6–12 × 2–3 mm, oblong-lanceolate, tomentose. Petals yellow, 3–7×1.5–3 mm, oblong-obovate or linear-oblong, obtuse, glands 1×0.7 mm, obovoid. Stamens numerous; filaments 4 - 6 mm long. Ovary 1.5 –2.5 × 1–1.5 mm, ovoid, villous ; stigma 4-lobed. Drupes7–12 mm across, subglobose, red or purple.
Common in deciduous forests and cultivated in fields.
Fl. and **Fr.**: February - August.
Distribution: Bangladesh, Sri Lanka and India : Himachal Pradesh, Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

Grewia hirsuta Vahl., Symb. Bot. 1:34. 1790; Roxb. Fl. Ind. 2. 587, 1832 ; Mast. In Hook.f., Fl. Brit. India 1:391. 1874; Duthie, Fl. Gangetic Plain 1:117. 1903 ; Naray. and R. Rao in J. Ind Bot. Soc 29:179. 1950; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3 : 501. 1993.

Asamia: Huktapata, Hindi: Gurusukri, Kurkurbicha; Kannad: Cikkudippe, Jana, Udippe; Marathi: Govli; Orria: Kulo, Sonaranga; Tamil: Kalunnu, Tavidu: Telgu: Bidaracipura, Budda, Cipuru, Cittijana, Nuvalcu, Tallajana; Urdu: Kakarundehrumi.

Shrubs, 3-6 m high. Leaves 1–12 × 0.7–4.5 cm, ovate, lanceolate, ovate-elliptic, subobtuse at base, acute or sometimes rounded at apex, serrate, pubescent above, densely tomentose beneath, 3 (- 4)-nerved; petioles up to 7 mm long. Flowers polygamous, in axillary, umbellate cymes; peduncles 1 - 3 together, up to 1 cm long; buds globose; pedicels 2 - 5 mm long. Sepals 8 mm long, elliptic-lanceolate. Petals white, 3mm long, oblong, rounded; glands half the length of petals. Receptacle short, subterete, dilated at apex, glabrous. Stamens more than 40. Ovary 2 mm across, globose, densely villous; stigma 5-lobed; lobes fringed. Drupes 1.2 cm across, subglobose, obscurely 4-lobed, fleshy, Wrinkled.

Common in deciduous and mixed forests.
Fl. and **Fr.** : July–February.
Distribution: Bangladesh, Sri Lanka and India : Uttar

Fig. 2. *Grewia abutilifolia* W. *Grewia tilifolia* Vent. *Grewia damine* Gaertn. *Grewia optiva* J. R. drumm. *Grewia tenax* fiori. *Grewia orientalis* L. *Grewia flavescens* Juss. *Grewia eriocarpa* Juss.

Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

Grewia abutilifolia W., Vent. Ex A.L. Juss. In Ann. Mus. Natl. Hist. Nat. 4 : 92, 1804 ; Fl. Ind. 2 : 591. 1832 ; Mast. In Hook.f., Fl. Brit. India 1 : 390, 1874 ; Duthie, Fl. Gangetic Plain 1:115. 1903 ; Dunn in Gamble, Fl. Pres. Madras 119. 1915. Naray. and R. Rao in J. Ind. Bot. Soc. 29 : 187, 1950 ; P, Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3 : 493. 1993.

Kannad: Karakele, Kown ; Malayalam : Pampukonta ; Marathi: Kharphulsa ; Orria: Bhamola, Ryna ; Tamil: Kaviya ; Telgu: Guvuadada, Peddatadaki, Potucamanti (Fig. 2).

Shrubs or small trees. Leaves 3.5–20 × 2–16 cm, elliptic-ovate, subcordate at base, acute or acuminate at apex, irregularly serrate, sometimes obscurely lobed, scabrous above, stellate-tomentose beneath, 5-nerved ; petioles 0.5–4.5 cm long. Flowers in axillary, umbellate cymes ; peduncles 1–3 together, up to 1 cm long ; buds 5–8 × 4 mm, ovoid or oblong ; pedicels 2 mm long. Sepals 8–12 mm long, narrowly oblong or lanceolate, acute, wooly outside. Petals white, 2–4 × 1–1.5 mm, oblong, obtuse, ciliate at base ; glands subglobose 2 mm across, densely ciliate. Receptacle 1 mm long, 5-angled, glabrous. Stamens many ; filaments 5 mm long. Ovary 1.5 × 1 mm, subglobose, villous ; stigma laciniate. Drupes 0.8–1.5 cm across, subglobose, fleshy, oubscurely 4-lobed, tomentose.

Along forest roads

Fl. and **Fr.** : October–May.

Distribution: Bangladesh, Myanmar, Indonesia and Malaysia. India: Himachal Pradesh, Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, West Bengal, Sikkim, Manipur, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Goa, Andhra Pradesh, Karnataka and Tamil Nadu and Kerala.

Grewia tilifolia Vent. ex Juss. Ann. Mus. Natl. Hist. Nat. 4 :92 1804 ; Vahl, Symb. Bot 1:35, 1790 ; Roxb. Fl. Ind. 2.587, 1832 ; Mast. In Hook. f., Fl. Brit. India 1 : 386. 1874 ; Fl. Pres. Bombay 142. 1901 ; Duthie, Fl. Gangetic Plain 1:115. 1903 ; Naray. and R. Rao in J. Ind. Bot. Soc. 29 : 179. 1950 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:511. 1993.

Hindi: Dhamin, Jujhana, Phalsa ; Kannad: Buttele, Jana, Tadacali, Thadsal ; Malayalam: Catacci, Chadicha ; Orria: Bhangia, Dhaman, Dhamono ; Sanskrit: Dhanuvriksha, Dharmana ; Tamil: Cadacci, Sadachi, Thadachi, Unnu ; Telgu: Charachi, Jana Nulijana, Tada, Tada-jana. Trees, 6–15 m tall ; bark peeling off. Leaves 1.7–36 × 1–24 cm, elliptic, ovate, obliquely cordate at base, acuminate or rounded at apex, serrate, glabrescent above, sparsely pubescent or tomentose beneath, 5-nerved ; petioles up to 4 cm long. Flowers 3–6, in axillary cymes ; peduncles 1–2 cm long ; buds 3–6 mm long, subglobose or obovoid-oblong, tomentose ; pedicels 4–13 mm long. Sepals 5–8 × 3 mm, elliptic or lanceolate, subacute, tomentose outside. Petals yellow, 3–4.5 × 1.5 mm, elliptic-oblong or spathulate, obtuse, notched at apex, sparsely ciliate at base ; glands 0.5 mm long. Receptacle minute, glabrous excepting at apex. Stamens many ; filaments 4 mm long. Ovary 1.2 mm across, globose, sparsely hirsute ; stigma 4-lobed. Drupes 2.5– 5 × 7 –10 mm, black, distinctly 2-lobed ; lobes globose.

In dry deciduous forests.

Fl. and **Fr.** : February–December

Distribution: Sri Lanka and Tropical Africa.India: Himachal Pradesh, Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Goa, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu and Kerala.

Grewia damine Gaertn., Fruct. Sem. Pl. 2 : 113.t.106, f.9.1790 ; Nov. Pl. Sp. 239.1821 ; Roxb. Fl. Ind. 2. 496. 1832 ; Mast. In Hook.f., Fl. Brit. India 1:386. 1874 ; Duthie, Fl. Gangetic Plain 1:115.1903 ; Dunn in Gamble, Fl. Pres. Madras 118. 1915 ; R.R. Stewart, Ann. Cat. Vasc. Pl. W. Pak. and Kash. 473. 1972 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:496. 1993 ; G. salvifolia Heyne ex Roth, Nov. Pl. Sp.: 239. 1821.

Kannad:Udikke ; Orria Dhatoki, Kola ; Tamil: Cavatalunnu, Naroduppi, Savandilunam ; Tegul: Adivipagari, Jara, Kondacipuru, Manickolupu, Narabudama, Uppidi.

Small trees or shrubs, 25 m high. Leaves 1.5–9 × 1–3.5 cm, ovate, elliptic or lanceolate, rounded or oblique at base, obtuse or subacute at apex, subentire or minutely serrate, appressed tomentose beneath, 3-nerved ; petioles 2–4 mm long. Flowers in axillary cymes ; peduncles up to 1.5 cm long ; buds 5–7 mm long, ovoid-oblong, tomentose ; pedicels up to 1.2 cm long. Sepals 8–12 mm long, linear to oblong, tomentose. Petals yellow, 3.5–6 mm long, elliptic-oblong, retuse ; glands 2 mm long, hairy. Receptacle 1.5 mm long, obscurely angled, glabrous. Stamens many ; filaments 3–4.5 mm long. Ovary 1.5 mm across, subglobose, stigma 4-lobed. Drupes 8–10 mm across, globose, distinctly 2-lobed, sparsely pubescent.

Fl. and **Fr.:** August–December.
Distribution: Nepal, Pakistan and Tropical Africa. India: Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu and Kerala.

Grewia optiva J. R. drummm. ex Burrett in Notizbl. Bot. Gart. Berlin-Dahlem 9.962. 1926 ; Naray. and R. Rao in J. Ind. Bot 79.1950 ; R. R. Stewart, Ann. Cat. Vase. Pl. W. Pak. and Kash. 472. 1972 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:496. 1993. *G. oppositifolia* auct. non. DC., 1824: Mast. In Hook.f., Fl. Brit. India 1:386. 1874 ; Duthie, Fl. Gangetic Plain 1:115. 1903.

Hindi: Bhimal, Biul, Biung ; Lep.: Taglar.
Small trees ; bark grey. Leaves 3–16 × 2 –8 cm, ovate or ovate-elliptic, rounded or obtuse at base, acuminate at apex, crenate-serrate, pubescent, 3-nerved ; petioles 5–10 mm long. Flowers in axillary or leaf-opposed cymes ; peduncles up to 3.5 cm long ; buds 10× 6 mm, elliptic, ribbed, tomentose ; pedicels up to 2 cm long. Sepals 1–12 cm long, tomentose. Petals white or pale yellow, 5–9 mm long, ovate. Stamens many ; filaments 6–10 mm long. Ovary 2 mm across, ovoid, stigma lobed. Drupes 2–2.5 cm across, 2–4-lobed, greenish black.

In lower Siwalik Hills.

Fl. and **Fr.:** April–December.

Distribution: Nepal, Bhutan. India: Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim.

Grewia tenax (Forssk.) Fiori in Agric. Colon. 5 (Suppl.) : 23. 1911 (publ. 1912) ; Mast. In Hook. f.., Fl. Brit. India 1:385. 1874, Duthie, Fl. Gangetic Plain 1:115. 1903 ; Fiori in Agric. Colon. 5: Suppl. 23. 1912 ; Dunn in Gamble, Fl. Pres. Madras 117. 1915 ; Burret in Notizbl. Bot. Gart. Berl. 9:689. 1926 ; Naray. and R. Rao in J. Ind. Bot 29:179. 1950 ; Tackholm, Stud. Fl. Egypt 234. 1956 ; Hutch. and Dalz., Fl. W. Trop. Afr. ed. 2. 1 (2) : 305. 1958 ; Maheshwari, Fl. Delhi 87. 1963 ; Jafri, Fl. Kar. 212. 1966 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:511. 1993. *Grewia populifolia* Vahl, Symb. Bot. 1:33. 1790 ; *Grewia belulaefolia* A. L. Juss. in Ann. Mus . Natl. Hist. Nat. 4:92. t. 2.1804.

Shrubs, 2–3 m high. Leaves 0.5– 4 × 0.5 –2.5 cm, broadly ovate, rotund or elliptic, rounded base, obtuse at apex, coarsely dentate, scabrid above, glabrous, 3-nerved ; petioles up to 1 cm long. Flowers in axillary or leaf-opposed cymes ; peduncles up to 1.5 cm long ; buds 8–10 mm long, oblong, tomentose ; pedicels up to 5 mm long. Sepals 1.2–1.8 cm long, linear-oblong, tomentose outside. Petals white, 6.5 mm long, linear-oblong, obtuse, usually notched at apex, ciliate at base ; glands 2 mm long. Receptacle 2.5 mm long, ribbed, glabrous, pilose at apex. Androgynophore 0.5 mm long. Stamens many ; filaments 5 mm long. Ovary 2.5 mm across, subglobose, 4-lobed, hirsute ; stigma 4-5-lobed. Drupes 6–10 mm across, 2-parted, each half didymous, orange-yellow, glossy, glabrescent.

Tamil: Accu ; Telgu: Gundukadira, Kadadarai, Kattekoluu.

In drier region of the state.

Fl. and **Fr.:** May–January.
Distribution: Pakistan, SriLanka, Mauritius, Afghanistan, W. Asia and Tropical Africa. India: Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi,

Fig. 3. *Grewia helicterifolia* Wall. *Grewia orbiculata* Rottler. *Grewia rothii* DC. *Grewia sapida* Roxb. *Grewia sclerophylla* Roxb. *Grewia serrulata* DC.

Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Goa, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

Grewia orientalis L., sp. Pl. 964. 1753: Mast. in Hook.f., Fl. Brit. India 1:385. 1874 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3 : 506. 1993. G. columnaris Sm. in Rees, Cycl. 17: no. 5. 1811.

Kannad: Udippeballi ; Malayalam: Payippala ; Tamil: Andikkullai, Panrippidukkan, Tavidalai ; Telgu: Bodeputika, Peyyarotta, Tagali.

Small trees or shrubs. Leaves 3.5– 13 × 1.8 –6 cm, ovate-elliptic, ovate-lanceolate, obliquely cordate at base, acute or acuminate at apex, crenate-serrate, glabrescent, 3-nerved ; petioles up to 7 mm long. Flowers in axillary, 1–3-flowered cymes ; peduncles up to 5 mm long ; buds conical, brown-tomentose ; pedicels up to 1 cm long. Sepals 1.5–2.5 cm long, oblong, acute, pubescent. Petals white, 5–8 mm long, ovate-lanceolate ; glands half the length of petals. Receptacle 6 mm long, angled, softly villous. Ovary globose, pilose ; stigma 5-lobed. Drupes 1–1.5 cm across,

subglobose, 4-lobed, yellow, bristly with stiff hairs.

Occasional in Bundelkhand region.
Fl. and **Fr.:** May–December.

Distribution: Sri Lanka, Mauritius, Afghanistan, W. Asia and Tropical Africa. India: West Bengal, Madhya Pradesh, Rajasthan, Gujarat, Goa, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu and Kerala.

Grewia flavescens A. L. Juss. in Ann. Mus. Natl. Hist. Nat. Hist. Nat. 4 ; 91. 1804 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:498. 1993. G. pilosa auct., non Lam., 1789: Mast. In Hook.f., Fl. Brit. India 1:388. 1874 ; Duthie, Fl. Gangetic Plain 1:112. 1903.

Hindi: Chaperandhavi ; Kannad: Chikkagarakele, Karakele, Sannagararakele ; Tamil: Cencadacci ; Telgu: Cpurutada, Kukkabudda, Madekava, Nalli, Tadikamullu (Fig. 3).

Trees, up to 6 m high. Leaves 1.5–13 × 1–7 cm, ovate-elliptic, oblong, subcordate or rounded at base, usually acute, rarely obtuse at apex, serrate, scabrous above, tomentose beneath, 3-nerved ; petioles up to 7 mm long. Flowers in short, axillary cymes ; peduncles 1–3 together ; buds 1.2–1.7 cm long, oblong, obtuse, slightly dilated, tomentose ; pedicels 2–5 mm long. Sepals 1.2–1.7 cm long, linear-lanceolate, acute, tomentose outside, glabrous inside. Petals yellow, 5–10 mm long, spathulate or linear-oblong, usually 2-fid ; glands 3 mm long, oblong. Receptacle 1.5–2 mm long, obconical, obscurely angular, glabrous, crenulate at apex. Stamens 1 cm long. Ovary 2 × 0.5 mm, subglobose or ovoid, pilose ; stigma 2-fid. Drupes 0.7–1 × 0.7–1.5 cm, 2–4-lobed, globose when not lobed, yellowish brown, stellate-tomentose.

Common in drier region.

Fl. and **Fr.:** August–January.

Distribution: Tropical Africa. India: Delhi, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu and Kerala.

G. eriocarpa Juss. In Ann. Mus. Natl. 4:93. 1804; Duthie, Fl. Gangetic Plain 1:113. 1903 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:497. 1993. G. vestita Wall. Ex Brandis, Forest Fl. N. W. India, 40.1874. G. elastic Royle, 3. Bot. Himal. Mts. 1:104, t. 22. 1834 ; *G. asiatica* L. var vestita (Wall. ex Brandis) Mast. In Hook.f, Fl. Brit. India 1:387. 1874.

Assam: Man-bijal ; Bangla: Dhamni ; Hindi: Bimla, Dhaman ; Nepali: Siyal phusra ; Orria: Mirgi-chara.

Trees, up to 20 m tall. Leaves 7–14 × 5–11 cm, obliquely ovate, oblong-ovate or elliptic, rounded or subcordate at base, acuminate at apex, crenate-serrate, hispid above, tomentose beneath, 5–6-nerved ; petioles up to 1 cm long. Flowers in axillary cymes ; peduncles up to 1.5 cm long ; buds 3 mm across, globose to ovoid, tomentose ; pedicels up to 1 cm long. Sepals 5–12 mm long, linear-oblong, hirsute. Petals yellow, ta 3.5 mm long, oblong or oblong-obovate ; glands 1.5 × 0.7 mm, oblong. Stamens numerous ; filaments 4 mm long. Ovary 2 mm across, globose, villous ; stigma lobed. Drupes 5–10 mm across, globose, obscurely 2–4-lobed, black, sparsely pubescent.

In sal forests.

Fl. and **Fr.:** February–May.

Distribution: Nepal, Bangladesh, Bhutan and Myanmar. India: Himachal Pradesh, Punjab, Uttar Pradesh, Bihar, West Bengal, Assam, Sikkim, Meghalaya, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra and Western Ghats.

G. helicterifolia Wall. ex G. Don, Gen. Hist. 1:548. 1831 ; Duthie, Fl. Gangetic Plain 1:113. 1903 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:500. 1993. *G. polygama* auct. non Roxb., 1832 ; Mast. In Hook.f, Fl. Brit. India 1:391. 1874 ; *G. hirsuta* Vahl var *helicterifolia* (Wall. ex G. Don) Haines, Forest Fl. Chota Nagpur. 196. 1910.

Hindi:Gurawa, Kakai, Sita-chabeni ; Telgu: Cinnacipuru, Jibilika.

Small trees or shrubs. Leaves 3–15 ×0.5–3 cm,

oblong-lanceolate, rounded, acute at apex, irregularly serrate, hispid or glabrescent above, densely tomentose beneath, 3-nerved ; petioles 3–6 mm long. Flowers in axillary, umbellate cymes ; peduncles 5–17 mm long ; buds 5 mm across, ovoid-oblong or subglobose, densely pubescent ; pedicels up to 8 mm long. Sepals 5–6 mm long, oblong-lanceolate, pilose. Petals white, 2.5 mm long, oblong, rounded or subacute ; glands 1.2 mm across, subglobose. Receptacle up to 1 mm long. Stamens 16–20 ; filaments 2–3 mm long. Ovary 1.5 mm across, globose, pilose ; stigma laciniate. Drupes 8–20 mm across, obscurely 4-lobed, sometimes 2-lobed, brown, glabrescent or sparsely hirsute.

In mixed and sal forests.

Fl. and **Fr.:** September–February.

Distribution: Bangladesh, Pakistan, Myanmar, Sri Lanka and Australia. India: Himachal Pradesh, Punjab, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

G. orbiculata Rottler in Neue Schriften Ges. Naturf. Freunde Berlin 4:205. 1803 ; Mast. In Hook. f, Fl. Brit. India 1:386. 1874 ; Duthie, Fl. Gangetic Plain 1:115. 1903 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:504. 1993.

Hindi: Kala dhaman ; Kannad: Jana, Karijana ; Orria: Mirgachara ; Tamil: Neyccitti ; Telgu: Jana, Nulitada.

Trees, 4–8 m high. Leaves 0.6–9 × 2–7 cm, orbicular, broadly elliptic, obliquely cordate at base, obtuse to acuminate at apex, irregularly crenate-serrate, grey-tomentose beneath, 5-nerved ; petioles 0.3–1.2 cm long. Flowers in axillary or leaf-opposed, umbellate cymes ; peduncles up to 3 cm long ; buds 6–10 mm long, oblong or elliptic-oblong ; pedicels 7–10 mm long. Sepals 6–10 mm long. lanceolate, woolly outside. Petals orange-yellow, 4–6 mm long, oblong. Receptacle 0.5–1 mm long, angular, glabrous, pubescent at apex. Stamens 4 mm long. Ovary 2.5 × 1.5 mm, obovoid, furrowed, pilose ; stigma 4-lobed ; lobes laciniate. Drupes 5–8 mm across, subglobose, obscurely 2-lobed, glaucous-tomentose.

In mixed forests

Fl. and **Fr.:** April–November.

Distribution: Myanmar, Sri Lanka and Australia. India: Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu and Kerala.

G. rothii DC., Prodr. 1:509. 1824 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:507. 1993. *G. excels* auct., non Vahl, 1790: Mast. In Hook.f, Fl. Brit. India 1:385. 1874, excl. syns. ; Duthie, Fl. Gangetic Plain 1:115. 1903.

Orria: Honolopoto, Kulo, Miri-chara ; Tamil: Cipura, Jana ; Hindi:Ghatiari.

Small trees or shrubs. Leaves 3–16.5 × 1–5.5 cm, ovate-oblong or ovate-lanceolate, obtuse or subacute at base, acute or acuminate at apex, serrulate, densely tomentose beneath, 3–4-nerved ; petioles ca 5 mm long. Flowers in axillary, clustered cymes ; peduncles 1.5–3.5 cm long ; buds 35–5 mm across, subglobose, tomentose ; pedicels 8–10 mm long. Sepals 6 mm long, elliptic-oblong or elliptic-lanceolate, tomentose. Petals 3 mm long, ovate-lanceolate ; glands 1 mm long, elliptic. Stamens many ; filaments 3–4 mm long, glabrous. Ovary 1.5 mm across, globose, tomentose ; stigma 4-lobed. Drupes 5 mm across, globose, tomentose, edible.

In mixed deciduous forests.

Fl. and **Fr.:** May–October

Distribution: Bangladesh and Tropical Africa. India: Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

G. sapida Roxb. ex DC., Prodr. 1:509. 1824 ; Mast. in Hook.f, Fl. Brit. India 1:387. 1874 ; Duthie, Fl. Gangetic Plain 1:115. 1903 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:508. 1993.

Shrubs. Leaves 1.5–10 × 1–7.5 cm, ovate, broadly elliptic, subacute or rounded at base and apex,

coarsely double-serrate, scabrid above, tomentose beneath, 5–7-nerved ; petioles up to 6 mm long. Flowers in axillary cymes ; peduncles slender ; 2–3 cm long ; buds 6–8 × 5 mm, obovoid or oblong-obovoid, tomentose ; pedicels 7–10 mm long. Sepals 8–12 mm long, oblong or oblanceolate, tomentose. Petals yellow. Receptalce glabrescent. Stamens many ; filaments 5–6 mm long, glabrous. Ovary 3 × 1.5 mm, elliptic-oblong, hirsute ; stigma lobed. Drupes 8 mm across, subglobose or broadly obovoid, obscurely 2-lobed.

Assam: Chuhura ; Hindi:Bhumiphalsa.

In sal forests.

Fl. and **Fr.:** April–November.

Distribution: Pakistan, Nepal, Bhutan and Myanmar. India: Himachal Pradesh, Punjab, Uttar Pradesh, Bihar, West Bengal, Assam, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh.

G. sclerophylla Roxb. ex G. Don, Gen. Hist. 1:550. 1831 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:509. 1993 ; *G. scabrophylla* Roxb. Fl. Ind. 2:584. 1832 ; Mast. in Hook. f, Fl. Brit. India 1:387. 1874 ; Duthie, Fl. Gangetic Plain 1:112. 1903.

Bangla : Phalsa.

Shrubs. Leaves 7–19 × 5–12.5 cm, rotund-ovate, obovate or obcordate, rounded or subacute at base, rounded, emarginate or acuminate at apex, serrate, tomentose, 3–5-nerved ; petioles ca 1.2 cm long. Flowers in axillary cymes ; peduncles 2–8 mm long ; buds 1–1.3 cm long, ovoid-oblong, ribbed, tomentose ; pedicels 0.5–1.2 cm long. Sepals 1.2–1.5 cm long, lanceolate, densely pubescent outside. Petals white, 6× 2.2 mm, oblong-obovate, obtuse, notched at apex. Receptacle short, hispid. Androgynophore 4 mm long, glabrous excepting at apex. Ovary 2×4 mm, depressed-globose, hirsute ; stigma 2-lobed. Drupes 1.2–1.8 cm across, globose, stellate-tomentose.

In sal and mixed forests.

Fl. and **Fr.:** August–March.
Distribution: Bangladesh and Myanmar. India: Himachal Pradesh, Uttar Pradesh, Bihar, West Bengal, Assam, Sikkim and Orissa.

G. serrulata DC., Prodr. 1 : 510. 1824 ; P. Danial and Chandrab. In B. D. Sharma and Sanjappa, Fl. India 3:509. 1993. *G. laevigata* auct. non Vahl, 1790: Mast. in Hook.f, Fl. Brit. India 1:389. 1874 ; incl. syns. ; Duthie, Fl. Gangetic Plain 1:112. 1903.

Assam: Kukur-huta ; Bangla: Pani-sara ; Hindi: Kath bimla, Pansaura ; Kannad: Javani-gale ; Nepali: Chiple, Kuail ; Orria: Kath bimla ; Tamil: Pirunnu ; Telgu: Allipayaru.

Trees or shrubs. Leaves 1–18 ×1.5–7 cm, lanceolate, ovate-lanceolate, elliptic-ovate, rounded or narrowed at base, acute or acuminate, sometimes obtuse at apex, sharply serrate, glabrous or glabrescent, 3-nerved ; petioles up to 1.5 cm long. Flowers in axillary, umbellate cymes ; peduncles 1–2 together, 1.5–2.5 cm long ; buds 8–15 × 5–8 mm, ovoid, ovoid-oblong or subglobose, tomentose ; pedicels up to 2.5 cm long. Sepals 9–16 × 3–5 mm, oblong or lanceolate, tomentose. Petals greenish white, 3.5 × 1.5 mm, ovate or obovate, usually notched, sometimes acuminate at apex ; glands slightly shorter than petals. Receptacle 2–3 mm long, grooved, pubescent in upper half. Stamens numerous ; filaments 4–5 mm long, glabrous. Ovary ca 2.5 × 1.5 mm, ovoid, pilose ; stigma 5-lobed ; lobes laciniate. Drupes 5–15 mm across, 2-lobed, globose when not lobed, dry black, glabrous when old.

In sal and mixed forests.

Fl. and **Fr.:** July–February.

Distribution: Pakistan, Nepal, Bhutan, Myanmar, Indo-China, Australia, Malesia and Tropical Africa. India: Punjab, Uttar Pradesh, Bihar, West Bengal, Assam, Meghalaya, Orissa, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu, Kerala and Andaman and Nicobar Islands.

Propagation and harvesting process

Phalsa is propagated commonly through seed and

also by cutting layers and budding. Cutting are difficult to root due to the presence of mucilage. Planting is done during the monsoon month. The planting distance is 2.5 m × 3 m. Loam soil is best for cultivation but can very easily grow in poor soil. It prefers hot and dry environment during fruiting. In winter it goes dormant and shed it leaves. For getting high fruit yields it requires irrigation at regular intervals of 20 days during April to June. No irrigation may be applied during rainy season and in dormancy.

For uniform ripening of fruits, apices of shoots may be pinched in mid May to check further shoot growth. Fruits start ripening in the first week of June and continue for a month. Only a few fruits in a cluster ripen at one time, so continuous harvesting is necessary. Fruit should be harvested twice a week. Fruits are packed in small baskets. Phalsa fruits perishable in nature, hence should be transported to the market soon after harvesting. The phalsa can also be grown as an intercrop in the mango or other fruit crop particularly during the initial years.

Phytochemistry

Phytochemical screening of plant parts of *Grewia* mainly contains alkaloids, tannins, anthraquinones, glycosides, saponins, flavanoids, steroids, phenols, resins.

The phytochemical tests of *Grewia asiatica* indicated the presence of carbohydrate, tannins, Phenolic compounds, flavonoids and vitamin-C in the methanolic extract while proteins in the aqueous extract of fruits. Leaves contain flavanoids and stem have triterpenoids, taraxerol, erythrodiol. The flower have been found to contain grewinol, a long chain keto alcohol, tetratricontane-22-ol-13 one, the seeds contain 5% of bright-yellow oil containing 8.3% palmitic acid, 11% stearic acid, 13.4% oleic acid, 64.5% linoleic acid, 2.8% unsaponifiable (Morton 1987). Stem bark of *Grewia optiva* alkaloids, tannins, anthraquinones, glycosides, steroids, terpenoids, reducing sugars, saponins, flavonoids, phlobatanins (Waliullah 2011). *Grewia tenax*, rich in Iron and Calcium, the drupes are also contain amino acid, mineral elements (potassium, calcium, manganeez, iron, copper, zinc) tannin and pectic substances (Sharma and Vidhyapatni 2012), leaves contain triacontanol, tetratriacont, beta-sitosterol and seeds contain sterols: sitosterol, stigmasterol and stem bark have triterpenoids, erythrodiol, betulin, sitosterol, triacontanol. Roots and stem of *Grewia tiliaefolia* contain triterpenoids, lupeol and friedelin. *Grewia flava*, fruit has a high content of sugar, carbohydrate, vitamin, protein and leaves have phenolic compound. The stem bark of *Grewia populifolia* are reported to constitute some phytochemicals like triacontan-l-ol, α-amyrin, β-sitosterol, lupenne, erythrodiol, betulin and tetratriacont-21-ol-12-one, the seeds contain palmitic acid, stearic acid, linoleic acid (Sharma and Vidhyapatni 2012) (Fig. 4).

Traditional uses of different parts

The plant *Grewia* is used as food, medicine, fiber, fuel, fodder, timber and every part of this plant is very useful from the ancient era. A few species of *Grewia* L. is traditionally used such as- *G. asiatica* (Phalsa), *G. hirsuta* (Gur-sukri), *G. tilifolia* (Thadassi), *G. abutilifolia* (Bhansuri), *G. damine*, *G. optiva* (Dhaman, Bhimal), *G. tenax* (Gangeti), *G. orientalis* (Ghenchi), *G. flava*, *G. bicolor* (white resin), *G. flavescens* (donkey berry), *G. laevigata* (cross berry) (Tables 1, 2).

Root

G. asiatica, root bark is used by santhaltribes for fever and rheumatism, root paste is applied on the back before going to bed in case of back pain (Amittomar 2009). Root paste of *G. hirsuta* is applied externally for wound healing (Singh et al. 2010). About 50 gram roots of *G. damine* are crushed and given to the animal with water, twice a day for three days for early healing of fractured bones. About 10 gram root of *G. tenax* chewed for one time get relax in snake bite. *G. bicolor*- A handful of roots cooked in water for 5–30 min. The infusion (250 ml) is administered thrice a day until diarrhea subsides. *G. abutilifolia*, root juice is applied on swelling and root paste is useful in diabetes (Patil and Patil 2006).

Stem

G. tenax wood is used in making weapon such as bows, arrows. Branches are useful for making char-

G. asiatica – Cultivated field

Fig. 4. *G. asiatica*–Cultivated field.

coal used as fuel. The wood of *G. bicolor* used for axe handles and sticks.

Bark

Bark is very useful part of *Grewia*, used as powder, paste, fiber *G. tilifolia*, the decoction of bark is applied all over the head before taking bath to treat mental illness (Revathi and Parimelazhagan 2010). Bark powder used to cure dysentery, bark is used as an effective tonic and bark fibers used to make rope (Ratheesh et al. 2010). *G. tenax* is ligno- cellulosic fiber with good tensile strength is made by bark used to make strong rope other holding. Bark is used in tuberculosis. Stem bark of *G. asiatica* is used to refining sugar. Bark fiber of *G. flava* used for making basket, mat. Bark juice of *G. abutilifolia* given in dysentery.

Leaf

G. asiatica leaves possess antimicrobial potential and are therefore used to treat skin rashes and pustular eruptions (Zia-Ul-Haq et al. 2012) Ethanolic extract of leaves showed antibacterial and antifungal activities. The extract showed potent results against eight bacterial strains ; *Proteus mirabilis*, *Citrobacter* sp., *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella typhi*, *Micrococcus luteus*, *Staphylococcus aureus* and *Bacillus subtilis*. The extract showed moderate as well as significant activity against nine fungal strains namely *Aspergillus effusus, A. parasiticus, A. niger*, *Saccharomyces cerevisiae, Candida albicans*, *Yersinia aldovae*, *Fusarium solani*, *Macrophomina phaseolina* and *Trichophyton rubrum* (Zia-Ul-Haq et al. 2013).

Leaf extraction of *G. asiatica* showed significant anticancer activity against liver cancer and breast cancer. Leaves possess antimicrobial property and therefore used to treat skin diseases and pastular eruption. The ash of leaves of *G. tenax* is mixed with butter to make poultice. The poultice is applied on wound and *abscesses* for children. Leaves also used in rheumatism and cough. *G. orientalis* commonly known as ghenchi, about 50 gram. Leaves are given orally to treat impaction. Leaf decoction of *G. asiatica* is used for checking pregnancy by tribal women of

Table 1. Medicinal uses of various chemicals present in *Grewia* L.

Sl. No.	Chemicals	Properties
1.	Alkaloids	Used in antimalarial (quinine), antiasthma (ephedrine), anticancer (homoharringtonine), cholinomimetic (galantamine), vasodilatory (vincamine), antiarrhythmic (quinidine), analgesic (morphine), antibacterial (chelerythrine), antihyperglycemic activities (piperine).
2.	Tannins	Used for stop local small hemorrhages, diarrhea sore mouth, bronchitis, burns, scars of the skin, wounds and many others.
3.	Anthraquinones	Help aid in digestion as a laxative, to reduce inflammation in arthritis patients and to inhibit the growth of cancer cells.
4.	Saponins	Treat malaria, lower blood cholesterol, hypertension aid, kill nematodes, bone health, cancer fighter, support immune system (build it up), parasite remover (tick, flea), automobile cleaner.
5.	Flavanoides	Reduced risk of cancer, heart disease, asthma and stroke.
6.	Steroids	Corticosteroids, the most common group of steroids, treat arthritis, asthma, autoimmune diseases, skin conditions and some kinds of cancer.
7.	Phenolic compounds	Used for treating sore throat pain, sore mouth and minor mouth irritation.
8.	Resins	Antimicrobial and wound healing in animals and in the plants that secrete them.
9.	Triterpenoides	Group of Terpenes (isoprenoids) is defined as terpenoid derviatives of triterpene molecules, Pentacyclic Triterpenes of the Lupane, Oleanane and Ursane group used in cancer therapy Inflammatory response, Hepatoprotective, Human immunodeficiency virus (HIV), Antioxidant activities.
10.	Palmitic acid	Paliperidone palmitate (marketed as INVEGA Sustenna), used in the treatment of schizophrenia, Retinyl palmitate is an antioxidantand a source of vitamin A. It strongly boosts metastasis in mouse models of human oral cancer cells.
11.	Stearic acid	Used in the production of pharmaceutical tablets and capsules.
12.	Oleic acid	Reduces blood pressure, increases fat burning to help with weight loss, protects cells from free radical damage, may prevent type 2 diabetes, prevents ulcerative colitis and generates brain myelin.
13.	Linoleic acid	Gamma linolenic acid (GLA) is used for conditions that affect the skin including systemic sclerosis, psoriasis and eczema.
14.	Pectic substance	Pectin increases viscosity and volume of stool so that it is used against constipation and diarrhea.
15.	Betulin	Betulin inhibited the maturation of sterol regulatory element-binding protein (SREBPs). Inhibition of SREBP by betulin decreased the biosynthesis of cholesterol and fatty acids. *In vivo*, betulin ameliorated diet-induced obesity, decreased the lipid contents in serum and tissues and increased insulin sensitivity. Furthermore, betulin reduced the size and improved the stability of atherosclerotic plaques.
16.	Lupeol	Displaying antiprotozoal, antimicrobial, antiinflammatory, antitumor and chemopreventive properties.
17.	β-sitosterol	Reduce benign prostatic hyperplasia (BPH) and blood cholesterol levels. High levels of β-sitosterol concentrations in blood have been correlated with increased severity of heart disease in men having previously suffered from heart attacks.

Madhya Pradesh. The paste of *G. damine* leaves, 4-5 egg of hen and milk of cow is mixed and pour into the mouth of suffering animal daily with the help of tumbler or drenching tube for ten days for early healing of fractured bone. *G. flavescens* leaves used in stomach disorder (Ana et al. 2010).

Fruit

A few species of *Grewia* yields edible fruits like *G. asiatica* drupes are astringent, refreshing, cool, sweet, antipyretic have highly antibiotic properties like ; vitamin-c, flavonoids use for curing burning

Table 2. Industrial uses of various chemicals present in *Grewia* L.

Sl. No.	Chemicals	Industrial uses
1.	Alkaloids	Used as low-toxic synthetic pesticides and insecticides.
2.	Tannins	They play a role in protection from predation and perhaps also as pesticides, regulating plant growth, important ingredient in the process of tanning leather, tannins can be used for production of anti-corrosive primer.
3.	Anthraquinones	Used as a bird repellant on seeds and as a gas generator in satellite balloons. It has also been mixed with lanolin and used as a wool spray to protect sheep flocks against Kea attacks.
4.	Phenolic compound	Used to prepare reagents, plastic manufacturing industries, commercially it is marketed by the name of Bakelite, used in the study extraction of biomolecules, cosmetic industries in the manufacturing of sunscreens, skin lightening creams and hair coloring solutions.
5.	Resins	Impervious to water so it can be used to treat objects to make them resistant to the damages caused by moisture. It can be used to seal seams, repair breaks/holes in boats, shoes and structures to prevent water leaks. It can be used to help start a fire in damp conditions.
6.	Palmitic acid	Used to produce soaps, detergents, cosmetics and industrial mold release agents, also used as surfactant emulsifying agent.
7.	Stearic acid	Used as intermediate, lubricants, surfactant cleansing agent and emulsifying agent, defoamers in food and beverage, also it can be used in a variety of cosmetic creams, cakes, soaps and pastes.
8.	Oleic acid	Moisturizer boosts hair growth and make hair thicker, longer and stronger, prevents dry scalp and dandruff. Anti-aging properties help slow down aging and prevent premature wrinkles and fine lines.
9.	Linoleic acid	Helping with weight loss, muscle-building and strength improvements, reducing food allergies and sensitivities.
10.	Pectic substances	Used as a gelling agent in a wide range of fruit-based products, such as jams, marmalades, jellies, fruit preparations for yogurts and desserts and fruit filling for bakery products, also reduces syneresis in jams and marmalades and increases the gel strength of low-calorie jams, used in confectionery jellies to give a good gel structure and a clean bite.
11.	B-Sitosterol	Cholesterol lowering and symptom improvement in mild to moderate benign prostatic hypertrophy.

sensation, inflammation, heart and blood disorders, throat trouble, diarrhea, colic and alcoholism. *G. optiva* fruit are eaten raw or cooked, pleasant acidic taste by gujjar tribe of district Rajouri, Jammu and Kashmir (Rashid et al. 2008). Beer fermented from the fruit of *G. flava*. Fruit of *G. tenax* consume large amount of Iron, Phosphorus, Calcium and can be used as refreshing drink and sherbet.

Conclusion

Grewia, tree or shrubs, the largest genera of family Tiliaceae having 150 species in the tropics and subtropics, rare in temperate region ; 31 in India. India grows several other known fruits in the *Grewia* genus but is not common as *Grewia asiatica*. *Grewia asiatica* is cultivated in India in very small scale in Punjab, Haryana, Uttar Pradesh, Maharashtra. The yield is quite low, offering roughly 3–5 kg per plant or 4.5–6 t/ha. The national average is 1.3 tons of fiber / ha. Phytochemical study of plant parts of *Grewia* ; mainly contain alkaloids, tannins, anthraquinones, glycosides, sapponins, flavonoids, steroids, phenol and resine. The *Grewia* is very useful plant, its every part is used in making medicine, common source of food, fodder, fuel, timber. The plant have very high medicinal value used in dysentery, diarrhea, headache, cough, wound healing, blood disorder, alcoholism and have great antibiotic properties. It is cultivated commercially mainly in Punjab, Haryana, Uttar Pradesh and Maharashtra. Many species of *Grewia* found all over the India. *Grewia* is a genus with a large number of species but now due to over exploi-

tation, habitat distraction and lack of cultivation the number of the species is less day by day.

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