

Tropical Forages

Indigofera spicata

Scientific name

Indigofera spicata Forssk.

Note: There is considerable confusion in the literature between *Indigofera spicata* Forssk. and *Indigofera hendecaphylla* Jacq., which were initially considered synonyms, but since 1993 they have been treated as separate species (du Puy et al., 1993). This leads to difficulties in ascribing effects attributed to *Indigofera spicata* pre 1993 and in more recent literature, to either species, particularly in relation to toxicity.

Synonyms

Indigofera spicata Forssk. No synonyms listed in GRIN.

Indigofera hendecaphylla Jacq.: *Indigofera endecaphylla* Jacq. ex Poir., orth. var.; *Indigofera neglecta* N.E. Br.; *Indigofera spicata* auct., pro parte majore (used in the sense of subsequent authors, for the greater part).

Family/tribe

Family: *Fabaceae* (alt. *Leguminosae*) subfamily: *Faboideae* tribe: *Indigofereae* subsection: *Alternifoliolae*.

Morphological description

Prostrate to weakly ascending, spreading, perennial herb, to 0.5 m high, and 1 m across, with strong, deep, woody taproot and low to submerged crown; young stems ridged (flattened when young), green or yellowish, strigose with sparse, hyaline to white appressed, equally biramous hairs; older stems brown, sometimes rooting at the nodes. Leaves alternate, 1.2–4 cm long, pinnate, (3–) 5–7 leaflets inserted alternately; stipules triangular (2.5–) 3.5–5.5 (–6.5) mm long, with scarious margins, glabrescent, not spinescent, persistent; petiole 2–6 mm long; rachis furrowed. Leaflets obovate, (3–) 4–11 (–16) mm long, 2.5–8 (–10) mm wide; upper surface glabrous or with sparse, appressed hairs; lower surface with sparse to moderately dense, appressed hairs; apex obtuse (with short mucro); veins not prominent; stipellae absent or inconspicuous, 0.2–1.2 mm long, membranous, some dividing into 2 or 3 segments. Inflorescence a spike-like raceme, 30–65 (–80) mm long; peduncle 15–20 (–25) mm long; bracts triangular (margin scarious), 1.2–2 mm long; flowers pink to orange-red, sometimes white; pedicel 0.3–0.7 mm long; calyx 2–3 mm long; lobes sub-equal, longer than the length of the tube and covered with sparse to moderately dense, white, appressed hairs; standard reddish, sometimes white, obovate, 3.8–4.9 mm long, 2.5–3.7 mm wide; hairs sparse (few at apex only), hyaline to white; apex obtuse; wings oblong to spathulate, 3.7–4.5 mm long, 0.5–1.1 mm wide; keel 3.9–4.4 mm long, 1–1.3 mm deep, lateral pockets 0.3–0.5 mm long; apex acute; glabrous or with sparse, hyaline hairs at the tip; staminal tube 2.3–3.2 mm long, colourless; ovary moderately to densely hairy. Pod descending, terete (often torulose when young), 10–18 mm long, 1.5–2 mm wide, yellowish and brown, strigose to glabrescent; hairs sparse, appressed; apex shortly pointed (to 0.5 mm long); endocarp not spotted; seeds cuboid, 4–8 per fruit, 1.3–1.6 mm long, 1–1.4 mm wide; 480,000–830,000 seeds/kg, depending on provenance.

Similar species

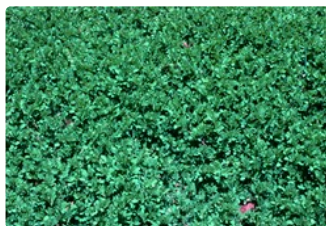
I. spicata: leaves 1.2–4 cm long, leaflets (3–) 5–7 (–8), obovate, base cuneate; inflorescence 3–8 cm long; staminal tube 2.3–3.2 mm long, not exceeding the calyx, keel apex acute; pod 10–18 mm long including short, blunt tip 0.5 mm long.

I. hendecaphylla: leaves 2.5–7.5 cm long, leaflets (7–) 9–11, narrowly oblong-elliptical to narrowly oblanceolate; inflorescence 5–16 cm long; staminal tube 4–5 mm long, distinctly larger than the calyx, keel apex rounded to obtuse; pod 22–27 mm long, including distinct beak 1.5–2.5 mm long.

Common names

Africa: tumba-djali (Angola); agoman (Benin); n'gara (Guinea); dawa-le nkop, hiri, musuusuu, olando (Kenya); emuchukuchuku, hiri, kipande, myata (Tanzania); kibwankurata (Uganda)

Asia: □□□□ sui xu mu lan (China); cherru-pulladi (India); basingan; baleh angin (Sulawesi); sibar (Sumatra) (Indonesia); Afurika-komatsunagi (Japan); khram-khrua (Thailand); cây đậu chàm, chàm bò, chàm bông, chàm gié, đậu tràm (Vietnam); mscheter, m'scheter, musaytir, schiter (Yemen)



Prostrate to weakly ascending, spreading, perennial herb; dense ground cover



Leaves alternate, pinnate with (3-) 5-7 leaflets inserted alternately; pods dark brown when mature



Inflorescence a spike-like raceme; mature pods dehiscent



Seeds

English: creeping indigo, lawn indigo, prostrate indigo, red nerinjy, spicate indigo, trailing indigo

Europe: indigo rampant; indigotier en épi (Réunion) (French); kriechender Indigostrauch (German)

Pacific: `iniko, `inikoa, kolu (Hawaii)

Madagascar: aika, anky, egitra, engitra, famafatsambo, sindahoripotsy

Latin America: amendoim-bravo (Brazil); añil rastrero (Puerto Rico)

Note: Many of the common names listed, particularly those from Asian countries, may well refer to the very similar species, *Indigofera hendecaphylla* Jacq., that is native to subtropical and tropical Asia as well as to Africa.

Distribution

Native:

Africa: Burkina Faso; Burundi; Cameroon; Central African Republic; Democratic Republic of the Congo; Ethiopia; Kenya; Malawi; Mozambique; Rwanda; South Africa (KwaZulu-Natal, Transvaal); Sudan; Tanzania; Uganda; Zambia; Zimbabwe

Indian Ocean: Madagascar; Mauritius

Arabian Peninsula: Yemen (S)

The endemic range of *I. spicata* is much more restricted than that of *I. hendecaphylla*, which extends into Asia. Since it is not possible to individualise some of the reported characteristics for the two species, much of the information here will relate to the *Indigofera spicata-hendecaphylla* complex.

Naturalized:

Widely naturalized in other parts of the tropics and subtropics.

Uses/applications

Forage

Mainly planted for cover, green manure and erosion control in coffee, tea and rubber plantations in the tropics and subtropics. It occurs in natural pasture, but has not been sown as forage.

Environment

Planted as ground cover, green manure, and erosion control in coffee, tea, and rubber plantations in warm parts of the Old World.

Other

Minor source of indigo dye.

Ecology

Soil requirements

Best adapted to dark clay and clay loam soils of pH 5.0–7.7, but also found on sandy soils, and soils with pH as low as 4.0 and as high as 8.5. Tolerant of low soil P status.

Moisture

Mostly found in areas with average annual rainfall of 600–1,500 mm, but up to 4,000 mm. Annual rainfall in collection areas in Yemen is as low as 200 mm, although these were edges of drainage lines. *I. spicata* appears to extend the distribution of the complex into lower rainfall areas, but is still found in higher rainfall areas.

Temperature

While primarily a warm season species complex, it is widely adapted, being found in areas of the lowland tropics and subtropics, and upland tropics (to 2,800 m asl at Quito in Ecuador). 24 hour average annual temperatures range from 13 to 27 °C.

Light

Found mostly in open grassland, but used as ground cover/green manure in plantation crops, suggesting preference for full light, but tolerance of at least light shade.

Reproductive development

I. spicata commences flowering in late summer/early autumn and fruiting in early/mid-autumn.

Defoliation

Extremely tolerant of regular low defoliation, becoming a weed in turf.

Fire

No information, but probably tolerant of fire by virtue of the very low or submerged crown.

Agronomy

Establishment

I. spicata often has high levels of hard seed, but these can be broken down with mechanical or hot water scarification. Care should be taken with some hot water treatments that can also kill previously germinable seed. *I. spicata* will in most cases nodulate effectively on native rhizobia, but seed can be inoculated with *Bradyrhizobium* strains such as 210407 (Japan) or CB 756 (Australia). Being a small seed, it should be sown no deeper than about 1 cm.

Fertilizer

In the absence of empirical information, it is probably appropriate to treat *I. spicata* like other moderate fertility legume species such as *Macropitium atropurpureum*. On soils with less than about 8 ppm available phosphorus, 20–30 kg/ha P may be required at establishment, and 10–20 kg/ha/yr P for maintenance. The need for other nutrients, particularly K and S, should be monitored by soil analysis or foliar deficiency symptoms. Molybdenum may be required at 100 g/ha Mo at establishment on deficient soils, and 100 g/ha Mo every 4–5 years as maintenance, particularly on more acid soils.

Compatibility (with other species)

Commonly found in association with lower growing and sward-forming grasses and legumes.

Companion species

Grasses: *Axonopus fissifolius*, *Cynodon dactylon*, *Digitaria didactyla*, *Paspalum notatum*, *Stenotaphrum dimidiatum*.

Legumes: *Chamaecrista rotundifolia*, *Grona triflora*, *Stylosanthes humilis*.

Pests and diseases

Very few pests and diseases of any consequence. Okra mosaic virus (OMV, tymovirus group) has been isolated from *Indigofera spicata* in Nigeria.

Ability to spread

Spreads readily due to prolific seed production, and ready establishment in disturbed situations, including heavily defoliated swards.

Weed potential

Most references to weed threat relate to toxicity (see Feeding value). It is rarely a weed in crops, but is a common weed of turf in some regions.

Feeding value

Nutritive value

Analyses of material from lines listed as *I. spicata*, but probably predominantly *I. hendecaphylla*, show CP levels as high as 23% and NDF values as low as 32%.

Palatability/acceptability

I. spicata and *I. hendecaphylla* are both highly palatable to most classes of livestock.

Toxicity

In the absence of conclusive exonerating data, all *Indigofera* species should be treated with caution in developing livestock feeding systems due to the presence of the toxic, non-proteinogenic amino acid, indospicine (2,7-diamino-7-amino-heptanoic acid), in leaves and seeds of some species. Initially identified in the *I. spicata* complex that has lent its name to the amino acid, indospicine is highly toxic to chickens, rabbits, pigs, goats, sheep, cattle and horses, and because it accumulates in the tissues, to susceptible animals (e.g. dogs) eating the flesh of these species. It causes loss of vitality and abortion in sheep, goats and cattle, liver damage in sheep, cattle and rabbits, and death in horses and chickens. Another toxic substance, 3-nitropropionate (3-NPA), has been isolated from *I. spicata*, which causes a range of largely irreversible neurological symptoms in the grazing animal. There is evidence from other *Indigofera* spp. that indospicine levels vary with seasonal conditions. While it has been reported that some African diploid strains are non-toxic, attempts at breeding very low mimosine varieties have so far been unsuccessful.

Feedipedia link

<https://www.feedipedia.org/node/286>

Production potential

Dry matter

While no yield data could be found for *I. spicata*, its more robust relative, *I. hendecaphylla*, has produced yields up to 5 t/ha green matter after 2 months and 25 t/ha after 6 months. As with most low-growing species, yield data would be greatly influenced by height and frequency of harvest.

Animal production

Due to the toxic nature of the species, it would be assumed that long-term effects would be negative. It is for this reason that *I. spicata* has been largely avoided in pasture legume evaluation programs.

Nevertheless, while it is clear that both species contain or are even dominated by toxic provenances, there is sufficient agronomic merit in the complex to warrant more definitive study to select for low toxicity in this potentially valuable forage legume. Rusa deer in Mauritius graze native *I. spicata*-dominant pastures at certain times of year, with apparently no ill effect.

Genetics/breeding

$2n=32$. Again there is confusion on the basis of true species identity.

Seed production

No information available.

Herbicide effects

I. spicata is not readily killed with simple herbicide applications that might kill tops but a high proportion of plants recover. Commercial broad spectrum compound herbicides comprising aminopyralid and 2,4-D amine or aminopyralid and metsulfuron methyl have given good control.

Strengths

- Drought tolerant.
- Nitrogen-fixing legume.
- Adapted to wide range of soil types and conditions.
- Tolerant of heavy grazing.

Limitations

- Toxicity.
- Paucity of information.

Selected references

Aylward, J.H., Court, R.D., Haydock, K.P., Strickland, R.W. and Hegarty, M.P. (1987) *Indigofera* species with agronomic potential in the tropics. Rat toxicity studies. Australian Journal of Agricultural Research 38:177–186. doi.org/10.1071/AR9870177

Christie, G.S., Wilson, M. and Hegarty, M.P. (1975) Effects on the liver in the rat of ingestion of *Indigofera spicata*, a legume containing an inhibitor of arginine metabolism. The Journal of Pathology 117:195–205. doi.org/10.1002/path.1711170402

Du Puy, D.J., Labat, J.N. and Scire, B.D. (1993) The separation of two previously confused species in the *Indigofera spicata* complex (*Leguminosae: Papilionoideae*) Kew Bulletin 48:727–733. <http://doi.org/10.2307/4118850>

Fletcher, M.T., Al Jassim, R.A.M. and Cawdell-Smith, A.J. (2015) The occurrence and toxicity of indospicine to grazing animals. Agriculture 53:427–440. doi.org/10.3390/agriculture5030427

Frahm-Leliveld, J.A. (1960) Observations on chromosomes in the genus *Indigofera* L. Acta Botanica Neerlandica 9:286–293. doi.org/10.1111/j.1438-8677.1960.tb00658.x

Hutton, E.M. and Guerassimoff, J. (1966) Problems in breeding the legume *Indigofera spicata* for tropical pastures. Euphytica 15:353–361. doi.org/10.1007/BF00022179

Kelly, W.R., Young, M.P., Hegarty, M.P. and Simpson, G.D. (1992) The hepatotoxicity of indospicine in dogs. In: James, L.F., Keeler, R.F., Bailey Jr, E.M., Cheeke, P.R. and Hegarty, M.P. (eds) Poisonous plants: Proceedings of the third international symposium. Iowa State University Press, Ames, IA, USA. p. 126–130.

Strickland, R.W., Lambourne, L.J. and Ratcliffe, D. (1986) The palatability, feeding value and apparent toxicity of 150 legume species fed to rats. Genetic Resources Communication No. 10. CSIRO Tropical Agriculture, St Lucia, Australia. bit.ly/33YYCUX

Strickland, R.W., Lambourne, L.J. and Ratcliff, D. (1987) A rat bioassay for screening tropical legume forages and seeds for palatability and toxicity. Australian Journal of Experimental Agriculture 27:45–53. doi.org/10.1071/EA9870045

Sunarno, B. (1997) *Indigofera hendecaphylla* Jacq. In: Faridah Hanum, I. and van der Maesen, L.J.G. (eds) Plant Resources of South-East Asia No. 11. Auxiliary Plants. Backhuys Publishers, Leiden, the Netherlands. p. 123–127. edepot.wur.nl/411331

Cultivars

None released.

Promising accessions

None reported.

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