

## SUNN HEMP

### *Crotalaria juncea* L.

Plant Symbol = CRJU

Contributed by: USDA NRCS Cape May Plant Materials Center, Cape May, NJ



Sunn hemp (*Crotalaria juncea*). (Photo by Chris Miller, USDA-NRCS, Cape May Plant Materials Center)

#### Alternate Names

Alternate Common Names: Indian hemp, Madras hemp, brown hemp

#### Scientific Alternate Names:

*C. benghalensis* Lam.,  
*C. cannabinus* Royle,  
*C. sericea* Willd.,  
*C. tenuifolia* Roxb.,  
*C. viminea* Wall.,  
*C. fenestrata* Sims,  
*C. porrecta* Wall.

#### Uses

**Commercial crop:** *Crotalaria juncea* is grown mainly in India, Brazil, and West Pakistan for its fiber. It is used in the production of twine, rug yarn, tissue paper, fish nets, sacking, canvas, and cordage (Duke, 1983). It can produce 500–810 lb/acre of fiber (Duke, 1983).

**Forage:** *C. juncea* is used as forage for goats and cattle. *C. juncea* contains toxic alkaloids, particularly in the seeds and pods. However, the variety ‘Tropic Sun’ is non-toxic (USDA-NRCS, 2009). Seeds contain 34.6% crude protein (Duke, 1983).

It should be grazed by goats when it reaches 4 ft, or roughly 45 days after planting. This provides enough time

for the stem to harden and the leaves to fill out, while still remaining short enough for goats to reach leaves.

The leaves of *C. juncea* can be used for cattle forage during late summer and early fall, but the amount of fiber in stems is too high 6 weeks after planting to be used as suitable forage (Mansoer et al., 1997). Mannetje (2012) found that the leaves and stems must be dried before fed to cattle and sheep.

**Cover crop/green manure:** *C. juncea* is used as a nitrogen-fixing green manure to improve soil quality, reduce soil erosion, conserve soil moisture, suppress weeds and nematodes, and recycle plant nutrients. It grows quickly and can produce more than 5,000 lb dry matter/acre and 120 lb nitrogen/acre in 9–12 weeks (Clark, 2007). Fertilized and hand-weeded plots have yielded 5.6–6.2 T (short tons) per acre (Duke, 1983). Leaves have a nitrogen concentration between 2–5% and roots and stems have between 0.6–2% (Treadwell and Alligood, 2008). Its fast growth makes it ideally suited for planting in late summer rotations before fall cash crops.

**Wildlife:** Deer will browse plants and turkey and quail will use *C. juncea* for shelter and food.

#### Ethnobotany

*C. juncea* has been grown as a fiber crop in India since 600 BC (Treadwell and Alligood, 2008) and is still used for fiber production in India and Pakistan (Wang and McSorley, 2009).

#### Status

*C. juncea* is an introduced species in the United States and the genus *Crotalaria* is listed as a noxious weed in many states (USDA-NRCS, 2012). Please consult the PLANTS Web site and your State Department of Natural Resources for this plant’s current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

#### Weediness

This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, or state natural resource or agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site. Please consult the Related Web Sites on the Plant Profile for this species for further information.

## Description

*General:* *C. juncea* is a shrubby, herbaceous, sub-tropical annual legume that grows 3–9 ft tall. It has a long tap root with vigorous lateral roots and a thick, ribbed, pubescent (covered in short, soft hairs) stem that grows from ½ in (Duke, 1983) up to 2 in diameter (Treadwell and Alligood, 2008). Root nodules are lobed.

Its short-stemmed, bright green, trifoliolate leaves are simple and elliptical, 1.5–5 in (4–12 cm) long and 0.25–1 in (0.5–3 cm) wide, and arranged in a spiral around the stem. Since it is a short-day annual, vegetative growth occurs during the longer days of summer.

The stemmed, yellow flowers are on 10-inch (25 cm) unbranched, elongated inflorescences with blooms maturing from the bottom upwards. The showy, butterfly-shaped blooms are similar to many in the Fabaceae, or the pea family. The upper petal (standard) is rounded and sometimes streaked purple; the side petals (wings) are smaller than the upper; and the lowest petal (keel) is twisted.

Most varieties are day-length neutral. The light brown, densely-haired seedpods contain many dry, loose seeds that rattle when shaken. The seedpod is 1 in long and ½ in wide and inflated. Seeds are heart-shaped and dark gray to black.

*Distribution:* The origin of *C. juncea* is not certain (Duke, 1983), but it has been grown in India since prehistoric times (Mannetje, 2012). It is a tropical or sub-tropical plant native to South Asia and introduced to the West in the 19<sup>th</sup> century. In the United States *C. juncea* seed production is limited to the deep South, including Florida, Texas, Puerto Rico, and Hawaii. It is also grown in South America, Africa, and Asia. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

*Habitat:* *C. juncea* is grown in tropical, subtropical, and temperate locations from sea level to approximately 5,000 ft elevation (FAO, 2007), but is not found in the wild.

## Adaptation

*C. juncea* is adapted to a wide range of soils, and is well-suited for sandy soils. It grows well on marginal soils and under droughty conditions (Treadwell and Alligood, 2008). It grows best between 47 and 81.5°F (8.4 and 27.5°C) (Duke, 1983) on well-drained soils with a pH from 6.0 to 7.0, but will tolerate a pH of 5.0 to 7.5 (Cook et al., 2005). It can be grown throughout the year in Hawaii below an elevation of 1,000 ft (USDA-NRCS, 2009), but in most of the United States, it can only be grown as a summer annual.

It is well adapted to, and more productive in high humidity (Cook et al., 2005). It is not winter hardy, and

has a low to moderate tolerance to saline soils (Cook et al., 2005; Duke, 1983; Mannetje, 2012).

## Establishment

Inoculate seed with cowpea-type (EL) rhizobia and drill seed at 30 to 50 lb/acre (USDA-NRCS, 2009) 1 inch deep on 6-inch rows in a tilled, weed-free seedbed. A higher seeding rate of 49–58 lb/acre has been used to establish thick stands for green manure (Wang and McSorley, 2009) and higher rates are also used in fiber production to insure upright stems, produce finer fiber, and to increase yield (Duke, 1983).

Seedlings will appear within the first week after planting. Sensitive to moist soil conditions, if initial planting is followed by heavy rains within the first few weeks, many seedlings will not survive (Treadwell and Alligood, 2008). Nitrogen fixation and growth will be reduced under cool and shady conditions (Cook et al., 2005).

## Management

If the seedbed is well-prepared, and *C. juncea* drilled at a heavy rate, cultivation and fertilizer amendments are not required (Duke, 1983). Adding phosphorus may help to increase yields (Cook et al., 2005), but first a soil test should be taken to determine the need for any soil amendments. When grown as forage, *C. juncea* can be harvested 6 to 8 weeks after planting, and every 4 weeks thereafter (Cook et al., 2005).

For green manure, plow or disc stand before it reaches full-bloom stage and becomes too fibrous for effective use. This will typically be between 10–12 weeks after date of planting (Wang and McSorley, 2009) or when 50% of the flower buds have opened (Treadwell and Alligood, 2008). If mowed in the fall, rapid mineralization will occur during the winter, and nitrogen will be released from the leaves (Mansoer et al., 1997). This could lead to nitrogen leaching from the soil and denitrification into atmosphere if the crop is not followed by a subsequent winter cover.

Cutting the crop down to 1 ft 100 days after planting and then letting the plant re-grow for a period of 70 days has been found to increase the N content of the biomass (Abdul-Baki et al., 2001). This will help to increase leaf yield, and the largest concentration of N (3.96%) is in the leaves (Wang and McSorley, 2009). To keep the greatest amount of N in the residue into spring, use a no-till system instead of conventional tillage (Mansoer et al., 1997), as conventional tillage will lead to quicker N mineralization.

Another management strategy has been to harvest the top 1.5 ft of the crop, air dry, grind, and store the residue for later use as a nitrogen fertilizer (Wang and McSorley, 2009). Normally *C. juncea* is planted as a monoculture, and only occasionally planted with pearl millet

(*Pennisetum glaucum*) or corn (*Zea mays*), and rarely with other legumes (Cook et al., 2005).

Due to the high lignin, cellulose, and hemicellulose content in the stem, residue will be slow to break down. If residue is left to overwinter after a late fall mowing, enough plant residue will be left on the field at time of planting in April to meet conservation compliance guidelines of 30% residue coverage (Mansoer et al., 1997).

The crop can be harvested with a combine and can be easily threshed when dry. When harvesting and soaking for fiber production, there is no difference in strength and quality of fiber in plants harvested at flowering or after seed has matured (Duke, 1983). The cultivar ‘Tropic Sun’ is drought tolerant, but maximizes growth when given 1 in of water per week (USDA-NRCS, 2009).

### Pests and Potential Problems

*C. juncea* is a naturally poor host for nematodes and it produces allelopathic compounds that suppress sedentary plant-parasitic nematodes such as root-knot (*Meloidogyne* sp.), soybean cyst (*Heterodera glycines*), and reniform nematodes (*Rotylenchulus reniformis*) (Wang and McSorley, 2009).

*C. juncea* is susceptible to diseases such as *Fusarium* wilt (*Fusarium udum* var. *crotalariae*) and anthracnose; and pests such as the sunn hemp moth (*Utetheisa pulchella*), pod borers, and stink bugs (*Nezara viridula*) (Wang and McSorley, 2009). Rotate fields at least every 3 years to avoid outbreaks of pests and diseases (Cook et al., 2005).

### Environmental Concerns

*C. juncea* contains toxic alkaloids, particularly the seeds and pods, but the variety ‘Tropic Sun’ is considered non-toxic to animals (USDA-NRCS, 2009). Because it does not develop seed north of 28°N latitude (Treadwell and Allgood, 2008), there is little threat to the plant spreading or becoming weedy within the continental US.

### Seeds and Plant Production

Due to lack of an adequate tropical climate, seed production in the United States is currently extremely limited, so seed prices remain high. Attempts to produce seed in Florida have not been successful. It is cross-pollinated by bees (Duke, 1983) and self-pollination occurs only if stigmas are manipulated by insects or humans (Cook et al., 2005).

The seed of *C. juncea* will rattle in the seedpod when ready for harvest (approximately 5 months after planting), stems will be dry, and leaves will have fallen. Seed is harvested mechanically with a combine or by hand. Seed yields have ranged from 500–2200 lb/acre, varying with environmental conditions and cultural practices. Seed should be dried to below 10% moisture and stored at 40°F (USDA-NRCS, 2009). The seed size varies widely from

11,000 to 77,000 seeds per pound (Duke, 1983; M.A. Gonter, personal communication, 2012; Mannetje, 2012, USDA-NRCS, 2009).

### Cultivars, Improved, and Selected Materials (and area of origin)

The largest challenge to using *C. juncea* in the United States is locating available seed. The cultivar ‘Tropic Sun’ was developed by the USDA NRCS and the University of Hawaii Institute of Tropical Agriculture and Human Resources and released in 1983. It is non-toxic to poultry and livestock and is resistant to root-knot nematodes. This is a short-day cultivar that cannot consistently produce seed north of 28° N latitude (USDA-NRCS, 2009), so adoption has been limited.

### References

- Abdul-Baki, A.S., H.H. Bryan, G.M. Zinati, W. Klassen, M. Codallo, and N. Heckert. 2001. Biomass yield and flower production in sunn hemp - effect of cutting the main stem. *J. Veg. Crop Prod.* 7:83–104.
- Clark, A., editor. 2007. Sunn hemp: *Crotalaria juncea*. In: *Managing cover crops profitably*. 3<sup>rd</sup> ed. Sustainable Agriculture Research and Education, College Park, MD. <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition/Text-Version/Printable-Version> (accessed 6 June 2012).
- Cook, B.G., B.C. Pengelly, S.D. Brown, J.L. Donnelly, D.A. Eagles, M.A. Franco, J. Hanson, B.F. Mullen, I.J. Partridge, M. Peters, and R. Schultze-Kraft. 2005. Tropical forages: an interactive selection tool. *Crotalaria juncea*. CSIRO, DPI&F(Qld), CIAT, and ILRI, Brisbane, Australia. [http://www.tropicalforages.info/key/Forages/Media/Html/Crotalaria\\_juncea.htm](http://www.tropicalforages.info/key/Forages/Media/Html/Crotalaria_juncea.htm) (accessed 28 July 2012).
- Duke, J.A. 1983. Handbook of energy crops NewCROP (New Crops Resource Online Program), Purdue Univ. Center for New Crops and Plant Products. [http://www.hort.purdue.edu/newcrop/duke\\_energy/Crotalaria\\_juncea.html](http://www.hort.purdue.edu/newcrop/duke_energy/Crotalaria_juncea.html) (accessed 28 July 2012).
- Food and Agriculture Organization of the United Nations (FAO). 2007. Ecocrop (on-line resource). <http://ecocrop.fao.org/ecocrop/srv/en/cropListDetails?code=&relation=beginWith&name=Crotalaria+juncea&quantity=1> (accessed 28 July 2012).
- USDA-NRCS. 2009. ‘Tropic Sun’ sunn hemp release brochure. Hoolehua Plant Materials Center, Molokai, HI. <http://www.plant-materials.nrcs.usda.gov/pubs/hipmcrb8433.pdf> (accessed 31 Aug. 2012).
- Mannetje, L. 2012. *Crotalaria juncea*. FAO grassland species index. <http://www.fao.org/ag/AGP/AGPC/doc/Gbase/DATA/PF000475.HTM> (accessed 29 July 2012).
- Mansoer, Z., D.W. Reeves, and C.W. Wood. 1997. Suitability of sunn hemp as an alternative late-summer legume cover crop. *Soil Sci. Soc. Am. J.* 61(1):246–253.

Treadwell, D. D., and M. Alligood. 2008. Sunn hemp (*Crotalaria juncea* L.): a summer cover crop for Florida vegetable producers. Publication #HS1126. Univ. of Florida IFAS Extension. <http://edis.ifas.ufl.edu/hs376> (accessed 26 July 2012).

USDA-NRCS. 2012. The PLANTS database. National Plant Data Team, Greensboro, NC. <http://plants.usda.gov> (accessed 31 Aug. 2012).

Wang, K.H., and R. McSorley. 2009. Management of nematodes and soil fertility with sunn hemp cover crop. Publication #ENY-717. Univ. of Florida, IFAS Extension. <http://edis.ifas.ufl.edu/ng043> (accessed 27 July 2012).

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