



'Tropic Sun' Sunnhemp

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The fast growing, heat loving legume sunnhemp (*Crotalaria juncea*), which originated in India and Pakistan, is an excellent green manure crop. It grows exuberantly, reaching a height of 6 ft (1.8 m) within 90 days. Its ability to rapidly add nitrogen and organic matter to over-farmed soils makes it a favorite for improving soil quality and rejuvenating fields. The cultivar described here, 'Tropic Sun', produces a compound that is toxic to several nematode species, making it an excellent weapon for pest management. 'Tropic Sun,' is a joint release by the USDA Natural Resources Conservation Service (NRCS) and CTAHR.

Characteristics

'Tropic Sun' sunnhemp is a tall, branching, annual legume. It grows rapidly, achieving a height of 4–6 ft (1.2–1.8 m) in 60 days when grown under favorable conditions. The pea-type flowers are bright yellow. Its seed pods are cylindrical, about 1 inch (2–3 cm) long, and $\frac{1}{4}$ – $\frac{1}{2}$ inch (5–10 mm) wide.

Environmental requirements

'Tropic Sun' can grow on infertile soils, but its production is improved with good soil fertility or fertilizer applications. It grows best at a soil pH between 5 and 7, is adapted to a wide range of soils, and has optimal production on well drained soils. It tolerates alkaline pH up to 8.4. 'Tropic Sun' sunnhemp is naturally adapted to hot, semiarid, and arid areas and is drought resistant. It should receive a minimum of 1 inch (25 mm) of moisture per week for maximum growth, and it does not tolerate waterlogging. In Hawaii, sunnhemp grows year-round at elevations ranging from sea level to 1000 ft. At higher elevations (up to 2000 ft) planting should be limited to the warmer spring and summer periods, accord-

Benefits provided by sunnhemp

EXCELLENT source of organic nitrogen, for increasing soil organic matter, for controlling root-knot nematodes, for loosening subsoil

Non-toxic to animals (unlike other *Crotalaria* species, which contain toxic alkaloids)

PLOW DOWN before reaching full-bloom stage, or it becomes too fibrous

USE IN annual production systems at lower elevations, including vegetables, herbs, cut flowers and ornamentals, and dryland taro



ing to NRCS. The plant tolerates mean annual temperatures between 47 and 82°F (8–27.5°C). As a short-day plant, sunnhemp grows best in spring, summer, and early fall plantings.

Establishment

Into a well prepared weed-free seedbed, broadcast pure live seed at 40–60 lb/acre (45–67 kg/ha), or drill at 30–50 lb/acre (34–56 kg/ha) to a depth of $\frac{1}{2}$ –1 inch (12–25 mm) in rows 6 inches (15 cm) apart. Use higher seeding rates if the crop will be incorporated within 30–45 days or if severe weed competition is expected.

When planting sunnhemp where it has not been grown before, treat the seeds with a rhizobia inoculant to ensure that the plants develop a nitrogen-fixing symbiosis. The "cowpea-type" rhizobia bacteria (a *Bradyrhizobium* species) is found in most soils, but it may be lacking or in very low numbers in soils of areas receiving <20 inches (500 mm) of rainfall, or in the soil of newly abandoned sugarcane or pineapple fields. After the initial inoculation, the rhizobia will persist in the soil for years, so seed inoculation of subsequent sunnhemp crops is not necessary.

Soil incorporation

'Tropic Sun' sunn hemp should not be allowed to grow beyond the full-bloom stage if it is being grown as a green manure. Plow down the crop in the bud or early flowering stage (normally about 60 days from planting). If allowed to grow beyond this stage, the plants become fibrous and difficult to mow and plow under. Maximum foliage nitrogen content is highest at or before the early bloom stage. Home gardeners with light tillage equipment should incorporate when plants reach a height of 3 ft (90 cm), within 30–50 days after planting.

Equipment options for incorporating

- With a tractor-drawn rotary tiller or mower, mow and then disk as soon as possible so the residues do not become too dry. If the field is plowed, the chopped material tends to pile and drag in front of the plow if too dry.
- Plow the erect, standing crop. A single plow will usually do a better job than multiple plows. Do not disk or lay the crop down before plowing, as the plant will become tangled in the plow.
- Rototill with a rear-tine tiller, but only when the plants are succulent. For crops over 4 ft tall, mow first.
- Disk with a heavy-duty disk when the plants are succulent.

Uses

Soil improvement

'Tropic Sun' sunnhemp produces about 2.5 tons/acre dry matter and about 50 lb of nitrogen per ton of dry matter, according to NRCS. In Florida, a 3-month-old crop produced about 8000 lb/acre of dry biomass and fixed 180 lb/acre of N. Also in Florida, sunnhemp fixed 248 lb/acre N, compared to about 30 lb for sorghum-sudangrass, a non-legume. Several demonstration plantings at

CTAHR's low elevation Waimanalo Research Station on Oahu to measure sunnhemp yield during different times of the year are summarized in Table 1.

The tissue nitrogen content in sunnhemp is about 2.9%, with a range of 2.0–3.12%. The C:N ratio of sunnhemp residues is 16, with a range of 13.5–24. Legumes can help reduce fertilizer costs by fixing atmospheric nitrogen and making it available for the next crop.

Additional significant benefits come from adding organic matter to the soil. As soil organisms digest plant material, they produce compounds that bind soil particles together in crumbs-like aggregates, resulting in better soil structure, which promotes plant health and growth and increased water infiltration and water-holding capacity. Crops benefit from improved soil structure, especially during times of drought.

Sunnhemp is also valuable as a tool for breaking up soil compaction due either to naturally heavy clay sub-soil layers or hard pans resulting from machinery traffic.

Nematode control

Recent CTAHR research has shown than sunnhemp suppresses many plant-parasitic nematodes including *Meloidogyne incognita*, *M. javanica*, *M. arenaria*, *Rotylenchulus reniformis*, *Radopholus similis*, *Trichodorus cristiei*, *Xiphinema americanum*, *Belonolaimus longicaudatus*, *Helicotylenchus multicinctus*, and *Hoplolaimus indicus*. An evaluation of cover crops in central Oahu showed that sunnhemp was the most promising for managing the reniform nematode (*Rotylenchulus reniformis*) in pineapple fields, as an alternative to the use of nematicides. Sunnhemp produces a toxic nematicidal compound called monocrotaline. Nematode management systems that use "Tropic Sun" sunnhemp as part of a crop rotation program can be effective in controlling nematode infestations. Root-knot and reniform nematodes may infect the roots, but the pests do not reproduce well due to the nematicidal compound.

Control of weeds, soil erosion, and wind damage

With its rapid, tall growth, sunnhemp provides excellent suppression of weeds, and it helps prevent soil erosion by protecting the soil from raindrop impact. In Florida, weed populations in sunnhemp plots were 60% of those found in sorghum-sudangrass hybrid grass plots. Sunnhemp can also be effective as a short-term wind-break for sensitive crops.

Table 1. Sunnhemp above-ground fresh weight in various demonstration plantings at the CTAHR Waimanalo Research Station, Oahu, for production as a green manure crop (average plot size 100 x 40 ft).

Planting date	Mowing date	Weeks of growth	Top growth (lb/acre)	Height (inches)
Winter—early spring planting				
Jan. 12	Mar. 23	9	17,700	50
Feb. 8	April 6	8	7,500	35
April 22	June 17	7	28,400	70
Average			17,900	52
Early summer planting				
May 19	Aug. 15	12	15,600	96
(intercropped every other row with corn)				
June 10	Sep. 28	15	31,500	52
(harvested for seed on Aug. 25, woody by late Sept.)				
June 24	Oct. 15	15	22,600	34
June 24	Sept. 8	9	21,500	31
Average			22,800	53
Late summer—early fall planting				
Aug. 4	Oct. 19	9	13,300	58
Aug. 17	Oct. 24	10	25,000	83
Sept. 1	Nov. 29	12	21,500	61
Sept. 1	Nov. 29	12	24,000	74
Sept. 18	Jan. 4	15	16,400	51
(poor establishment and stands affected by wind)				
Sept. 26	Dec. 15	10	19,600	70
Average			20,000	66

Management cautions

Do not allow sunnhemp to grow beyond the full-bloom stage (about 60 days after planting) if it is to be incorporated as a green manure, as it becomes excessively fibrous and difficult to manage. The most common complaint about sunnhemp comes from farmers who "let it get away" and fail to mow it down early enough.

Pest problems

Aphids (*Aphis* species) and the bean butterfly (*Lampides boeticus*) are the main insect pests of 'Tropic Sun' in Hawaii. As a legume, it hosts many of the same insect pests that attack vegetable crops. This may be desirable if beneficial insects (natural pest enemies) are also at-

tracted to the field, which could then suppress pests in a following cash crop. However, growers should periodically scout sunnhemp fields to ensure that the plots are not becoming a nursing ground for particular pests such as whiteflies, stinkbugs, and thrips. Damping-off caused by *Rhizoctonia* may reduce sunnhemp stands when planting in humid weather or waterlogged soils. Sunn-hemp is susceptible to the nematode *Practylenchulus zea*.

For assistance:

Contact your nearest Cooperative Extension Service office for additional assistance in selecting appropriate cover crops and green manures for your farm and cropping situation. Help can also be obtained from the USDA Natural Resources Conservation Service field offices located on each island.

Visit CTAHR's Sustainable Agriculture for Hawaii Program Website at <<http://www.ctahr.hawaii.edu/sustainag>> to find additional information about green manure and cover crops. The site also includes references and links to other useful on-line resources.



Sustainable Agriculture in Hawaii . . .

. . . integrates three main goals—environmental health, economic profitability, and social and economic equity. Sustainable farms differ from conventional ones in that they rely more on management practices such as crop diversification and crop rotation, agroforestry, integrated pest management, rotational grazing, and innovative marketing strategies. For further information on Sustainable Agriculture in Hawaii, contact:

Dr. Richard Bowen,
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