

'TROPIC SUN' SUNN HEMP
Crotalaria juncea L.

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INTRODUCTION

This sunn hemp cultivar is a cooperative release by the United States Department of Agriculture, Soil Conservation Service; and the University of Hawaii, Hawaii Institute of Tropical Agriculture and Human Resources, Department of Agronomy and Soil Science.

ORIGIN

The seed of 'Tropic Sun' (*Crotalaria juncea* L.) was purchased in 1958 from a farmer who grew it as a cover crop on the island of Kauai. No other information is available regarding its origin. In the past, the Pineapple Research Institute did considerable work with the *Crotalaria* species and may have brought in this strain.

'Tropic Sun' is a direct increase of the original seed after comparing it with a number of other strains in a *Crotalaria* species nursery. It was further tested with three other promising *Crotalaria* species and various commercially available legumes and nonlegumes for use as a green manure crop. The Agricultural Research Service's Poisonous Plant Laboratory and the University of Hawaii tested the plant and its seeds for toxic substances, nematode resistance, and chemical content.

Sunn hemp is generally considered native to India, where it is used extensively for soil improvement, bast fiber, and occasionally for forage. It is probably the most widely grown green manure crop in the tropics, and is found in Indonesia, Rhodesia, Malaysia, Taiwan, Thailand, and China.

DESCRIPTION

'Tropic Sun' is an erect, branching, annual legume. It is a rapid, vigorous grower, achieving a height of over 4 ft (1.2 m) in 60 days when grown under favorable conditions (Figure 1). It can attain a height of over 6 ft (1.8 m) in approximately 90 days.

The plants are generally unbranched from the ground to approximately 2 ft (60 cm). Above this height, many branches will develop if plants are

not crowded. Branching begins higher and to a lesser extent if plant population is high, as for a green manure crop. The simple elliptical leaves are 2½ to 5 in (6½ to 12½ cm) long and ½ to 1 in (1¼ to 2½ cm) wide.

The flowers are bright yellow, and normally 18 to 20 of them will develop on terminal racemes (Figure 2). The papery, inflated seed pods are cylindrical, 1 to 1¼ in (2½ to 3 cm) long and ¼ to ½ in (½ to 1¼ cm) wide.

Seeds are dark slate green and about ¼ in (½ cm) long. There are about 15,000 seeds per pound (30,000 to 35,000/kilogram). Seed germination is high. Seeds and forage of 'Tropic Sun' were nontoxic in laboratory tests and feeding trials. Other species of *Crotalaria* contain poisonous alkaloids and, under certain conditions, can be toxic to animals.

USE

'Tropic Sun' is principally used as a green manure crop for soil improvement. It is an excellent, rapid-growing green manure to be included in rotation with vegetable, ornamental, and other plants to add nitrogen and organic matter, to suppress weeds, and to reduce root-knot nematodes. To achieve maximum benefits, plantings should be made at regular intervals in a planned crop rotation scheme.

'Tropic Sun' has added 134 to 147 lb of actual nitrogen per acre (150 to 165 kg/ha) to the soil when grown for 60 days and then incorporated in test plots. Organic matter yields of as much as 3 tons/acre (7 t/ha) air-dry weight can be produced within 60 days if growing conditions are favorable. In addition, 'Tropic Sun' is resistant to root-knot nematodes (*Meloidogyne* spp.). Experiments have shown that the number of root-knot nematodes in the soil can be reduced, probably because 'Tropic Sun' is not a suitable host.

Other possible, although as yet untried, uses for 'Tropic Sun' are as an annual source of papermaking fiber, cordage, and biomass for fuel.



Figure 1. 'Tropic Sun' sunn hemp at 50 days of age.



Figure 2. Flowers of 'Tropic Sun' sunn hemp.

ADAPTATION

'Tropic Sun' is adapted year round in Hawaii below an elevation of 1,000 ft (300 m) and in summer below 2,000 ft (600 m). Below 1,000 ft (300 m), it will grow well the entire year; however, because it is a warm-season plant, its growth during the winter may be slower than in summer. It is not recommended for use above an elevation of 2,000 ft (600 m).

'Tropic Sun' is adapted to soils ranging from coarse to fine textured, and on infertile as well as fertile soils. It grows best on well-drained soils with pH levels from 5 to 7.5.

'Tropic Sun's' full range of adaptation is not yet known since most of the testing has been limited to Hawaii's conditions. Guam, however, should be able to use 'Tropic Sun' and in the continental United States it should be adapted to spring and summer planting in the South and Southwest.

ESTABLISHMENT AND MANAGEMENT

To establish a successful stand, 'Tropic Sun' seed should be broadcast and covered or drilled about $\frac{1}{2}$ to 1 in ($1\frac{1}{4}$ to $2\frac{1}{2}$ cm) deep in a well-prepared, weed-free seedbed. For maximum yields, a soil test should be taken and the fertilizer and other soil amendments applied as recommended. Calcium carbonate for pH adjustment to at least pH 6.0 and phosphorus are needed for maximum dry matter and nitrogen production. Soils low in these elements should be fertilized to meet the needs of the crop. For example, some soils low in phosphorus may require an application of 300 lb/acre (336 kg/ha) treble superphosphate or 600 lb/acre (673 kg/ha) of single superphosphate fertilizer before planting. This phosphate can also be used by the succeeding cash crop.

If broadcast, 'Tropic Sun' should be seeded at the rate of 40 to 60 lb pure live seed per acre (45 to 67 kg/ha). If drilled, the seeding rate should be 30 to 50 lb/acre (34 to 56 kg/ha) in 6-in rows. The higher seeding rates should be used if the crop is to be incorporated in less than 60 days (30 to 45 days) or if severe weed competition is expected. High plant populations also tend to enhance stem succulence for easier incorporation. The seed should be inoculated with cowpea-type or "EL" inoculant to ensure effective nodulation as some soils may not contain the correct *Rhizobium* strain.

Damping-off disease of seedlings may occur during periods of high rainfall when the soil remains moist, although this has not been a serious problem. Good seedling vigor of 'Tropic Sun' seedlings makes it easy to achieve a thick stand.

Irrigation may be necessary to promote rapid germination and early growth. 'Tropic Sun' should receive a minimum of 1 in (25 mm) of moisture per week for maximum growth; however, it is quite drought tolerant. In a trial planting on Molokai, it produced a modest yield of about 1,000 lb/acre (1120 kg/ha) of green matter after 6 weeks on a total of only 2 in (50 mm) of moisture.

Sunn hemp should never be allowed to grow beyond the full-bloom stage if it is being grown for green manure. The crop should be plowed down either in the bud or early flowering stage (Figure 3), which normally is about 60 days or less after planting. If allowed to grow beyond this stage, the plants will become fibrous and will be very difficult to plow under. Home gardeners and farmers with light tillage equipment should plan to incorporate the plants when they are no taller than about 3 ft (90 cm), in 30 to 50 days.

When turned under at or before early bloom stage, nitrogen content will be high and decomposition rapid. This is important when a large quantity of nitrogen is desired immediately for subsequent cash crops.

Timing of plow-down is especially important in high-rainfall areas where too much soil moisture may prevent plowing at certain times. It is better to plow the green manure crop under earlier than usual when soil moisture conditions are favorable, rather than risk having the crop become overmature. Conversely, it may be necessary to irrigate before plowing in order to bring soil moisture to a favorable level in low-rainfall areas.

Satisfactory methods have been developed to turn the crop under. They are: (1) mow with a rotary or flail mower, then plow as soon as possible so the material does not get too dry; the chopped material plows under easily when green, whereas when dry it becomes light and tends to pile and drag in front of the plow; (2) plow the erect, standing crop; a single plow will usually do a better job than multiple plows; the crop should not be lightly disked or otherwise laid down before plowing, as the plants will become tangled in the plow; (3) rototill with rear-tine machines when the plants are succulent; if the crop is tall (over 4 ft), it should be mowed first; (4) disk with a heavy duty



Figure 3. Rototilling in a crop of 'Tropic Sun' sunn hemp at about 50 days of age.

disk when the plants are succulent; soil moisture must be at the correct level for any of these tillage methods to work well.

'Tropic Sun' may be incorporated as early as 30 to 45 days after planting and still contribute nitrogen and organic matter, although at reduced levels. This may be important to growers who want to keep their land in cash-crop production for the maximum amount of time. The plants will be 18 to 36 in (45 to 90 cm) tall. At this stage of growth, plowing, disking, or rototilling are easily accomplished. Growers who prefer to incorporate the crop 30 to 45 days after planting should seed at the rate of 60 lb/acre (67 kg/ha).

SEED AVAILABILITY AND PRODUCTION

'Tropic Sun' seed will be available in 1983 under the Seed Distribution Program of the University of Hawaii, or commercial sources. Breeder and Foundation seed will be maintained by the Soil Conservation Service's Plant Materials Center on Molokai.

Limited amounts of 'Tropic Sun' seed can be produced by allowing a small area of planting to mature and develop seed pods. The pods may be hand-harvested when the seeds rattle in the pods, normally about 5 months after planting. The pods are then crushed or cracked and the seeds separated. This procedure is labor intensive and is practical where only a small amount of seed is needed or where seed is not commercially available.

For commercial or large-scale seed production, use the following procedures:

1. Drill **three to four** seeds per foot about $\frac{1}{2}$ in (1 $\frac{1}{4}$ cm) deep in 36 to 42 in (90 to 105 cm) rows. This will give a seeding rate of approximately 3 to 4 lb/acre (3 to 5 kg/ha). Isolate the seed field from other *Crotalaria* plants.
2. Apply fertilizer according to recommendations developed from soil test results as a broadcast application before planting, or banded next to seed at planting.
3. Apply a preemergence herbicide (DCPA and trifluralin have been successfully used), and irrigate with at least 1 in (25 mm) of water to incorporate.
4. Irrigate if needed until about 75 percent of the plants are flowering. This stage usually occurs at the end of the third month. Stop irrigating after the 75 percent bloom stage.

'Tropic Sun' is easily threshed when dry and to enable the plants to dry naturally it is best to time the planting so that flowering, seed set, and harvest occur during the dry season.

5. Cultivate as needed to control weeds. The fields should be free of weeds at harvest to prevent contamination of the crop. If wild *Crotalaria* are present, they must be removed before harvest.
6. Observe the crop for insect and disease buildup and spray if necessary. Aphids (*Aphis* spp.) and the bean butterfly (*Lamproptides boeticus*) have been the main insect pests. Powdery mildew (*Oidium* sp.) may appear on leaves during very humid weather.
7. Combine when the seeds rattle in the pods, which will be about 5 months from planting. Raise the combine header as high as possible without leaving seed pods on the plants. This will prevent an excess amount of straw from slowing the combine operation. When starting, set the concave clearance at 1/8 to 3/16 in (1/3 to 1/2 cm) and the cylinder speed at 1150 to 1200 RPM and adjust as needed according to crop conditions.
8. When the seed crop is ready for harvest, the plants should be dry and self-defoliated; however, if showers after the last irrigation should keep the crop green, it will be necessary to desiccate the plants before combining. Otherwise, moisture from the green plants will create a sticky mass in the combine and make seed harvest very difficult, if not impossible. To dry the plants sufficiently for harvesting with a combine, spray with sodium cacodylate + cacodylic acid (as Montar), paraquat, or similar materials 1 to 2 weeks before harvest.
9. Clean the seed with standard commercial seed-cleaning equipment. Seed cleaning is easily accomplished if the fields are kept free of weeds. Dry the combined material before cleaning if necessary.
10. If commercial seed-drying and storage facilities are available, dry the seed to below 10-percent moisture and store at low temperature and humidity. Storage conditions are considered adequate for most crop seeds if the total of temperature in degrees

Farenheit plus percentage of humidity does not exceed 100, i.e., 60-degrees F. plus 40-percent relative humidity, or 70-degrees F. plus 30-percent relative humidity, etc.

Seed yields of over 2200 lb/acre (2470 kg/ha) may be expected; however, this will vary according to crop conditions, weather, and other factors. Actual seed yields of 'Tropic Sun' after harvesting by combine and cleaning with a commercial screen-type seed and grain cleaner have ranged from 1300 lb/acre (1460 kg/ha) to 2240 lb/acre (2510 kg/ha).

DISCLAIMER

Reference to a company or product name does not imply approval or recommendation of the product by the College of Tropical Agriculture and Human Resources, University of Hawaii, or the United States Department of Agriculture to the exclusion of any others that may be suitable.

'TROPIC SUN'

- Improves soil condition
- Provides additional nitrogen
- Produces large amounts of organic matter
- Resists root-knot nematodes
- Suppresses weeds
- Is nontoxic to poultry and livestock
- Tolerates drought
- Is adapted to a wide variety of soils
- Is not found in the wild
- Is not an alternate host for diseases known to affect commercial crops
- Produces high seed yields
- Is commercially available

IMPORTANT: To avoid difficulty when plowing down, till under at bud or early bloom stage.

Hawaii residents may order single copies of this publication free of charge from county offices. **Out-of-State inquiries or bulk orders** should be sent to the Agricultural Publications and Information Office, College of Tropical Agriculture and Human Resources, University of Hawaii, 2500 Dole Street, Krauss 6, Honolulu, Hawaii 96822. Price per copy to bulk users, \$.50 plus postage.

NOTE: As part of a structural reorganization, the Hawaii Agricultural Experiment Station and the Hawaii Cooperative Extension Service have been merged under the new name HAWAII INSTITUTE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES, College of Tropical Agriculture and Human Resources, University of Hawaii.

Hawaii Institute of Tropical Agriculture and Human Resources
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