Sunn hemp is an excellent choice for a summer cover crop because of the many benefits it can provide to the farming system. This article summarizes the available literature on sunn hemp from a variety of sources, including published research from UF faculty.

Figure 1. Sunn hemp seed (Courtesy of USDA).
History and Botanical Overview

A member of the family Fabaceae, it is a sub-tropical annual legume grown historically as a nonwoody fiber crop. Sunn hemp (*Crotalaria juncea* L.) has been used as a fiber crop in India since 600 BC, and is one of the earliest recorded fiber crops in history (Chadhury et al., 1978.). The genus name *Crotalaria* means “rattle” and refers to the noise made by the seed pods when they have matured. Research has been conducted in the US on sunn hemp since the 1930’s when it was reported to be valued for its ability to improve soil quality (Cook and White, 1996). Sunn hemp is also grown to provide biologically fixed nitrogen (N) to subsequent crops, suppress weeds and nematodes, add organic matter to soils, and in some parts of the world, it is used as a
forage crop. The distribution of sunn hemp includes tropical, subtropical and some temperate locations. In North America, distribution is limited to the Deep South including Texas, Florida, and Arkansas. Sunn hemp is also grown in South America, Central Africa, China, India and Indonesia.

Sunn hemp is an herbaceous annual that can grow to a height of 6 feet under favorable growing conditions. At the soil level, the stem diameter can reach 5 cm when sunn hemp is tall. The root system has a long tap root, and has many well developed lateral roots. The inflorescence is a terminal raceme, with yellow flowers typical of the sub-order Papilionaceae or pea group. Several flowering types of sunn hemp are reported. Most commonly they are day neutral, with days to flower ranging from 30-35 days in New Delhi, India (Chaudhury et al., 1978) to 170 days in Homestead, FL (Abdul-Baki et al., 2001). Mature pods bear numerous seeds that are dark grey and loose in the pod at maturity (Fig.1).
Cultivation and Management

Sunn hemp grows well during drought and on marginal soils with a pH between 5.0 and 7.5. Sunn hemp emerges around 3-7 days after planting (Fig. # 2), and grows very quickly (Fig. # 3). Germination and establishment is favored by moist but not wet soil conditions. Sunn hemp does not establish well if heavy rains follow planting, especially in the first few weeks. Seeding rate is typically 40-60 pounds of pure live seed per acre for green manuring, and seed can be drilled (40 lb/A) or broadcast (60 lb/A). If drilled, a row spacing of 6 inches is recommended by the USDA NRCS. Heavier seeding rates can be used if the desired objective is weed suppression, or if the crop will be terminated less than 60 days after seeding.
The cultivar ‘Tropic Sun’ was released by the USDA NRCS and the University of Hawaii Institute of Tropical Agriculture and Human Resources in 1983. This cultivar is not toxic to livestock or poultry (USDA NRCS, 2006). ‘Tropic Sun’ is popular with US growers, but production is largely limited to Hawaii and supply to US producers is often inadequate to meet demand. Sunn hemp is a short-day plant; it will not set seed north of 28°N latitude (Corpus Christi, TX) and therefore poses little risk of becoming a weed in production areas in the south. Long days favor vegetative growth, a desirable characteristic for cover crops. Because sunn hemp is a short-day plant, seed production in the US has been a challenge. Sunn hemp is typically seeded in June and July in Florida. When seeded at this time, the plant required more than 3 months to produce seed (Abdul-Baki et al., 2001).

For green manure applications, practices that produce high quality material and abundant biomass are most desirable. Nitrogen concentrations are generally higher in leaves and secondary branches than main stems. Increasing the ratio of succulent foliage to woody stems can be accomplished by increasing row width to induce more secondary branching, or by cutting the main stem. In Homestead FL, sunn hemp was seeded at 56 kg/ on April 15 and produced 20 mT/ha of dry biomass in ten to twelve weeks (70 to 84 days) (Abdul-Baki et al., 2001). However, management of the large woody stems is challenging and the crop can be difficult to incorporate without proper equipment. An alternative is to mow the sunn hemp periodically during the season to prevent development of woody stems. This will result in improved residue quality including an increase of secondary branches, higher shoot to root ratio, and an increase in percent N (Abdul-Baki et al., 2001).
Nitrogen Contributions by Sunn Hemp

Sunn hemp should be grown for at least 60 days to allow for sufficient biomass production if a N contribution is desired. Nitrogen in foliage ranges from 2-4% depending on the stage of growth. Nitrogen content is greatest at the onset of floral initiation to mid bloom, and declines as N reserves are allocated to seed production. For this reason, the optimum time to terminate sunn hemp is when approximately 50% of the terminal flower buds have opened. Leaves and flowers account for 50% of the total N throughout the production season, and 50-60% of the biomass during the first 4 to 6 weeks. Later in the season, stems account for the majority of sunn hemp biomass (Cherr et al., 2006). Roots extracted from soil samples to 60 cm accounted for 6% of total plant N and 10-13% of total plant biomass by the end of the growing season; little root mass was found below 60 cm (Cherr et al., 2006).

On sandy soils in warm climates, even short lag times between the release of green manure N and subsequent crop demand resulted in significant leaching losses (Weinert et al., 2002). In south Florida, summer cover crops terminated and incorporated prior to fall tomato were estimated to have a N content of 501 lb/A from sunn hemp, 230 lb/A from velvetbean and 93 lb/A from cowpea (Wang et al., 2003). In Citra, FL, sunn hemp grown as a summer cover crop before sweet corn (Zea mays L.) accumulated 146 kg/ A of N from 8.0 Mg/ha biomass and 172 kg/ha of N from 12 Mg/ha biomass over a 12-14 week period in 2001 and 2002, respectively (Cherr et al., 2006). Although approximately only 50% of this nitrogen would be available to subsequent crops, the actual N availability is difficult to predict due to the variety of biotic and abiotic factors that influence decomposition and microbial nitrification.
The potential for rapid mineralization of tropical legumes soon after incorporation necessitates preventative actions such as reducing the seeding rate, limiting overhead irrigation immediately following cover incorporation, planting a mixture of legume and nonlegume species, or maintaining cover residue on the surface for reduced tillage operations. The risk of N loss due to excessive nitrate in soil solution is exacerbated when incorporated cover crops are followed by a direct seeded crop. Small seeds placed 0.5 – 1.0 inch below the soil surface or small transplants do not develop a root system fast enough to utilize the rapid downward flow of nitrate driven by precipitation and irrigation in our sandy soils.

Previous Florida studies have shown that nematodes communities are affected by nutrient source (synthetic verses organic sources of N) and the C:N of the substrate and soil organic matter, but effects of tillage are minimal (Wang et al., 2004; Wang et al., 2005). A Florida study was conducted to determine if sunn hemp hay applied as an organic fertilizer could maintain key nematode taxa involved in nutrient cycling more than ammonium nitrate (Wang et al., 2005). Sunn hemp hay N was applied at 100 lb/A and 200 lb/A and compared to a control of 100 lb/A of ammonium nitrate in Cucurbita pepo ‘Crookneck Early’. The researchers observed that although ammonium nitrate produced larger plants with higher yields, the effects by sunn hemp on yield varied. Sunn hemp maintained high numbers of nematodes involved in nutrient cycling versus ammonium nitrate.

**Diseases and Insect Pests of Sunn Hemp**

Few serious diseases of sunn hemp have been reported. Powdery mildew (*Microsphaera diffusa* Cook and Peck) and a root and stem rot (*Sclerotium rolfsii* Sacc.)
were reported by Farr et al. (1989). In Texas, the soil fungus *Phymatotrichum omnivorum* Duggar causes a root rot in sunn hemp, while anthracnose (*Colletotrichum curvatum* Briant and Martyn) and wilt (*Fusarium udum* Butler f.sp. *crotalariae* Subramanian) are problems in India (Cook and White, 1996).

In Florida, the lima bean pod borer (*Etiella zinckenella* Treit.) and the bella moth (*Utetheisa bella* L.) have been reported to attack the pods of sunn hemp and reduce seed production (Seale et al., 1957). Foliar feeders such as flea beetles (*Longitarsus belgaumensis* Jac.), stink bugs (*Nezara viridula* L.) and silverleaf whitefly (*Bemisia argentifoli*; Bellows and Perring) have been observed on sunn hemp (Cook and White, 1996), but the influence of the cover crop on their life cycles and subsequent damage to following crops has not been fully explored in research.

**Insect and Nematode Suppression by Sunn Hemp**

A number of Florida studies have been completed on the role of sunn hemp in creating an unfavorable soil environment for key nematode species known to be crop pests.

Cover crops that are closely related to the following cash crop should be avoided since it is likely that both crops will have similar ability to host the same nematode pests. For example, peas planted after sunn hemp should be avoided.

Sunn hemp has been demonstrated to reduce populations of sedentary endoparasitic nematodes, a group that remains in one location and feeds on roots throughout their life cycle. This group includes root knot (*Meloidogyne* spp.), sting (*Belonolaimus longicaudatus*), stubby root (*Paratrichodorous minor*), dagger (*Xiphinema americanum*) and burrowing (*Radopholus similis*) nematodes (Wang and McSorley, 2004). The leaf extract of sunn hemp suppressed reniform nematodes in laboratory studies and can
also enhance natural enemies of plant-parasitic nematodes (Wang et al., 2001). A summary of the effects of sunn hemp on plant-parasitic nematodes is presented in the EDIS publication by Wang and McSorley (2004).

**Weed Suppression by Sunn Hemp**

In some cases, periodic mowing of cover crops during the season may facilitate an increase in total seasonal biomass production or an increase in the concentration of phytotoxins. When weed suppression is a primary objective for planting sunn hemp, increasing biomass production and toxin concentration are important management considerations. Sunn hemp suppresses weeds by reducing the light penetration at the soil surface (Cherr, 2004) as well as through chemical extracts (Alder and Chase, 2007).

Producers should keep in mind that the same toxins that negatively impact weed seed emergence can also reduce emergence of crops under some conditions. In a recent study on the effects of cover crop foliar extracts on germination of vegetable seeds, germination of bell pepper (*Capsicum annuum* L.) was suppressed after receiving extracts of cowpea (*Vigna unguiculata* L. Walp) foliage at 5% strength and sunn hemp foliage at 10% strength but were not affected by velvetbean when compared to a control of no extract (Adler and Chase, 2007). Only cowpea extract negatively affected the germination of tomato (*Solanum lycopersicum* L.). The authors noted that the negative effects could be minimized if the residue is incorporated, at least around the seed as in strip tillage, prior to planting. The use of large seeded crops or transplants can also
minimize negative effects of toxins, perhaps due to increased planting depth or more developed root system.

**Economics**

Sunn hemp seed is often difficult to find in large quantities, and the cost ranges from $1.55 to $2.75 per pound. Since no sunn hemp is grown for seed in the continental US, shipping can be prohibitively expensive. The cultivar ‘Tropic Sun’ is produced in Hawaii, South America and South Africa, and the shipping costs from Hawaii for a 50 pound bag is typically around $50. This brings the total cost to around $150 per acre, if a seeding rate of 50 pounds per acre is used. With sufficient biomass production, it is possible to offset fertilizer, herbicide and nematicide costs due to its N contribution and weed suppressive and nematode suppressive qualities. The long term benefits to soil quality and pest management of including sunn hemp in a vegetable rotation have not been evaluated.

**Summary**

Sunn hemp is a promising summer annual cover crop for the Southeast due to the many benefits it provides to the farming system. Seed availability and consequently the higher cost of seed may limit adoption, at least in the short term. Several growers in our area have expressed an interest in developing a production program for sunn hemp seed production. As seed becomes more available, adoption may increase.
Literature Cited


http://plants.usda.gov/plantguide/doc/pg_crju.doc


http://edis.ifas.ufl.edu/NG043