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Cover Crop Benefits for South Florida Commercial Vegetable Producers[1]

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This document describes the use of cover crops in southern Florida. The intent of this document is to identify cover crops that work in Florida's climate. Identified cover crops must also contribute to nutrient conservation and improve soil organic matter by incorporation of cover crop biomass. This document also includes discussion of other aspects of cover crop use in the vegetable production systems of south Florida.

The target audience for this document includes vegetable producers and other agricultural producers whose land is idle for several months each year. Certified Crop Advisers, farm consultants, and other parties interested in nutrient and soil conservation practices that address agricultural sustainability in Florida may also find this information of value. For growers with short term leases, cover crops may not be financially advantageous without additional arrangements with the landowner.

Cover Crop Overview

A cover crop is planted for the purpose of covering and protecting the soil, and in some cases for harvesting residual nutrients that were not used by the previous crop. Cover crops can either be crops grown between cash-crop cycles, such as vegetables, or intercropped with the cash crops (Figure 1), e.g. to cover the bare ground in orchards, groves, and other perennial crops.

Cover crops may also be grown as green manure (Figure 2). A cover crop used as green manure is usually incorporated into the soil while still green or just before it sets seed. This practice recycles nutrients that are contained within the green manure crop and contributes organic matter to the soil.

For the purposes of this document, cover crops were produced with minimal inputs. No irrigation or fertilizer was added to any of the crops described herein. Additionally, no pesticides or herbicides were used to protect the cover crops.

1. This document is SL-242, a fact sheet of the Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date June 2006. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.

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Figure 1. Example of a cover crop, *Centrosema macrocarpum*, grown between banana plants in Tarapoto, Peru. Attempts at intercropping cover crops in a tropical fruit grove were unsuccessful in south Florida. However, citrus growers in southwest Florida have successfully used perennial peanut in row middles (For example: Guide to Using Perennial Peanut as a Cover Crop in Citrus. http://edis.ifas.ufl.edu/CH180 .)

Figure 2. Cover crop being used as a green manure. This crop, Sunn hemp, is being cut (top photo) and rototilled (bottom photo) into the soil.

Typically, vegetable growers are faced with low organic, course-textured soils (usually less than 2% organic matter), which contributes to low nutrient and water-holding capacities within these soils. Soils are usually composed of sands (Figure 3), or gravels (Figure 4). These coarse particles further contribute to low water and nutrient holding capacities. Both gravel and sand soils pose wind erosion problems for seedlings and transplants. Selected cover crops can address this problem by acting as wind breaks, or just by providing additional organic matter to hold soil particles in place, which reduces the number of loose particles available for wind erosion.

Figure 3. The profile of a sandy soil, typical of the Flatwoods in Florida. This soil happens to be a Myakka fine sand, which is the Florida state soil.

In addition to having poor water holding capacity and low nutrient availability, vegetable land with coarse soil may also be affected by parasitic nematodes. Nematodes often adversely affect vegetable crop production causing damage to the roots and further restricting both water and nutrient uptake by the plant (Figure 5). Certain grassy or leguminous cover crops strongly suppress plant-parasitic nematodes. However, a given cover crop may not be effective against all species of parasitic nematodes in a region.

***Sorghum sudangrass* [*S. bicolor x S. bicolor var. sudanense* (Piper) Stapf.]**

Sorghum sudangrass, also known as Sorghum Sudan, (Figure 6) has been used as a cover crop throughout Florida at one time or another, and is still used by some growers during the fallow summer period in south Florida. Sorghum sudangrass usually

Figure 4. The profile of a gravelly soil. The soil is typical of soils found in the Homestead area, in the southern peninsula of Florida.

Figure 5. Okra roots affected by nematode infestation. Cover crops may decrease nematode infestations, providing better root-growing characteristics for subsequent vegetable crops.

produces 5-7 tons dry mass per acre. Since 0.92 percent of this material is nitrogen, the amounts of nitrogen potentially available to the subsequent cash crop range from about 90 to 130 pounds per acre. However, Sorghum-sudangrass falls short as a good cover crop for Florida. This plant grows poorly in many Florida soils, having been developed for the finer textured soils in the Midwest and South West. Sorghum-sudangrass often grows quite tall, requiring mowing to prepare the crop for green manuring, which adds cost to the crop. Its large fibrous stems have a high Carbon:Nitrogen ratio (C:N), which slows decomposition, and may immobilize nitrogen from the soil during decomposition. Lastly, Sorghum sudangrass often attracts armyworms and corn silk flies, which may be detrimental to subsequent vegetable crops. Even so, sorghum sudangrass suppresses weeds and some parasitic nematodes, and the seed is inexpensive ($1.00 to 1.50 per pound of seed).

Figure 6. Sorghum-Sudan (*S. bicolor x S. halepense*) being grown as a cover crop in the Homestead, FL area on a Krome soil series (loamy-skeletal, carbonatic, hyperthermic Lithic Udorthents). Note the good, healthy color and relatively uniform stand. This crop is helping to recycle nutrients for the next vegetable crop.

Sunn hemp (Crotalaria juncea L. cv. 'Tropic Sun')

Sunn hemp (Figure 7 & Figure 8) has a number of advantages compared to Sorghum-Sudan as a cover crop. This plant is an annual tropical legume that has a fast, 60- to 80-day production cycle, during which the plant may exceed 6 feet in height. Sunn hemp is a short-day plant that is quite drought-tolerant, grows well in both high and low pH soils, and is also resistant to root-knot nematode. Typically sunn hemp produces 6 to 8.5 tons of dry mass per acre. Since 2.85 percent of this material is nitrogen, the amounts of nitrogen potentially available to the subsequent cash crop range from about 340 to 450 pounds per acre. However, Sunn hemp does have several limitations. Seeds are rather high-priced ($1.50 to $4.00 per pound) due to import costs and limited seed availability. Seeds require *Rhizobium* inoculation before planting. In some fields, Sunn hemp stands may be reduced due to damping-off from *Pythium* or a form of *Fusarium*. Even with these possible limitations, Sunn hemp was among the best of the tested cover crops in southern Florida conditions.

Figure 7. Sunn hemp (*Crotalaria juncea* L. cv. Tropic Sun). Note the uniform stand and the height compared to weeds at the bottom edge of the photograph. Weed suppression and reduced weed-seed bank in the soil will reduce weed pressures on subsequent vegetable crops.

Figure 8. Mown and standing Sunn hemp.

Velvetbean (Mucuna deeringiana (Bort.), Merr.)

Velvetbean (Figure 9) is also an annual tropical legume that produces a large amount of biomass, is drought-tolerant, suppresses parasitic nematodes, and grows well in both high and low pH soils. Velvetbean may produce 5 to 7 tons per acre of dry biomass consisting of 2.6 percent nitrogen, which may provide from 260 to 360 pounds of nitrogen to the subsequent cash crop. However, velvetbean's large seed requires a special planter, and volunteer plants may persist into the next cash crop, requiring weed control. However, a small seeded cultivar, 'Georgia bush', can be seeded with some conventional seeders. Additionally, velvetbean may be potentially allelopathic to some subsequent vegetable crops. In field trials, velvetbean ranked among the best of the tested cover crops.

Figure 9. Plants, seeds (large size), and a planter for Velvetbean (*Mucuna deeringiana*). Top photo shows seeds of Sunn hemp, sorghum-sudangrass, and velvetbean from left to right.

Cowpea *(Vigna unguiculata L. cv. 'Iron Clay')*

Cowpea is a legume that grows well in a variety of soils, is resistant to root-knot nematodes, and has a short growing season of 40 to 50 days. Cowpea may produce 3 to 5 tons per acre of biomass consisting of 2 percent nitrogen, which may provide from 120 to 200 pounds of nitrogen to the subsequent cash crop. However, in southern Florida conditions, cowpea is not tolerant to flooding and produces a rather low biomass.

Aeschynomene (*Aeschynomene evenia* C. Wright)

Aeschynomene grows well on calcareous soils in southern Florida, and is a warm-season legume forage. It is resistant to root-knot nematodes. Aeschynomene's single apparent disadvantage for southern Florida conditions is its low biomass production.

Sesbania (*Sesbania exaltata* Raf.)

Sesbania, like aeschynomene and cowpea, is a warm-season legume forage that is well adapted to Florida conditions. However, sesbania is susceptible to root-knot nematodes, and does not quickly form a closed canopy, competing rather poorly with some of Florida's persistent weeds.

German millet (*Setaria italica* (L.) P. Beav.)

German millet grows well in southern Florida and has been proven to be resistant to root-knot nematodes; however, like some of the other tested crops, German millet produces low biomass.

Measured Effects of Selected Cover Crops in Southern Florida Conditions

As stated before, cover crops can capture residual nutrients during their growing cycle and subsequently make these nutrients available for the following vegetable crop. This process retains nutrients in the field, which is a well recognized Best Management Practice (BMP). When cover crops are returned to the soil (green manuring), they contribute considerable organic matter to the soil (shown as Dry Matter in Table 1). Typically, production of approximately 5 tons dry matter per acre is equivalent to raising the organic matter of the soil in a six-inch layer by 1% (This calculation assumes that a 6-inch layer of soil weighs 2,000,000 pounds per acre, a typical value for a sand). Since many of Florida's soils have between 2 and 3% organic matter, this 1% increase is a substantial change. Because of Florida's hot, humid climate, this additional organic matter will be broken down rather quickly. Nonetheless, the additional organic matter will directly contribute to the subsequent vegetable crop, both through enhanced nutrients as well as some improvement in soil water holding capacity. In almost all cases, cover crops improved the yield of the following vegetable crop in South Florida field studies.

Table 1. Dry matter production and nitrogen content from selected cover crops in southern Florida.

Cover Crops	Maximum dry matter (tons/ac)	N in Cover Crop (lb/ac)
Sunn hemp	5	300
Velvet bean	6	282
Cowpea	3	86
Sorghum-Sudan	2	33

Another contribution that cover crops can make is to increase the available nitrogen and other plant nutrients in the soil. Legumes can convert atmospheric nitrogen to plant available forms through a symbiotic relationship with *Rhizobium* bacteria, further contributing to plant nutrition.

Cover crops are often selected based on their rapidity of establishing, covering the ground, and producing copious amounts of biomass. These traits suppress weeds and help to reduce the weed-seed bank in the soil. Also some cover crops release chemicals into the soil through their roots or from their shoots after soil incorporation, and these chemicals suppress weeds, plant-parasitic nematodes, and some pathogens. Weed suppression also benefits subsequent cash crops, which often experience decreased weed competition. Decreasing the weed population may also reduce pest pressures on vegetables because weeds often serve as hosts for insects and/or disease pathogens.

Parasitic nematode infestation is a frequent problem for vegetable production in Florida. Cover crops effectively reduced the harmful effects of nematodes, preventing yield loss, or avoiding total crop failure. Cover crops have been shown to reduce populations of the following harmful nematodes: *Helicotylenchus; Meloidogyne* (root-knot, a major parasitic nematode of tomato and okra plants); *Pratylenchus; Rotylenchulus reniformis*; and *Quinisulcius*.

Unsuitable Cover Crops for South Florida

A number of other cover crops have been tested in southern Florida and found to be unacceptable (Table 2), though some of these do quite well in the northern part of the state. Some grow poorly in southern Florida conditions, while others are not suited for commercial use for one reason or another. For example, a cover crop may become a weed in the subsequent vegetable production cycle, or the cover crop may enhance nematode populations, thereby adversely affecting the subsequent vegetable production cycle.

Potential Cover Crops for South Florida

There are a number of additional crops that are being used in other parts of the United States as cover crops. These crops have not been tested in southern Florida conditions and cropping systems; however, future research will address these crops (Table 3). As research progresses, UF/IFAS will schedule field days (Figure 10) to demonstrate new cover crops and equipment that might be associated with their production. Because nutrient and pest management are linked directly to BMP activities, the use of cover crops in an effective and cost-efficient manner is important to the sustainability of Florida agriculture.

Table 3. Additional cover crops used in other parts of the United States that show promise for southern Florida conditions.

Common Name	Genus and Species
Pigeon pea	*Cajanus cajan* L.
Horse bean	*Vicia faba* L.
Runner bean	*Phaseolus coccineus* L.
Bell bean	*Vicia faba* L.
Lupin	*Lupinus angustifolius* L.
Mustard	*Brassica juncea* L.
White clover	*Trifolium repens* L.
Bahiagrass	*Paspalum notatum* Flugge
Bromegrass	*Bromus inermis*
Jack bean	*Canavalia ensiformis* L.

Summary

Cover crops are an effective way to retain nutrients for subsequent vegetable crops, and thus, are an important BMP for southern Florida. These crops also suppress weeds and pests such as parasitic nematodes; and return as much as 5 tons dry matter per acre to the soil, directly affecting nutrient and water holding capacities of the soil. Marketable vegetable yields benefited from following a cover crop, making the use of these crops worthwhile to vegetable producers. While no cover crop is without some limitations, this research demonstrated that Sunn hemp and velvetbean were superior to the other tested cover crops.

For Further Reading

The following EDIS publications deal with related issues and may be of interest to the reader. Please visit the EDIS Web site at http://edis.ifas.ufl.edu.

Chambliss, C. G., R. M. Muchovej, and J. J. Mullahey. 2003. Cover Crops. http://edis.ifas.ufl.edu/AA217.

Dunn, R. A. 2003. Soil Organic Matter, Green Manures and Cover Crops For Nematode Management. http://edis.ifas.ufl.edu/VH037.

Rich, J. D. Wright, J. Marois, and D. Sprenkel. 2003. Selected Legumes Used As Summer Cover Crops. http://edis.ifas.ufl.edu/IN483.

Rouse, R. E., R. M. Muchovej, J. J. Mullahey. 2001. Guide To Using Perennial Peanut As A Cover Crop In Citrus. http://edis.ifas.ufl.edu/CH180.

Wang, K. H, and R. McSorley. 2004. Management of Nematodes with Cowpea Cover Crops. http://edis.ifas.ufl.edu/IN516.

Simonne, E., and G. J. Hochmuth. 2003. Cover Crops in the BMP Era for Vegetable Crops Grown in Florida in the BMP Era. http://edis.ifas.ufl.edu/HS164.

Figure 10. UF/IFAS Cover Crop Field Days where growers and other interested parties are able to discuss crop management, weed and pest control options, and equipment requirements with the researchers and extension state and county faculty members.

Table 2. Cover crops that have proved to be unsuitable for southern Florida growing conditions or commercial vegetable production operations.

Common Name	Genus and Species	Notes
Buckwheat	*Fagopyrum esculentum*	Poor germination and slow growth
Savanna Stylo	*Stylosanthes quionesis*	Poor germination and slow growth
Crimson Clover	*Trifolium incarnatum*	Low biomass
Hairy Vetch	*Vicia villosa* Roth	Low biomass
Austria winter pea	*Pisum sativum* spp *arvense*	Poor growth
Perennial peanuts	*Arachis glabrata* Benth	Take long time for establishment
Peanuts	*A. sativa*	Long growing season, possible weed, pest host
Soybean	*Glycine max* L.	
Sunflower	*Helianthus annuus* L.	Low biomass
Guar	*Cyamopsis tetragonolobus* L	Grows well, but low biomass
Oats	*Avena sativa* L.	Poor growth
Hairy indigo	*Indigofera hirsuta*	Reducing root knot nematodes, but poor germination and slow growth
Mexican sunflower	*Tithonia rotundifolia*	Poor growth