Management Considerations for Annual Cover Crops in Florida Vegetable Systems

Danielle Treadwell and Michael Alligood

Cover crops are crops grown for purposes other than harvestable yield, and are grown concurrently with a vegetable crop (living mulch), incorporated while alive (green manure), chemically or mechanically killed and incorporated, or left on the surface as a mulch (conservation tillage). Cover crops can improve soil physical properties, supply nitrogen, suppress weeds and interfere with pest life cycles. While not all of these benefits are realized at each application, producers should select cover crops that offer multiple benefits at once. Producers should also consider potentially negative consequences of the cover crop to the cropping system prior to selecting cover crop species. In some instances, the cover crop can serve as an alternate host to crop insects or diseases, require additional labor and expense or delay crop planting. A cover crop should satisfy the producer’s objective, be easy to establish with minimal to no inputs, be
managed with equipment and labor resources at hand, not compete with the primary crop and perform well under various environmental conditions.

Matching suitable cover crop species to objectives and regional conditions is critical. Producers must estimate planting and killing dates to compliment primary (cash) crop rotation. Cover crops are annuals and perennials, tropical (unlikely to survive at temperatures lower than -2 °C) or temperate (can withstand temperatures to -10 °C), erect or prostrate. Annual cover crops are most often used in intensive vegetable rotations, since perennial species such as perennial peanut (*Arachis glabrata* Benth.) may take several months to a year to fully establish. This month’s Cover Crop Corner focuses on planting, seasonal management and method and timing of cover termination.

**Temporal Opportunities in Vegetable Rotations**

Opportunities for inclusion in the cropping system are limited due to the nine month growing season, but several options are available. For producers in south Florida (south of Tampa), the best opportunity to grow a cover crop is summer (July-September) since few producers have cash crops in production at that time. Although the summer climate may be unsuitable for vegetable crops due to the high temperatures and heavy precipitation, a number of tropical species are well adapted for these conditions. The most widely used tropical legume green manures are *Crotalaria juncea* L. (sunn hemp), *Glycine max* L. (soybean), *Indigofera* spp. (Indigos), *Mucuna* spp. (velvetbean), *Vigna unguiculata* Walp. (cowpea), *Cajanus* (pigeonpea) and *Sesbania* spp. (Cherr et al., 2006). Sorghum sudangrass [*Sorghum bicolor* x *S. bicolor* var. *sudanense* (Piper) Stapf.] and its relatives are good candidates for summer plantings due to their ability to survive periodic flooding.
North Florida producers (north of Ocala) can produce cover crops during summer months as well as winter months (November through March). Winter annual cover crops are typically planted as a “catch crop” to uptake nutrients remaining in the soil following a summer or early fall vegetable crop harvest. Erect species such as cereal rye (*Secale cereale* L.) can serve as a wind break as well as a physical support for vining legumes. Temperate species used in the northern part of the state include rye, ryegrass (*Lolium multiflorum* Lam.), wheat (*Triticum aestivum* L.) and oats (*Avena sativa* L.). These winter annual cereal grains have well-developed root systems that are capable of utilizing soil N from profiles lower than vegetable crops. Red clover (*Trifolium pratense* L.) ‘Southern Belle’ released by the Florida Agricultural Experiment Station in 2002 may be a good candidate for a winter cover crop throughout Florida due to its high biomass, early flowering as well as its adaptation to the cool temperatures, low precipitation and low light of Florida winters.

**Production Considerations**

*Seed Availability.* Popular cover crops such as sorghum sudangrass and cowpea have many named varieties and are widely available at local feed and seed stores and national seed retailers such as Johnny’s Seeds. Frequently seeds of these varieties are treated with a fungicide to prevent seed-born diseases but vendors are often very accommodating and with advance notice they will work with suppliers to reserve seed prior to treatment. Certified organic cover crop seed is becoming increasingly available, but demand is greater than supply and therefore seed can be expensive.

Cover crops with emerging popularity such as velvetbean can be difficult to locate in large amounts. Typically, they are sold as unnamed cultivars and are available from a
limited number of sources. National retailers specializing in open pollinated seed are a
good source for unnamed cultivars. Awareness of the diversity of cover crops has been
facilitated by research efforts at universities and innovative producers. However, cover
crop breeding efforts at universities and private industries is rare. Perhaps if demand for
cover crops increases, there will be increased motivation to invest in research and
development for crop improvement.

*Polycultures.* Two or more species can be planted concurrently (polycultures) to
achieve multiple objectives or to reduce the risk of crop loss. Polyculture plantings
require additional planning but can be beneficial. For example, combining vining types
such as legumes with tall cereal grains allow for the potential of increased biomass due to
the structural support of the legume by the cereal grain. Production constraints of
polycultures typically involve extra equipment, as some seed drills may not be able to
seed two or more species of different seed sizes in the same pass. Thus, additional passes
or an alternate method of planting such as broadcasting may be necessary. In general,
using a drill to plant cover crops is the recommended method. Drilling results in a better
stand than broadcasting because seeds are protected from predation of birds and small
animals as well as the high temperatures and dry conditions on the soil surface. If
broadcasting is necessary, seeds should be lightly incorporated with a tillage implement
designed for minimal soil disturbance such as a tine or basket weeder. In addition,
producers should ensure the method and timing of kill is appropriate for both or all
species included in the mix.

*Planting.* Poor stands of legume cover crop may result if seed are not properly
inoculated with appropriate inoculums for the species. Cover crops are rarely fertilized
since they have no immediate cash return, however the additional biomass gained with ensuring adequate nutrition per soil test results may offset some fertilizer N costs in the following cash crop. Many tropical cover crops are commercially available but untreated, and may be susceptible to soil born diseases such as *Fusarium spp*. Failure to achieve an adequate stand may result in increased weed occurrence. Several UF-IFAS extension publications on cover crop production are available electronically on EDIS including recommended planting dates for north, central and south Florida (Whitty and Chambliss, 2005) and a recent summary of summer cover crop species and benefits for south Florida producers (Li et al., 2006; Rich et al., 2003).

*Seasonal Management.* 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. 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 ha$^{-1}$ on April 15 and produced 20 mT·ha$^{-1}$ of dry biomass in ten to twelve weeks (70 to 84 days) (Abdul-Baki et al., 2001). However, sunn hemp has large woody stems and 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).
Timing and Method of Kill. Timing of cover crop termination is dictated by the desired cover crop services and production constraints. If the objective is N provision, timing of kill is very important. When legumes are used, the maximum amount of nitrogen that can be accumulated by the plants will occur at midbloom, or when one half of the inflorescence is fully expanded and the other half of blooms are in bud (Creamer et al., 1995). Under these conditions, nitrogen and carbohydrates are translocated from storage organs to the inflorescences, but these nutrients have not yet been acquired in seeds. Producers should resist the temptation to terminate cover crops before adequate biomass has accumulated. Adequate biomass is necessary to achieve weed suppression through preemptive use of resources, physical or mechanical suppression (when surface mulch is used in row middles or for conservation tillage). If early termination in spring or fall is necessary due to short breaks in the rotation, select species that accumulate biomass quickly (such as rye in the winter for north Florida or sorghum in the summer for south Florida).

Producers have a variety of chemical and mechanical options for terminating cover crops. If a chemical option is selected, producers need to verify that the chemical is labeled for the cover crop. Organic producers will have only mechanical methods available, while conventional producers have both options available. The choice of cover termination methods depends on what function the producer desires for the plant material. For example, a desire to create surface plant mulch for weed suppression will lend itself to a different kill method than an objective to improve soil physical properties. The effectiveness of mechanical kill depends on the cover species, growth stage of the cover, equipment selection and to some degree climatic conditions at the time of kill. In
an Alabama study, the effectiveness of a roller-crimper to kill cover crops of cereal rye, black oat and wheat was compared to labeled rates of the herbicides paraquat or glyphosate (Ashford and Reeves, 2003). Cereal grains killed following anthesis with the roller-crimper and half the herbicide rate averaged a 94% kill compared to the full herbicide rate treatment, while cereal grains were killed as effectively with a roller crimper as the full rate of herbicides (95% mean kill across mean methods) when killed in the soft dough growth stage.

Equipment typically used in killing cover crops includes mowers, undercutters, roller/crimpers, and plows. Rotary cutters such as Bush Hog (Selma, AL) are composed of free swinging blades designed for medium duty applications such as grass, corn stalks and light brush. The cut material is severed at the base and may be cut again as the material is moved under the deck. The result is surface mulch cut in relatively long sections and generally distributed across a wider area than the width of the deck. Producers wanting more control over the distribution or size of the material may opt to use a flail mower. Flail mowers consist of vertical swinging blades, and in some models the direction of the rotation can be reversed for a controlled rear discharge of plant material. Additionally, plant biomass is cut in smaller, more homogeneously sized pieces so that incorporation and decomposition occur more rapidly and consistently throughout the bed compared to a rotary cutter. Because the meristematic area of monocots (grasses) is close to the crown of the plant, the mower blade must be set very low to cut the growing area and terminate growth. Air temperatures that are sufficiently hot (several consecutive days above 90 F) can facilitate termination of temperate grass cover crops following an aggressive mowing. Should dicots continue growing after mowing, a second
mowing with the blade set to remove the growing tips should be sufficient to kill the cover especially if high temperatures are present.

Undercutters were very popular in the 1940’s and 1950’s using V-shaped blade cutters. An updated version was designed and tested by researchers at Ohio State University that features a long blade that runs just below the soil surface to severe roots of cover crops just below the ground (Creamer et al., 1995). On the surface, a rolling basket is located to the rear of the blade to flatten the severed crop. The advantage of this implement is that kill can be achieved without cutting the cover crop. This method of kill is suitable for producers who desire slowly decomposing surface mulch for weed suppression. The undercutter has successfully killed spring and summer annuals but has been less successful with biennial and perennial species such as perennial ryegrass, red clover and fescue. Further, success has been limiting with sorghum-sudangrass, cow peas and pearl millet.

Similar to the undercutter, roller crimpers kill cover crops by crushing and crimping the stems therefore preventing nutrient and water flow through the vascular system. Roller crimpers come in a variety of styles and sizes.

Many producers have made their own using weighted drums with welded angle iron strips running horizontally or in a spiral. Many producers have complained of excessive vibration of the roller passing over the cover crop that has obligated them to
reduce operational speed. Designs that feature a spiral blade design or a short and staggered straight blade system reduce vibration and are as effective as the long straight blade system in killing cover crops (Raper et al., 2004). Rolling stalk choppers, such as the Buffalo stalk chopper made by Fleischer (Columbus, Nebraska) are a popular choice for killing cover crops. Parallel linkage allows smaller roller units to float independently, an advantage on uneven land. One disadvantage of these rollers is that plant material can wrap around the bearings, but this can be eliminated with the addition of a protective cover around the wheel bearing.

In a study of three methods of kill of summer cover crops in North Carolina, undercutting killed 95% of five of the six broadleaf species tested and two of five grass species (Creamer and Dabney, 2002). Mowing was effective on all the broadleaf covers, but did not kill immature grasses. Only nearly mature German foxtail millet and mature Japanese millet did not re-grow after mowing. Rolling with a roller-crimper was effective on German and Japanese millet, and mature buckwheat.

In summary, how cover crops are managed can have significant ecological impacts on the cropping system including crop establishment, nutrient availability and pest occurrence. Future Cover Crop Corner issues will continue to explore these relationships, as well as highlight the biology and best management practices of individual cover crop species.

**Literature Cited**


