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Cover Crops [1]

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Introduction

The use of cover crops dates back over 2,500 years. Several ancient Greek and Roman sources suggest growing cover crops to produce green manure for vineyards and other crops. However, during the past century there has been a trend within conventional agriculture to ignore the role of soil organic matter in crop production, and the use of commercial chemical fertilizers for agricultural crop production has greatly increased. Although chemical fertilizers are affordable and easy to apply, they don't add to soil organic matter. In fact, the gradual decline in soil organic matter associated with continued chemical fertilizer use, particularly in the extremely sandy soils of Florida, makes it difficult to maintain crop vigor, yield and quality.

Appropriate use of cover crops, on the other hand, may partially replace chemical fertilizer usage and thus, reduce dependence on fossil fuels and foreign oil. Moreover, cover crops function as slow release fertilizers, thereby reducing excessive nutrient leaching. Their use may also sustain/enhance soil organic matter content. This is critical or many Florida soils, especially for sandy soils which typically have low inherent soil fertility, do not retain much water or nutrients, and are often prone to excessive nutrient leaching losses. Whether cash crops are produced organically or conventionally, the incorporation of cover crops/green manures into a management plan will provide numerous benefits and some challenges. This publication provides some basic guidelines for the successful use of cover crops.

Potential benefits/challenges

Cover crops can be used for several purposes:

1. To control weeds since cover crops compete for light, water and nutrients;

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2. To prevent soil losses associated with heavy rainfall (soil water erosion);

3. To reduce soil losses due to strong winds (e.g. prevent soil wind erosion and a potential "dust bowl") and to protect more sensitive crops such as watermelon from sand blasting damage;

4. To scavenge and retain nutrients that otherwise might be lost in water runoff or by leaching during the off-season. This helps reduce fertilizer costs for future crops and also protects the environment from problems caused by excess nutrient loading in our water sheds;

5. To reduce populations of certain soil pathogenic nematodes;

6. To generate supplemental income (e.g. via hay production);

7. To form a suitable mulch cover for row middles and/or mulched beds;

8. To provide habitat for beneficial birds and insects.

Many cover crops will fulfill several of the above purposes. For example, a crop that will produce enough growth to outcompete weeds should produce enough herbage to sustain and/or improve soil organic matter content. Although cover crops provide many benefits, some may also be excessively tall, woody and/or weedy. They can also potentially interfere with cultivation or harvesting, while others may harbor pests and diseases. Consequently, selection of the right cover crop for a particular situation is critical.

Cover crop classification

One of the main issues to consider when choosing a cover crop is the season or period in which it will be needed. We can differentiate between crops that are short-lived (annual cover crops such as winter rye) vs and crops that can remain for many years (perennial crops such as bahiagrass and perennial peanut). Annual cover crops can be categorized into two main classes, : 1) crops that are adapted to cool, short days (winter cover crops such as hairy vetch) and 2) those that are adapted to hot, long days (summer cover crops such as cowpea). We can further differentiate between grass/grain vs. leguminous type cover crops. An overview of available cover crop within each of these groups and their performance, in terms of herbage (biomass) and nitrogen (N) production is presented in Table 1.

Leguminous crops, initially, tend to grow slower than grass/grain crops, and may not produce as much seasonal biomass (herbage) but they may add between 60-200 lbs N/ac per cropping season. Legumes have the ability to symbiotically associate with certain soil bacteria (rhizobia) that fix atmospheric nitrogen. Therefore, if an appropriate inoculant is used or sufficient symbiotic N-fixing bacteria are present in the soil, no supplemental N fertilizer is necessary to produce abundant biomass. Their herbage also tends to be richer in proteins with no nitrates, and decomposition is more rapid, compared to grass/grain crops. Since legume inoculants are readily available and relatively inexpensive, it pays to inoculate legume seed prior to planting, especially if that species of legume was not recently grown in the field.

Summer cover crops tend to generate more biomass and cool season leguminous crops, on the other hand, require adequate soil moisture, fertility (especially phosphorus), and a suitably high (6.0 – 6.5) soil pH to perform well. These winter season legumes often do not perform well on sandy soils during the first years of cultivation. In contrast, many of the warm season annual leguminous crops listed in Table 1 tend to be a little bit more vigorous and require additional management.

Cover crop establishment

Cover crops are grown in pure or mixed stands. Most annual cover crops need to be established each year, but some types may reseed naturally (e.g. alyceclover, iron/clay cowpea, and hairy indigo). Reseeding types may be preferable for groundcovers in orchard systems since they may reduce replanting cost. However, in other systems they may potentially become weeds and need to be mowed in a timely

fashion to prevent problems. An overview of suggested seed rates is outlined in Table 1 .

Cover crops can be planted in rows spaced 8-24 inches apart or broadcasted. Use of more narrow row spacing will hasten initial groundcover and is more effective for weed suppression. Cover crops may be grown in rotation with various cash crops as a temporary or permanent ground cover (living mulch) in tree groves and citrus orchards. The advantage of perennial species is that they need to be established only once and provide a continuous ground cover. Perennial crops that are propagated asexually by sprigs are more expensive unless equipment and plant material is available on-farm. Perennial peanut tends to establish slowly and usually take 1-3 years to obtain a satisfactory solid ground cover. Cover crops may be maintained as living mulch, harvested as hay, or incorporated into the soil once they have broken down. Depending on the seed rate and seed cost, establishment costs are on the order of $60-$150/acre and $160-400/acre for annual and perennial cover crops, respectively. The use of cover crops is typically most cost-effective if one crop fulfills multiple needs.

Conclusions

One of the key challenges in using cover crops is to maximize crop nutrient accumulation as well as matching the demands of a succeeding commercial crop to the specific nutrient release patterns from of a cover crops residues that meet the demands of a succeeding commercial crop. Since cover cropping was integral to past Florida farming practices, it may be worthwhile to take advantage of the experience and knowledge of older farmers in your region who farm similar soils and have used cover crops successfully. There is no perfect cover crop for each and every situation. Finding the best cover crop to address your specific needs may take some patience and experimentation with different crops, crop combinations, and management practices. However, use of appropriate technological innovations and/or suitable equipment (e.g. crimpers or flail mowers) and/or herbicides may facilitate improved cover crop benefits. Use of multiple species can further enhance the adaptability and performance of a cover crop system. This is especially important when growth conditions are less favorable for one of the component species (e.g. poor and variable soil fertility and unpredictable weather conditions). In this case, plant types should be chosen that complement each other rather than compete with each other. The crops listed in Table 1 can supply large amounts of material to contribute to the soil organic matter. A more comprehensive and detailed review of the use of cover crops and green manure can be obtained from the references listed below.

Suggested Reading

Cherr, C.M., J.M.S. Scholberg, and R. McSorley. 2006. Green manure approaches to crop production: a synthesis. Agronomy Journal 98:302-319.

Y. Li, E. A. Hanlon, W. Klassen, Q. Wang, T. Olczyk, and I. V. Ezenwa. 2006. Cover crop benefits for South Florida commercial vegetable producers. EDIS publication SL242. http://edis.ifas.ufl.edu/pdffiles/SS/SS46100.pdf.

Table 1. Cover crops for use in Florida.

Crop	Yield - Biomass[1] (lbs/acre)	Yield - N[1] (lbs/acre)	Seeding Rate(lbs/acre)	Seeding Date
ANNUAL SUMMER COVER CROPS				
Leguminous Crops				
Aeschynomene	2000 - 4000	50-100	6-8[2]	Mar. 1 - June 30
Alyce clover	1500-3500	20-65	15-20	Mid April to late June
Cowpeas	4000 - 6000	50-90	6-8[2]	April to August
Hairy Indigo	7 to 10 tons of greenchop/acre	80-150	6 - 10	Middle of March to May/June
Sesbania	2000-8000	35-80	25-30	Mar. 1 - July 15
Sunhemp	4500-10,000	90-180	30 - 50	Mar. 1 - June 30
Velvetbeans	2200 - 4000	50-85	30-50	Mar. 1 - June 30
Grain Crops				
Pearlmillet	6000-8000	55-70	12 to 15 lb/acre in rows, of 30 to 40 lbs/acre if broadcast	Mid March to June in North Florida, earliest planting is April 1st.
Sorghum-sudan	6500-9500	55-80	24-30	Mar. 1 - June 30
ANNUAL WINTER COVER CROPS				
Leguminous Cropos				
Crimson Clover	1500-5000	35-120	20-25	Oct. 1 - Nov. 15
Hairy Vetch	2000-4000	35-150	20-30	Oct. 1 - Nov. 15
Lupine	2000-4500	45-120	30-45	Oct. 1 - Nov. 15
Grain crops				
Black oats	1500-3500	20-40	80-100	Oct. 1 - Nov. 15
Winter rye	3000-6000	30-50	80-100	Oct. 15 - Nov. 15
PERENNIAL COVER CROPS				
Leguminous Crops				
Rhizoma Peanut (living mulch)	2000-10000 (12-months)	50-130	80-100bu of rhizomes/acre[3] (1 bu=1.25 cubic ft.)	Dec. to March
Perennial Grasses				
Bahiagrass	3000-8000	55-140	15-20	Junt to August (if rainfed)
Pangola digitgrass	4000-9000	60-135	500-1000[3]	Mar. 1 - Aug. 15

[1]Lower productivity reflects poor growing conditions (water stress, poor inherent soil poor inherent soil fertility/inoculation) while higher values are indicative of crop performance under optimal conditions.
[2]Dehulled seed (naked).
[3]Planted vegetatively.
For additional information, please visit the 'Forages of Florida' website at:
http://agronomy.ifas.ufl.edu/ForagesofFlorida