

Success with Cover Crops



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Why Cover Crops?

- Reduces erosion
- Improves soil quality
- Minimizes nutrient loss
- Improves water quality
- Increases water infiltration and storage and reduces risk of short-term drought
- Reduces weed populations
- Supplies nitrogen from legumes



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- Cover crops provide several benefits. These include:
 - controlling erosion by keeping the soil covered,
 - improving soil quality by increasing soil organic matter,
 - increasing water infiltration and storage and minimizing short-term droughts,
 - retaining nutrients in biomass and through deep roots that prevent leaching.
- The combination of decreased erosion, improved infiltration and reduced leaching of nutrients can improve water quality.
- Well-managed cover crops can also help reduce weed populations in many situations.
- Finally, if legumes are used, cover crops can be a source of nitrogen.

Maximize Biomass

- Maintain soil fertility and pH
- Plant good quality seed
- Establish a good stand
- Inoculate legume seeds - specific & fresh
- Plant early
- Terminate late



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- The best way to obtain these benefits is to maximize cover crop biomass.
- Start with good soil fertility and the proper pH.
- Use quality seed to ensure a good stand. Drilling is the preferred method for good stand establishment. Use the recommended inoculant with legumes.
- Planting early and fertilizing will allow the cover crop to obtain maximum growth. The cover crop should be terminated as late as possible to obtain as much biomass as you can work with, unless it is a dry year. In dry years, you will want to terminate earlier to make sure the cover crop does not deplete soil moisture.

Selection of Cover Crops

- What is your cash crop?
- What are your desired benefits?
- What are your growing conditions?
- What is your experience level?

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•Cover crops should be thought of as part of an integrated system. The cover crop you choose, how it's planted, fertilized (or not) and terminated will vary depending on your farming operation and goals. Maximizing benefits from cover crops starts with selecting cover crops correctly. Because most farmers' primary cash crops are summer crops, we will give examples on selection for these crops. Here are several questions you should ask.

Selecting Cover Crops

What is your cash crop?

- Peanuts or soybeans: any small grain
- Corn: cereal rye, triticale or legume
- Cotton: any small grain or legume
- Vegetables: cereal rye, triticale, millets or legumes



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•First, what summer crop will follow the cover crop? For example, if you will be planting peanuts or soybeans, you would not want to use a legume cover crop. However, legumes might supply needed nitrogen for a heavy nitrogen feeding crop like corn or sorghum. If corn is your summer crop, you may want to use rye planted early in the fall and fertilized at planting to obtain maximum biomass.

•If you are planting cotton, the later planting date makes it easier to get the needed biomass for weed suppression. Rye is a good choice but you could use any small grain, a small grain/legume mixture or a legume.

•Cover crop use with vegetables can be tricky depending on the crop and market; however, farmers have had success with strips of rye cover crops between the rows of black plastic culture. The rye prevents wind blasting of the young transplants but should be killed prior to planting into the plastic to reduce damaging insects that may be harbored in the cover. Other growers have had success transplanting into heavy rye or vetch cover crops.

Selecting Cover Crops

- What are your desired benefits?
 - Nitrogen
 - Crimson clover or hairy vetch
 - Reducing weed pressure
 - Rye/black oats, triticale or wheat
 - Water conservation
 - Rye/oats, triticale or wheat



Annual rye - note heavy residue and no weeds

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•What are your desired benefits? If you want to supply nitrogen, crimson clover or hairy vetch are good choices. If you are interested in a heavy mulch cover to reduce weed pressure, then annual rye, common oats (*Avena sativa*) or black oats (*Avena strigosa*) would be the best option. These cover crops provide high biomass and also leach chemicals that can prevent small-seeded weeds from germinating. Research in Alabama indicates heavy rye residue can prevent weed germination for 4 to 6 weeks after planting.

Selecting Cover Crops

- What are your desired benefits?
 - Erosion control
 - Aim for 100% cover
 - Minimizing nutrient loss
 - Deep-rooted covers (rye)
 - Improving soil and water quality
 - Cover crops in general



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- Many farmers use cover crops to prevent erosion. Small grains or legumes can be effective as long as these provide sufficient cover. Although it costs to plant cover crops, many farmers have found it cheaper than having to repair the blowouts and gullies that can routinely form with heavy winter rains.
- Deep-rooted covers such as rye also are effective in preventing nutrient loss, particularly nitrogen.
- In general, the use of cover crops has been shown to improve both soil and water quality.

Selecting Cover Crops

- What are your field conditions?
 - Wet soils
 - pH
 - Sandy vs. clay
 - Winter temperatures



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•What are your growing conditions? If your soils tend to be wet, you should avoid legumes. Small grains are also less productive under prolonged wet conditions, but are more tolerant than legumes. In addition, small grains generally tolerate a wide range of pH better than legumes. Of the small grains, oat is the most sensitive to low soil pH (< 5.6). Lime soils so that the pH values range from 6.0 to 6.5. Most cover crops in Georgia grow well on all soil types ranging from sandy to clay textures.

•Finally, for fall seeded covers, you should consider winter temperatures. Species such as common oat and black oat tolerate frost but not temperatures much below 24 degrees F so they shouldn't be used in north Georgia. In addition, very early maturing varieties of winter wheat may also be frost sensitive.

•Check the local Extension small grain variety performance test bulletin for small grain varieties that perform best in your area.

Selecting Cover Crops

- What is your experience level?

→ None = wheat



→ Some = rye

→ A lot = clover or mixtures



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•And finally, what is your experience level? People who are not used to planting into residue should start with covers like wheat that don't produce a lot of biomass. As you gain experience, cover crops like rye, common oat or black oat that can produce a lot of biomass may be preferable. Generally, you should gain experience with these small grains before you move to covers with legumes or small grain/legume mixtures.

Planting Cover Crops

- Planting dates
- Planting method
- Seeding rates
- Pest control



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•For cover crops to be effective in conservation of water and soil, a good, dense stand of plants that will produce adequate biomass must be properly established. Planting date, planting method, seeding rate and good pest control are all important factors in establishing the proper stand. A well-established stand of cover can produce in excess of 6-8 tons of biomass.

Planting Cover Crops

- Planting Date
 - Fall planting
 - Cool season small grains and legumes
 - Spring and Summer
 - Warm season grasses and legumes



Rye planted: Nov. vs. Oct.

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- Planting date is one of the most important factors that affect the amount of biomass that can be achieved during the growing season.
- Cool season grasses such as small grains and small-seeded legumes are suited only for establishment during the fall, while warm season grasses and legumes should be established during the warmer days of spring and summer.
- Planting cool season grasses or legumes during the hot days of August can lead to severe stand losses from disease and insect infestations. It is best to use a summer grass such as millet in the early days of August.
- Begin establishing cool season cover crops in the early fall. If these crops are established during the warm, moist days of September or October, apply fungicide seed treatments prior to planting to decrease seedling diseases. If planting wheat, consider using a Hessian fly-resistant variety.
- Studies have shown that dry matter losses in cool season grasses and legumes increase significantly as planting is delayed to the colder days of December. Planting date studies of wheat, triticale, rye, clover and vetch in Tifton, Ga., show when planting is delayed to November and December, dry matter losses increased by 30 and 60 percent, respectively.
- Most warm season grasses and legumes can be successfully established once soil temperatures reach above 65 degrees F.

Planting Cover Crops

- Planting methods
 - Drill or direct seeding preferred
 - Broadcast
 - Prior to peanut harvest
 - Prior to cotton defoliation
 - Broadcast and incorporate seed by harrowing or cultivating
 - Be very careful of seed depth
- Tillage
 - Avoid soil compaction - wet soil
 - Deep tillage (paraplow, chisel or subsoil shank) improves biomass production

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•Cover crops can be planted by broadcasting or drilling (direct seeding). Drilling seed is more reliable because seeds are placed in direct contact with the soil at a specific depth. Broadcasting requires more seed due to losses from uneven depth placement and losses to insects and birds. In addition, broadcasting leaves the seed on top of the soil where it can be exposed to enough moisture for germination but not for establishment.

•Cool season cover crops can be broadcast over soybean and cotton prior to leaf drop (defoliation) or into peanut fields after digging but before harvest. Chances of success are greatly improved if the seed is broadcast over the primary crop residue before a rain. If irrigation is available, then irrigate before and after broadcasting the seed to ensure establishment of the cover.

•Many drills have a small-seed attachment that is well suited for establishing small-seeded grasses or legumes. Ryegrass, millet or clover are best planted using a small seed attachment. If you are planting with a small seed attachment, place the drop tube outside the furrow to avoid planting too deep.

•Do not take equipment onto fields that are wet. This will significantly increase soil compaction and lead to biomass yield losses.

•In dense clay soils, most cover crops can be successfully established with a drill. In sandy soils with a hardpan, deep tillage with a chisel plow, paraplow or subsoil shank will improve biomass production. Paraplowing and chisel plowing can disrupt hardpans while leaving significant amounts of residue on the soil surface. Use a roller attached to the deep tillage tool to firm the seed bed. If you plan to use deep tillage for the following cash crop, then extra tillage may not be necessary.

Planting Cover Crops

- **Seeding rate**
 - Drilling takes less seed than broadcasting.
- **Seeding depth**
 - Grasses and large seeded legumes should be planted 1 to 1.5 inches deep.
 - Plant smaller seed 0.25 to 0.5 inches deep.

Cover	Drilling (7.5")	Broadcasting
Small grains	Seeds per row ft.	Seeds per Sq. ft.
Wheat	15 to 18	40 to 45
Oat	12 to 15	25 to 30
Triticale	15 to 18	40 to 45
Rye	18 to 22	45 to 50
Legumes	Lbs. per acre	Lbs. per acre
Crimson clover	12 to 15	20 to 30
Hairy vetch	15 to 20	25 to 35
Grasses		
Millet	8 to 10	20
Sorghum-sudan	15 to 20	30
Legumes		
Velvet bean	60	120
Cowpea	30 to 40	60 to 70

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•Seed size, the amount of hard seed and cost will influence the decision about seeding method. An approximate 15 percent higher seeding rate is needed when cover crops are planted late in the season to ensure sufficient soil cover and biomass production. The table provides the information you need for proper cover crop establishment.

Planting Legume Cover Crops

- Seed treatments for legumes
 - Inoculants



Note nodules on roots

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• Legume cover crops should be inoculated with the appropriate type of bacterial inoculant before planting. The correct inoculant ensures the formation of nitrogen fixing sites or nodules on the plant roots. If legumes are not properly inoculated, they do not form nodules and have to take up nitrogen from the soil.

Pest Control in Cover Crops

- Herbicides
 - May need to control weeds
 - Carry-over from previous crop
- Insects
 - Hessian fly and aphids
- Seed treatments for small grains
 - Fungicides



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- While dense planting of cover crops should minimize weed infestations, herbicides may be needed to suppress weeds in some heavily-infested fields. If herbicides are used in managing cover crops, check the herbicide label before using to ensure that its use does not interfere with the planting or production of your planned cash crop. Note any restrictions related to the use of the herbicide in rotations or associated with application rates as listed on the herbicide label. Also, increased soil organic matter can affect the effectiveness of some herbicides. Soil sampling to a 3-inch rather than 7-inch depth and requesting organic matter analyses allows for adjustments in herbicide application rates.
- Some cover crops and subsequent crops are sensitive to herbicide carryover. Check herbicide labels for compatibility and carryover risks.
- Insects generally do not cause stand losses except in cases of Hessian fly in wheat. Use varieties resistant to Hessian fly when planting wheat. If no resistant variety is available, then apply an approved insecticide seed treatment. Seed treatments are listed in the Georgia Pest Control Handbook. Aphids can cause the transmission of the barley yellow dwarf virus, which will reduce biomass production. Insecticide seed treatments are also effective against aphids. If aphids are present, an application of an approved pyrethroid 30 to 35 days after plant emergence will control them.
- If cover crops are seeded during the warm, moist months of September and October, apply seed treatments before planting to decrease seedling diseases. Recommended treatments can be found in the current Georgia Pest Management Handbook. Many ready to use (RTU) fungicide seed treatments are available. Some require the seed to be treated by a commercial seed treater. RTU seed treatments can be applied directly to the seed before planting. Be sure to thoroughly mix the treatment with all the seed and allow it to dry before planting. Disease pathogens such as Rhizoctonia, Fusarium, Bipolaris, Helminthosporium, and Pythium can infect seedlings and reduce stands. These can be prevented by using an appropriately labeled fungicide.

Cover Crop Fertility

- Small grains and summer grasses
 - Need nitrogen
- Cool season and summer legumes
 - Fix nitrogen



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- Grasses require the addition of nitrogen fertilizer for productive growth. Legumes can fix their own nitrogen. Both cover crop types need at least medium soil test levels of phosphorus and potassium to ensure good biomass production. A soil pH of 6.0 to 6.5 is preferred, particularly for legumes. As pH declines, cover crop biomass will also decline.
- In general on fall-planted cover crops, it is best to apply phosphorus and potassium for the following cash crop during the late winter or early spring to avoid losses or uptake by the cover crop. If this is not possible, then apply all the nutrient needs of the following cash crop before planting the fall cover.
- Animal wastes such as poultry litter are excellent sources of nutrients for both cover and cash crops. Do not apply any waste products without a proper nutrient analysis.

Fertility

- Small Grains
 - Add N to get more biomass production
 - Fall applications of N if cover is for corn
 - Winter applications of N if cover is for cotton, peanut, soybean or grain sorghum
- Legumes
 - Proper inoculant will produce 50 to 150 lbs. N

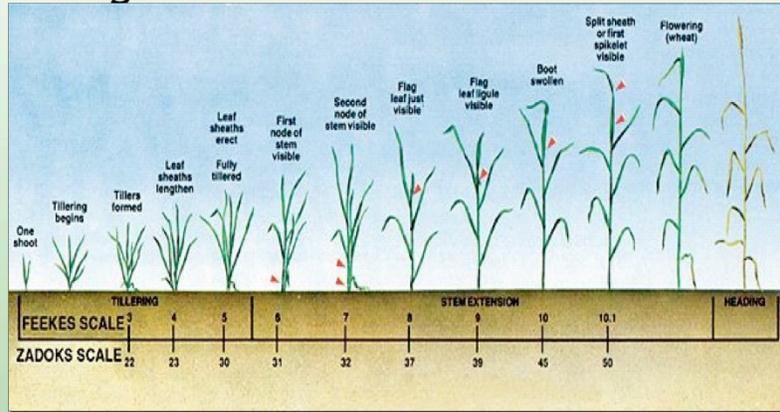
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•If the cover crop will be terminated in the early months of February or March for corn production, then apply 30 lbs. of nitrogen per acre to small grain cover before planting in the fall. If the cover is terminated until late April or May, then apply 30 lbs. of nitrogen per acre in late January or early February. Nitrogen is critical for adequate biomass growth, particularly for late fall planted small grains.

•Properly inoculated legumes will fix enough nitrogen for cover crop growth. In addition, good legume production can provide 50 to 100 lbs of nitrogen for the following cash crop.

Terminating Cover Crops

- Timing



Low biomass, quick decomposition

High biomass, slow decomposition

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•Cover crop termination is important to reduce competition with the cash crops for water and nutrients. The timing of cover crop termination is critical and affects things such as residue persistence, soil moisture, insect pressure, and nutrient availability. The growth stage of the cover crop is important. There are also differences in how legumes and small grains should be handled in terms of available nutrients.

Cover Crop Decomposition

- C:N ratio > 25-30 results in nitrogen immobilization
- Cover crops and C:N ratio
 - Small grains have high C:N ratio
 - Mature, older crops have high C:N ratio
 - Legumes have low C:N ratio
 - Succulent, young crops have low C:N ratio

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•Differences in managing small grains and legumes are due to their carbon:nitrogen ratios. Generally, plant materials with lower C:N ratios decompose more quickly than those with higher C:N ratios. This has to do with the amount of nitrogen that microbes need to decompose the plant materials. The rule of thumb is that plant materials with C:N ratios greater than about 25 are slow to decompose and require more nitrogen to break down. The microbes tend to out-compete plants for nitrogen; consequently, nitrogen is immobilized in the decomposition process and can sometimes cause nitrogen deficiency in the crop. Sometimes, heavy residue will immobilize enough nitrogen so the subsequent cash crop will need an additional 20 to 30 lbs. per acre above normal. It is critical that the additional N be applied at planting following the cover crop. It is important to monitor the cash crop for nitrogen.

•Legumes have a low C:N ratio (typically 10:1 to 20:1) and release nitrogen.

•Small grains such as annual rye have higher C:N ratios than legumes. Young rye, before it begins to head out, has a lower C:N ratio and will decompose relatively quickly. Rye that is left to mature will have higher C:N ratios (typically 40:1 to 80:1) and will decompose more slowly over the growing season.

•These facts affect cover crop management and when the crop should be terminated.

Small Grain Termination

- Late termination for higher weed suppression
- Terminate three to four weeks before planting to reduce
 - Soil moisture depletion
 - Insect pressure
 - Allelopathy effects on the following crop



Note weed suppression in cotton

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•If the cover is terminated too early, it will not have developed enough lignin content and will be prone to “melting away.” Early-terminated covers do not provide as much weed suppression or mulch to conserve water.

•However, there can be a trade off between letting the cover crops mature for maximum residue. Soil moisture decreases and some insect pests increase as cover crops reach maturity. In most cases, you should try to terminate the cover crops three weeks before planting the cash crop. This allows time for rains to replenish soil moisture. This also decreases the chance that cut worms will still be present in the cover crop to attack the newly-germinating crop.

Legume Termination

- More difficult to terminate than small grains
- Manage to allow reseeding if possible



Note reseeded crimson clover

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- Terminating a legume crop is more difficult than terminating a small grain and typically requires a combination of herbicides and close monitoring.
- Some legume cover crops, such as crimson clover, can be managed to allow seed production depending on when the cash crop is planted. By allowing seed production, the legume can reestablish in the fall, reducing costs and providing for earlier on set of cover crop production. Be aware, the closer the termination is to planting the cash crop, the higher the risk for insect damage, competition to crop growth, disease pressure in the cash crop, free ammonia toxicity (in cotton) and allelopathy problems.
- Legume cover crops can be terminated in strips, rather than terminated at one time. This strategy can also be used to allow seed production by the cover crop as discussed above. Leaving 35% cover in strips between the rows will allow successful re-establishment of crimson clover. If you do leave a green strip, terminating the green strip before the cash crop germinates will reduce insect pressure. Caution: Leaving the strip to full maturity may cause some yield reduction in the cash crop due to competition for water and light.

Terminating Cover Crops

- Termination method
 - Burn-down herbicides



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•Cover crops can be terminated using burn-down herbicides or a roller-crimper. In conventional farming systems, cover crops are usually terminated by using burn-down herbicides such as paraquat or glyphosate. These herbicides are very effective at killing and desiccating the cover crop. Where cover crops produce a high biomass, farmers may need to adapt their spray equipment and herbicide application practices to effectively terminate the cover crop. For example, if rye or triticale have been grown to produce maximum biomass, the spray boom may need to be raised to effectively cover the crop. If legumes are used, one application of glyphosate is often not very effective. You may need to include 2,4-D or dicamba in your spray mix.

Terminating Cover Crops

- Termination method
 - Roller-crimpers



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•Roller-crimping can be used in conjunction with the use of herbicides, especially when biomass production is high or when cover crops have lodged. Roller-crimping terminates the cover crop by physically crushing and cutting the stem. Roller-crimping can reduce the plant height to a manageable level to ease planting.

•Research conducted at the ARS National Soil Dynamics Laboratory in Auburn, Ala., indicated that roller-crimping termination of small grain cover crops was effective if the cover crops matured past the flowering to the early seed development stage. In this case, both herbicides and roller-crimping provided 100% termination of the cover crop; however, roller-crimping was not effective before heading. Roller-crimping in conjunction with a half rate of herbicides provided an effective cover crop termination at the flowering stage of growth.

•Rollers with straight crimping bars produce a high level of vibration. Two new types of crimpers are being examined, one with a curved blade and another that is smooth but has a crimping bar. Research with these rollers has shown reduced vibrations with adequate cover crop termination.

Cover Cropping Summary

- Cover cropping provides environmental, production and economic benefits when used in a conservation tillage system
- Maximum benefits come from maximum biomass
- Cover cropping needs to be managed carefully to provide desired benefits

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•Cover crops are an important part of conservation tillage systems. They can provide environmental, production and economic benefits including: reduced soil erosion, improved soil quality, improved weed control, increased water infiltration and increased nutrient conservation. Economic benefits result from less wear and tear on equipment, less fuel usage and decreased labor. You may also need less fertilizer and pesticides, especially after a conservation tillage system with cover crops has been used for several years.

•Maximum benefits are found with maximum biomass; however, this requires experience to achieve. Cover crops need to be planted in a timely manner and managed properly to provide desired levels of biomass or fixed nitrogen.

•Erosion control benefits from cover cropping are often obvious within the first year. In addition, cover crops improve soil quality, water infiltration and water holding capacity, which help reduce the risk of drought in cash crops. However, the impact of these benefits are not fully realized immediately.

•Even though these benefits take time to fully realize in any system, they will contribute to the long-term profitability of your operation.

Cover Crop Resources

- Cover crops at UGA
<http://www.caes.uga.edu/commodities/sustainag/contillage/index.html>
- Managing Cover Crops Profitably, 2nd ed. Sustainable Agriculture Network
<http://www.sare.org/publications/covercrops/covercrops.pdf>
- Sustainable Practices for Vegetable Production in the South
<http://www.cals.ncsu.edu/sustainable/peet/index.html>
- National Sustainable Agriculture Information Service (ATTRA)
<http://www.attra.org>

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These are some references that are available online and in the literature to assist the farmer in selecting, using and terminating cover crops.

Check with your local Cooperative Extension program for additional information.

Another very good source is a farmer who has been using cover crops and has some experience with management and use of cover crops for maximum benefits.

Information in this presentation was developed through a cooperative effort between:



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Electronic Bulletin 102 / Reviewed March 2014

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