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Agriculture and Natural Resources

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Understanding Cover Crops

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What is a cover crop?

A cover crop is an unharvested grass, forb or legume grown between cropping seasons to provide ground cover resulting in improved soil quality/health, nutrient availability and reduced erosion and runoff.

Benefits provided:

- Reduced soil erosion and runoff
- Improve soil structure and aggregate stability
- Increased soil health and organic matter content
- Nutrient sequestration to recycle nutrients and limit surface and groundwater contamination
- Increases biological diversity and disrupts pest and disease cycles
- Improved water infiltration and soil moisture use efficiency
- Reduced soil compaction
- Weed suppression through reducing the soil temperature, reducing weed seed emergence, allelopathy and competition
- Increased beneficial insect populations
- Soil nitrogen credit accumulation from legume covers

Introduction

Between cash crop seasons, the soil is often left fallow and exposed, allowing for soil erosion and weed growth. Cover crops are grown in the gap between cash crops to provide soil cover and weed suppression. Nutrients from the unharvested cover crops, especially legume cover crops, can significantly reduce the amount of inorganic fertilizer needed by the following cash crop, resulting in potential savings by reducing input costs.

Legume cover crops are capable of fixing atmospheric nitrogen (N) to the plant-available form, ammonium, due to symbiotic bacterial colonies in the root systems. Upon cover crop termination, the residue decomposes and releases plant-available N for the following cash crop. Other cover crops, such as oilseed radish or daikon radish, have been shown to increase phosphorus (P) concentrations in the root zone by mining nutrients from lower soil depths and depositing the nutrients where the tap root decays.

Soil health is a very important consideration, as conventional agricultural management often focuses on short-term goals instead of long-term issues. Cover crops are an essential tool to help improve or maintain healthy soils, as they can increase overall soil productivity and resilience.

The majority of cover crops in Arkansas are most commonly grown in the winter between summer cash crops and are referred to as “winter cover crops,” but cover crops can also be grown in the summer when fields might be fallowed or following land-leveling activities. Late summer cover crops can help protect soils during fallow periods and identify areas of leveled fields that need additional attention (weak spots that may need additional poultry litter applications).

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The success of cover crops is most often tied to biomass production. The majority of the benefits gained from the use of cover crops is directly associated with the amount of biomass produced, both above and below ground (roots). Biomass production by cover crops is influenced by a combination of planting date, seeding rate and termination date. Above ground biomass provides soil coverage and protection. Figure 1 shows the biomass accumulation of various cover crops at multiple planting dates. Figure 2 shows various cover crop species' canopy cover in mid-January. Potential costs associated with cover crops can include seed, inoculum, labor inputs, tillage, herbicides and fuel and should all be taken into account to optimize potential cover crop benefits.

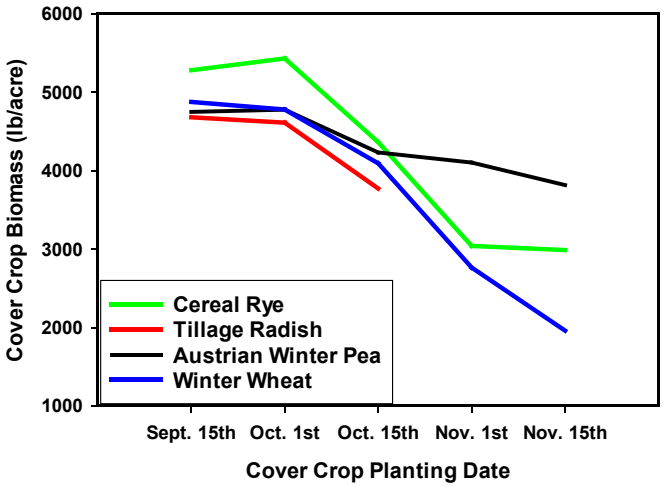

Figure 1. Biomass accumulation in the spring across multiple fall planting dates and cover crops.

Environmental Impact

Biomass produced by cover crops improves overall soil quality and health. Cover crops reduce soil erosion by protecting bare soil and promoting water infiltration into the soil profile. Additionally, cover crops improve soil structure and aggregate stability, which allows plant roots to access nutrients deeper in the soil profile. Cover crops also help control nutrient runoff and leaching. By taking up excess nutrients in the soil and retaining them in their biomass and by filtering surface runoff, cover crops reduce the amount of harmful chemicals in surface and groundwater.

Weed Control

Cover crops can reduce emergence of problematic weeds. Methods of weed suppression by cover crops are directly related to biomass production and include reducing the soil temperature, reducing weed seed emergence, allelopathy and out-competing weeds. Utilizing cover crops can be an effective integrated weed management technique, allowing for improved control of problematic weeds and better herbicide stewardship.

Depending on the cover crop used and the anticipated cash crop, chemical burndown or mechanical destruction of the cover crop can be utilized. In a no-till system, herbicides are used to terminate the cover crop prior to planting the cash crop, and the crop is seeded directly into the residue. It is essential to select an herbicide which will not have residual effects on the following cash crop. In a conventional till system, the cover crop can be desiccated prior to tillage. Use MP44, *Recommended Chemicals for Weed and Brush Control*, for burndown recommendations, and be sure to follow all label instructions.

Insect Control

Cover crops can provide a habitat for beneficial insects and allow them to carry into the following crop where they prey on troublesome insects and minimize their negative impacts on the crop. Incorporating cover crops into a production system can also lower populations of problematic insects. However, cover crops can also harbor pest insects and allow them to become problematic in-crop. Proper selection of the cover crop, in conjunction with regular scouting, is essential in minimizing this risk. It is recommended to scout and terminate a cover crop 2-4 weeks before planting a cash crop to eliminate the "green bridge."

Common Cover Crops Grown in Arkansas

Winter Cereals

Multiple species of winter cereals are commonly grown as cover crops in Arkansas for the large production of biomass, fibrous root system, nutrient sequestration and relatively low cost of establishment. Optimum results are seen in no-till systems, allowing erosion control, weed suppression, soil crusting prevention and improved soil organic matter. These crops have a large window of successful planting dates, ranging from September to mid-November. While there are several benefits associated with utilizing winter cereals as cover crops, some challenges include difficulty planting the cash crop into the heavy biomass in the spring and the slow release of nutrients back into the soil.

Wheat (*Triticum aestivum*)
- Plant in September through early November
- Enhances nutrient cycling [N, P and potassium (K)]
- Fine root system improves topsoil tilth
- Does not perform well in poorly-drained soils

Oats (*Avena sativa*)
- Plant in early September through November
- Performs well in waterlogged soils (rice soils)
- Allelopathic compounds in roots and residue can suppress weed growth for a few weeks
- Reduces root-knot nematode populations
- Takes up excess N
- 2,000 to 4,000 pounds biomass per acre

Triticale (*Triticosecale*)
- Plant in early September through November
- High resistance to wheat streak mosaic virus
- High biomass production
- Good weed suppression

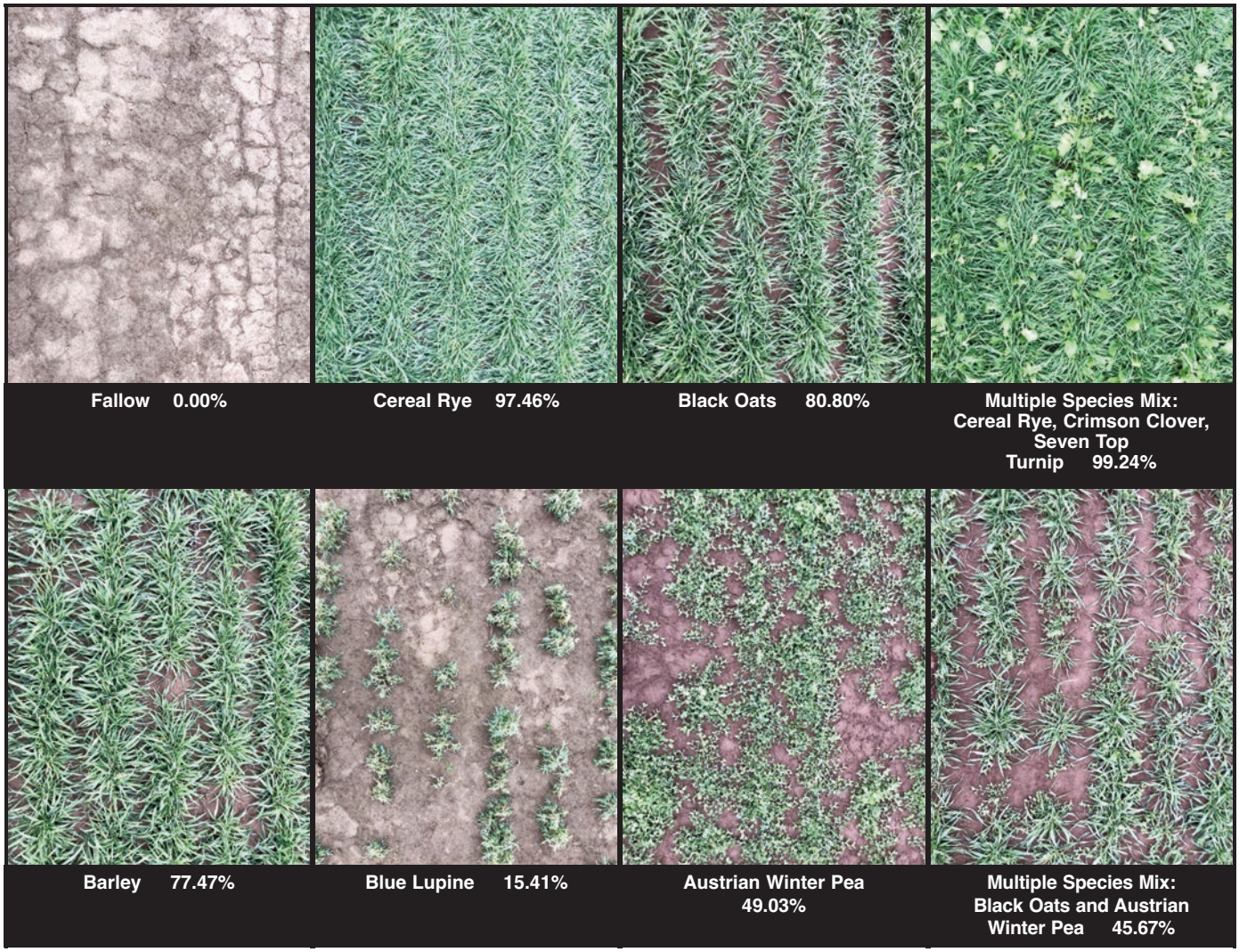

Figure 2. Winter cover crop canopy coverage in mid-January, 2018, at the Vegetable Research Station near Alma, Arkansas.

Figure 3. Winter wheat seed and plant.

Figure 4. Oat seed and plant.

Figure 5. Triticale seed and plant.

Cereal Rye (*Secale cereale* L.)
- Plant late summer to mid-November
- Inexpensive to establish and grow
- High biomass production
- Efficient scavenger of residual nutrients in the soil, reducing the risk of losing those nutrients to runoff
- Can grow on a variety of soil textures

Barley (*Hordeum vulgare*)
- Plant in mid-September to mid-November
- Deep, fibrous root system reduces erosion, improves nutrient uptake and improves soil structure
- Abundant biomass production
- Reduces populations of leafhoppers, aphids, armyworms and root-knot nematodes
- Can be trap crop for aphids as they tend to be more attracted to this particular winter cereal

Figure 6. Cereal rye seed and plant.


Figure 7. Barley seed and plant.

Winter Broadleaves

Many benefits are seen when growing winter broadleaves as cover crops, including biodiversity with grass cash crops (i.e., corn, grain sorghum), high soil coverage in the winter and nutrient recycling. Early planting date is essential to allow adequate vegetative growth before winter, with a narrow window for good establishment (September 1 through October 15). The small seeds can be difficult to plant with conventional equipment and increase the plant susceptibility to herbicide carryover damage.

Tillage Radish (*Raphanus sativus* L.)
- Plant in September through October – later planting dates past October 15 are discouraged
- Absorbs many nutrients from various soil depths and deposits them in the cash crop root zone
- Compaction alleviation
- Decomposes quickly to release nutrients into the soil
- Moderate biomass production covers more ground, but decays very quickly, reducing duration of weed suppression
- Winterkill varies from year to year depending on winter low temperatures; earlier plantings more likely to winterkill than late plantings

Oilseed Radish (*Raphanus sativus* L.)
- Plant late July to mid-October, late March for summer cover
- C:N ratio of 19:1, net mineralization
- Thick, deep taproot penetrates compacted soil layers
- Nitrogen scavenger at deep depths
- Exude chemicals that help suppress soil pests such as nematodes

Kale (*Brassica oleracea* var. sabellica)
- Plant August through October
- Large leaves can provide large soil surface coverage
- Medium water use
- Fair salinity tolerance

Turnip (*Brassica rapa*)

- Plant in late July through early October
- Large leaves can provide large soil surface coverage/protection
- Large root system

Figure 10. Kale seed and plant.

Figure 11. Turnip seed and plant.

Winter Legumes

Winter legumes provide many benefits to a production system but often have a high seed cost. Biological nitrogen fixation and high mineralization rates result in an increased level of plant-available N for the following cash crop. Large biomass production and soil coverage protects the soil surface from erosion and adds organic matter. However, inoculation is essential to secure these benefits and should be matched to the specific winter legume species (each species requires a specific inoculant). Winter legume species' ability to withstand waterlogged soils varies greatly and should be considered prior to planting to aid in species selection.

Austrian Winter Pea (*Pisum arvense*)

- Plant mid-August through early November
- Can provide as much as 160 pounds N per acre depending on termination date (mid-May). Earlier termination will result in significantly lower N credits (mid-March termination = 40 to 60 pounds N per acre)
- Performs well in poorly drained soils
- Produces 1,000 to 6,500 pounds biomass per acre
- Improves soil structure, reduces compaction
- Residue decomposes very rapidly, providing short duration of soil surface coverage

Figure 12. Austrian winter pea seed and plant.

Clovers (*Trifolium*)

- Plant October 15 to November 15
- Provides approximately 50 pounds N per acre but can provide up to 100 pounds N per acre
- Can be grown in poorer textured soils where other legumes cannot be grown
- Easy to establish
- Harmful to cattle when consumed in large quantities
- Relatively low biomass production compared to other legumes
- Potential to increase specific pest pressures including red-banded stinkbug

Hairy vetch (*Vicia villosa* Roth)

- Plant late August through mid-October
- Provides as much as 135 pounds N per acre
- Produces large above-ground biomass (4,000 to 7,000 pounds biomass per acre); good for forage and erosion control
- Attracts beneficial insects

Figure 13. Crimson clover about to flower and seed.

Figure 14. Hairy vetch plant and seed.

Multiple Species Blends

Including multiple species in a cover crop program can increase biological diversity and soil coverage but may also increase field variability and complicate management. Interspecies competition increases and some species may not succeed, resulting in a wasted seed cost. Diverse soil covers may serve as hosts for a larger range of pests and diseases. Cover crop blends can increase the number and magnitude of benefits, but they also require increased management to be successful.

How to Select a Cover Crop

Selecting the right cover crop and being successful with its establishment and termination rely on a well thought out management plan. Producers must think of cover crops with the same level of intensity that they would their cash crops. Remember, the more time and effort that you put into planning your cover crop, the higher the likelihood of success and the greater benefit that can be realized from the cover crop itself. Cover crop success takes time, money and energy; don't let all that go to waste because you didn't take time to plan ahead!

Example 1: Cover Crop Selection for Soybean

Step 1 – Select the cash crop:
Soybean

Step 2 – Determine desired benefits:
Possible benefits desired for cover crops ahead of soybean include weed suppression, ground cover for erosion prevention, improved infiltration, reduced crusting and improved soil health.

Step 3 – Select cover crops based on desired benefits:
The majority of the desired benefits above are going to be achieved with high biomass cover crops. Look for winter cereals or blends where the majority of the blend is a winter cereal. Potential single species include cereal rye, oats, triticale and barley. Most of these are similar in their biomass production and desired results when planted at optimum seeding rates of 35 to 55 pounds of seed per acre. Use seed cost to help determine what fits best for your production system. Potential blends could include any of the above winter cereals as 85% to 95% of the blend with the addition of oilseed radish, turnips, tillage radish, clover, Austrian winter pea or vetch as the remainder of the blend. These blends can provide high biomass production but will also help to increase soil health at a faster pace.

Step 4 – Develop a date and plan for termination:
To get the most out of cover crops and truly reap the desired benefits, it is best to terminate cover crops with herbicides and plant soybean no-till into cover crop residue. Single species winter cereals are easy to terminate (typically with glyphosate), whereas blends can require a greater quantity or more herbicide modes of action for total kill. Please have a plan for cover crop termination prior to cover crop planting.

Example 2: Cover Crop Selection for Corn

Step 1 – Select the cash crop:
Corn

Step 2 – Determine desired benefits:
Possible benefits desired for cover crops ahead of corn include nitrogen credits, ground cover for erosion prevention, improved infiltration, reduced crusting and improved soil health.

Step 3 – Select cover crops based on desired benefits:
The majority of the desired benefits above are going to be achieved with high biomass cover crops that also fix nitrogen. Look for winter legumes or blends where the majority of the blend is a winter legume. Potential single species include Austrian winter pea, hairy vetch and blue lupine. Most of these are similar in their biomass production but can have significantly different nitrogen credits depending on termination date. Austrian winter pea tends to produce more nitrogen at earlier termination dates in the spring than other legumes. Use seed cost and seeding rate to help determine what fits best for your production system. Potential blends could include any of the above winter legumes as 85% to 95% of the blend with the addition of any of the winter cereals as the remainder of the blend. These blends can provide high biomass production but will also help to increase soil health at a faster pace.

Step 4 – Develop a date and plan for termination:
Winter legumes are oftentimes harder to terminate using herbicides than are winter cereals. Please use consultation to determine the best options for burndown based on the specific winter legume or winter legume blend that is selected. Typically, glyphosate is not an adequate product for total burndown of winter legumes.

Keys to Success

Consider the following cash crop and rotate accordingly.

Soybeans and cotton should be preceded by predominately grass cover crops or blends.

Grass cash crops (corn, grain sorghum and rice) should be preceded by predominately broadleaf or legume cover crops or blends.

Consider the specific goal or outcome you want to achieve with cover crops.

Plant cover crops on small acreage the first time to reduce risk.

Plant early to achieve maximum ground cover and potential benefits.

Use no-till or reduced tillage systems to maximize soil benefits when using cover crops.

Scout for pests and diseases in cover crop and cash crop.

Terminate cover crop at least 2 to 4 weeks before cash crop planting to reduce pest pressure.

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