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Cover crops management for no-till grain crop production

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Cover crops are forage grasses, legumes, small grains or other crops grown to protect and improve the soil. Cover crops are becoming increasingly important in Missouri, because soil losses of 10.9 tons of cropland per acre are occurring annually through sheet and rill erosion. About 20 cents worth of nutrients is lost in each ton of soil, which means a loss of over $2 per acre per year. In addition to soil loss from erosion, Missouri is losing nutrients equivalent to over $25 million in fertilizer each year.

Value of cover crops

Cover crops reduce soil erosion. Indiana research shows that plowing a winter cover crop under in the spring reduces water runoff by 55 percent and reduces soil loss by 50 percent compared to fields with no winter cover. More recent studies show soil losses were reduced by 90-95 percent where corn or soybeans were no-till planted into a vigorous growth of rye or wheat compared to corn or soybeans planted in conventionally tilled soils. The added cover protects the soil from wind and water erosion before and during cash crop establishment and after harvest when the new cover crop is seeded.

A cover crop can improve one or more of the following: (1) soil aeration, (2) water holding capacity, (3) tilth and (4) fertility (primarily nitrogen).

Cover crops also recycle nutrients that might otherwise be lost to leaching during the winter and spring. Long-term data from the University of Missouri Sanborn Field indicates corn yields increased 5-10 bushel per acre when corn followed a clover cover crop seeded in wheat as compared to corn following corn at the same nitrogen rate.

Cover crops can increase the days available for planting. During wet years, cover crops use the moisture for continued growth, thus removing some of the water that keeps the soil cool. During dry years, you can kill the cover crop early and the mulch will conserve moisture.

Cover crop selection

A few of the important characteristics you want in a cover crop are: fast germination and emergence; competitiveness; tolerance to adverse weather and soil conditions; ease of suppression; fertility benefits and low cost of establishment. This guide describes several potential cover crops and their strengths and weaknesses with respect to these characteristics.

Ease and economics of establishment

Crops like red clover, sweet clover and annual ryegrass can be established early under various conditions. Their seed costs are relatively low. On the other hand, crownvetch is difficult to establish, slow to grow, and seed costs are high.

Of the small grains, rye is the most easily established, whereas barley has specific planting date and fertility requirements. Hairy vetch and crimson clover are relatively easy to establish but only suited to southern Missouri.

Soil site and fertility

Legumes are, in general, lime lovers. Sweet clover will not establish and grow well at a pH below 6. Lespedeza is an exception. Once known as the poor farmers' legume, lespedeza will tolerate a soil pH down to 5. Cereal crops grown for cover have the

same fertility needs as those grown for grain. They can be produced on less fertile soil, but they will not produce the vigorous growth desired for optimum erosion control or soil tilth development. Some crops like alfalfa do not tolerate wet conditions, whereas rye tolerates poorly drained to droughty conditions.

Method of establishment

Timely seeding is many times not possible due to Missouri's sometimes wet, often-delayed row-crop harvest. Aerial seeding can help overcome this problem. Studies in Kentucky show that aerial seeding of small grains is a good alternative to conventional seeding. This is especially so in wet years when more timely seeding could be done by air.

In many cases, aerial seeding may be less expensive than conventional seeding especially when you could use your time and labor to do other jobs during the busy fall. A big advantage to aerial seeding is that more winter cover growth can be produced with less erosion hazard than conventionally seeded cereal cover crops. Aerial-seeded cereal grains usually need an increased seeding rate compared to conventional seeding. Two bushels of wheat is a suggested rate for aerial seeding, while the rate for drilled seeding is 1½ bushels. Aerial seeding appears to be more suitable for soybean fields than corn fields. If the cover crop is seeded just as soybean leaves are falling, moisture retention at the soil surface is enhanced and seedling survival is increased. Generally, fall aerial seeding of a small-seeded legume on untilled land is too risky. While most forage grass and legume cover crops require prepared seedbeds, red clover and sweet clover, for example, can be overseeded into a small grain stand in the early spring.

Nitrogen benefit

With the high price of many legume seeds, it is important to consider the economic returns of nitrogen. The amount of nitrogen available to row crops from the various legumes is demonstrated in Table 1. This chart assumes a good growth of the legume before row crop planting.

Nitrogen fixed by a legume crop will not be lost if the crop is killed and its residue is left on the surface of the soil rather than plowed down. Studies in Delaware show that one-third of the nitrogen derived from mulch cover is released to the crop in a single season with 90 percent coming from the top growth. The amount of nitrogen contributed by a legume crop depends on the amount of top growth produced. In Ohio, tests show that over 80 percent of the nitrogen in several forage species is contained in the top growth. Results also indicate that leaving clover on the soil surface for a year before turning it under does not result in increased nitrogen lost.

Table 1. Potential nitrogen fixation of various legumes

Legumes	Estimated production lbs. N/A/year*
Ladino clover	180-200
Alfalfa	160-200
Sweet clover	140-180
Clovers (medium, mammoth, & alsike)	120-140
Crownvetch	80-120
Lespedeza (annual)	40-60
Sericea	20-40
Winter annual legumes	40-60

*Only 50-60 percent of this may be available to the following crop.

Two-thirds of the nitrogen contained in the clover is released the first year after plowdown for crop use and the remaining goes into the residual supply of nitrogen in the soil. In Iowa, little difference in corn yields was found when comparing legume crops that were completely plowed under and those that were partially plowed under.

The contribution of legume cover crops to nitrogen nutrition of no-tillage corn in Delaware was judged to be equivalent to as much as 99 pounds of applied nitrogen per acre. In Georgia, legume cover crops supplied about 60 pounds of nitrogen per acre to the following no-till grain sorghum crop.

Economics

Before you can justify the time and money required to establish a cover crop, you must weigh the advantages and disadvantages. You must also weigh the profits and the costs. Some of the advantages are soil saved, nitrogen added (if legume) and harvest of a forage crop if time permits. Some of the disadvantages are cost of seed and planting, cost of chemicals and application for cover crop control and loss in yield if cash-crop planting is delayed because of the standing cover crop harvest.

A cover crop usually more than pays for itself by increasing production of the row crop that follows. No amount of value can be placed on soil once it is gone. The value of soil saved increases as soil tilth and productivity are added back to the land.

Cover crop suppression or kill

Often with summer or fall annual crops such as spring barley, oats, sudangrass and annual ryegrass, winter kills the crop, eliminating the need for a chemical kill in the spring. You can kill a legume cover crop prior to planting corn or grain sorghum

with combinations of atrazine, Bladex, 2,4-D, and/or Banvel. You can also use paraquat or Roundup to kill annual grass crops. Roundup is most effective for control of established perennial grasses. Split applications of paraquat in the fall or spring, however, can be effective for controlling established tall fescue. When applied before you plant corn or grain sorghum, the addition of atrazine, Bladex or liquid nitrogen to paraquat or Roundup improves control of perennial grass cover crops. The "Weed Control Guide for Missouri Field Crops" contains specific information about herbicide uses and rates for no-tillage crop production.

With some legume crops (alfalfa, crownvetch, clovers) only suppression is desired, creating a living mulch. You can use paraquat, Roundup, 2,4-D or Banvel to suppress the crop to eliminate competition with a following grain crop. It is difficult to predict, however, the amount of cover crop suppression that will be obtained at various herbicide rates. During certain climatic conditions and growth stages, cover crops can become tolerant to herbicides. Inadequate suppression may result in competition that causes loss in grain crop yields. Use of postemergence herbicides on a timely basis might reduce this problem but will also add more cost. Under other conditions, too much kill may result in the need for reseeding. The impredicability of the degree of cover crop suppression with herbicides restricts the use of living cover crops (living mulch, sleeping sod) in no-tillage crop production.

For maximum soil and moisture conservation, tilth improvement and fertility benefits, delay killing the cover crop as long as possible in the spring. The more nitrogen you want to add to the soil from a legume cover crop, the more top growth you should allow to accumulate during the fall and early spring. By not killing the cover crop early, however, moisture loss in the seedbed can occur.

Cover crops in the rotation

Each cover crop has certain characteristics that make it more compatible with the rotation. The following are but a few examples.

Although not generally recommended, soybeans following soybeans is a popular rotation in Missouri. Small grains, particularly rye, lend themselves to overseeding in the fall as soybean leaf drop occurs. You can kill the rye with paraquat or Roundup in the spring, or harvest it as grain, hay, straw, silage or be pastured. This provides an extra benefit from the land. If you take the rye before full heading, you will still need to apply a herbicide before soybean planting. You could also plant spring oats instead of rye in the fall. Oats would be naturally killed in the winter, eliminating the need for burndown herbicides unless weeds grow through the cover.

Overseeding legumes into wheat in the spring offers excellent fall cover and nitrogen benefits for a following corn or grain sorghum crop. Soybeans are not recommended following legume crops. The best nitrogen benefit occurs if you don't harvest the legume in the fall and allow it to regrow as much as possible in the spring. This may delay corn planting. You could take a legume hay crop in May, if needed, still allowing for timely planting of grain sorghum. Harvesting the hay would reduce the amount of nitrogen available to the grain sorghum crop. The triazine and phenoxy herbicides commonly used with corn and grain sorghum easily control these legume cover crops.

Many other possibilities are mentioned with each cover crop description. The conditions needed for a satisfactory stand, as outlined in Table 2, and planned herbicide usage normally dictate which cover crops you can use.

Characteristics of common crops used for cover

In addition to characteristics listed in Table 2, the following discussion highlights the potentials (and problems) in using various crops for cover.

Tall fescue

Tall fescue is adapted to a wide range of climatic conditions. It is the only cool-season grass that persists through hot summers and cool winters year after year. Tall fescue is tolerant of poorly drained, infertile soils. It is one of the most drought resistant grasses suitable for humid regions. Though generally used as a permanent pasture and hay crop, you can overseed it in wheat or soybeans in late summer.

Cost of seed is low and establishment is easy. Control may be difficult in front of soybeans. Otherwise, tall fescue carries all the advantages of an excellent cover crop except it does not fix nitrogen. Tall fescue is a perennial grass, so it is difficult to treat it as an annual cover crop. Established stands, however, can be used for no-till corn production. Other common perennial forage grasses react similarly and are also useful.

Annual ryegrass

Farmers sometimes use annual ryegrass as a pasture crop in southern Missouri where the winters are not so severe. Annual ryegrass is vigorous and competitive, growing well in areas of low fertility and poor drainage. You can sow it aerially effectively, and it is easy to kill with herbicides (or is winter killed in the north). You can use the perennial grasses, such as fescue, this way but they are not as vigorous in the fall and are not easily winter killed.

Table 2. Cover crop specifications

Species	Seeding rate (lbs./acre)	Planting depth (in.)	Seeds/lb. X 1,000	Planting date*	Planting method	*Seedling* Competitive ability	*Seedling* Emergence/ vigor	*Tolerance to* Moist soil	*Tolerance to* Low fert.	*Tolerance to* Mod. acid soils	Winter hardiness
Grasses:											
Tall Fescue	15	1/2	227	3/1-4/15 8/15-9/15	drill	High	Med.-High	Yes	Yes	Yes	Excellent
Ryegrass (annual)	20-25	1/2	227	3/1-4/15 8/15-9/15	drill, broadcast or aerial	High	High	Yes	Yes	Yes	None
Sudangrass	20-25	1/2-1	55	mid May to mid June	drill	High	High	Yes	Yes	Yes	None
Legumes:											
Crimson Clover	15-20	1/4-1/2	140	8/15-9/15	drill	Med.-High	High	Yes	Yes	Yes	Moderate
White Clover	2-4	1/4-1/2	800	before Sept. 1 or Feb. overseeding	drill or broadcast	Low-Med.	Med.-High	Yes	Yes	Yes	Good
Sweet Clover	8-15	1/4-1/2	260	before Sept. 1 or Feb. overseeding	drill or broadcast	Med.-High	Med.	Yes	Yes	No	Good
Red Clover	8-10	1/4-1/2	275	before Sept. 1 or Feb. overseeding	drill or broadcast	High	Med.-High	Yes	Yes	Yes	Good
Hairy Vetch	20-30	3/4	20	before Sept. 15 or Feb. overseeding	drill, broadcast or aerial	Med.-High	High	Yes	Yes	Yes	Moderate
Alfalfa	8-15	1/4-1/2	200	3/1-4/15, 8/15-9/1	drill or broadcast	Med.-High	Med.	No	No	No	Good
Serecia lespedeza	10-15	1/4-1/2	350	early spring	drill or broadcast	Moderate	High	Yes	Yes	Yes	Good
Korean lespedeza	10-15	1/4-1/2	225	early spring	drill or broadcast	Moderate	High	Yes	Yes	Yes	None
Birdsfoot Trefoil	4-6	1/4-1/2	375	3/1-4/15	drill	Low	Low	Yes	Yes	Yes	Good
Crownvetch	5-15	1/4-1/2	110	3/1-4/15	drill	Low	Low	No	Yes	Yes	Good
Cereals:											
Winter Wheat	120	1	15	before Oct. 5	drill or broadcast	High	High	No	Yes	Yes	Good
Winter Rye	112	1	18	before Oct. 15	drill, broadcast or aerial	High	High	Yes	Yes	Yes	Excellent
Winter Barley	120	1	13	before Oct. 1	drill or broadcast	Med.-High	High	No	No	No	Moderate
Spring Oats	96	1	13	before Oct. 1	drill or broadcast	High	High	Yes	Yes	Yes	None

*In the Bootheel go with the latter part of the range for the fall dates and the early part for spring dates

Crimson clover

Crimson clover has been regarded as one of the more important potential winter annual legumes for the south, especially in the Delta region of Missouri. It grows under a wide range of climatic and soil conditions. Because crimson clover fixes nitrogen, corn or grain sorghum would be the best crops to follow. Crimson clover is well adapted to low soil fertility levels and acid soils. You must plant crimson clover sufficiently early in September so plants can develop before cold weather. Where temperatures are low and areas are subject to soil heaving, plants must be well established or they will winter kill.

Conversely, rank growth going into winter months is conducive to the development of crown and stem rot disease, which may completely kill the plant. This

disease may aid in controlling the plant before the planting of a grain crop. A good stand of crimson clover produces a ton or more of dry hay per acre if left to flowering. In this case, grain sorghum could still follow in a timely fashion.

White clover

White (or ladino) clover is one of the most widely adaptable perennial legumes. However, it prefers well-drained silt loam and clay soils with a pH range between 6 and 7. White clover tolerates wet soil conditions better than most other clovers or legumes. This crop is not competitive with grass in a mixture. Control is easy and inexpensive. White clover is noted for adding large amounts of nitrogen to the soil for the corn or grain sorghum crop to utilize.

Sweet clover

Sweet clover has an extreme range of adaptation. About the only consistent requirement is one of high pH. Sweet clover needs a pH of 6 for proper nodulation to occur and has a higher calcium requirement as well. Sweet clover is able to obtain phosphorus from relatively unavailable soil phosphates and grows on soils where alfalfa, red clover or white clover fails. Except for its high lime requirements, it is similar to lespedeza, which tolerates low fertility conditions. It exceeds alfalfa in its ability to withstand droughty conditions and high temperatures. Sweet clover is a true biennial, surviving only one winter.

Crownvetch

Crownvetch is difficult to establish because of its poor seedling vigor. Seed is also costly. Once a stand develops, it makes excellent cover as typified by its extensive use for road bank stabilization. It is adapted to poorer soil conditions. In several states, farmers plant corn into a chemically suppressed, but not killed, crownvetch stand. By fall, crownvetch is rejuvenated and provides winter cover.

Red clover

Red clover is a short-lived perennial and is the most widely grown of all the true clovers. It is easy to establish by broadcast seeding over wheat in late winter. Soybeans should not follow red clover for two reasons: nitrogen fixed by red clover will not be useful to soybeans and bud blight, a disease of soybeans, can be transmitted from any volunteer red clover.

Hairy vetch

Hairy vetch is a vigorous winter annual cover crop that produces well on moist soils in the southern United States. It is best adapted to the Delta region of Missouri. While seed costs are high, it is easy to establish under a variety of fall conditions. Hairy vetch is known as a menace in wheat. Unless controlled with 2,4-D, its seed cannot be easily separated in combined wheat.

Alfalfa

Alfalfa is one of the more expensive cover crops to seed. It needs to be planted where competition for light does not limit seedling growth. Once established, it is highly vigorous and competitive. Alfalfa doesn't grow well in areas of poor drainage but can produce high levels of nitrogen. It is also winter hardy. Alfalfa is harder to kill once it is established because of its extensive root system. The biggest problem with this crop is the large expense and the time needed for establishment.

Birdsfoot trefoil

Although birdsfoot trefoil is typically considered a pasture legume, it may have value strictly as a crop for cover. It is well adapted to wet or poorly drained soils and does reasonably well where fertility conditions are poor. It is difficult to establish because it has poor seedling vigor, and it lacks productivity in droughty conditions.

Lespedezas

Sericia (perennial) and Korean (annual) lespedeza are especially valuable on badly depleted soil, where it is difficult to establish other legumes. Annual lespedezas are the most popular in Missouri. Korean has been more useful because of its potential for a seed crop and because it reseeds itself easily. The lespedezas are easy to establish by overseeding in wheat. Lespedeza produces from 1 to 2 tons of hay per acre and is dependable during dry years. The soybean cyst nematode is harbored by lespedeza, so lespedeza is not a valuable rotation crop if the cyst is present and soybeans are grown.

Small grains

Spring oats planted in the fall is a vigorous growing, easy, cheap crop to establish. It is winter killed, so requires no burndown herbicides in the spring. Spring barley planted in the fall performs similarly but requires better management and costs more to establish. Spring barley therefore would be a second choice to oats.

Although wheat and rye are easy to establish and economical, you must chemically kill them in the spring. Rye is better than wheat because it grows faster and is more tolerant to less-intensive establishment methods like overseeding into soybeans in late

summer. Rye is the most tolerant of all small grains to wet or dry conditions and poor fertility.

Sudangrasses

If you use sudangrass and related sorghums for summer annual pasture, their residues make a good winter cover, which need not be killed chemically in the spring. The less grazing in late summer, the better winter cover that will exist.

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