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Cereal Rye: Manure and Livestock's New Best Friend

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Why cereal rye?

Cereal rye is a versatile cover crop for livestock-based cropping systems. It recycles manure nutrients, especially nitrogen. It can provide excellent pasture in fall and spring when perennial pastures are least productive and vulnerable to traffic and winter injury. When green chopped in the boot stage, rye can produce 1 to 2 tons of dry matter per acre. Saving a few acres to harvest as grain will provide next season's seed, straw for bedding and, after harvest, a site for manure applications. Additional benefits include[2]:

- A rye cover crop and manure applications are **mutually beneficial**. Manure nutrients aid in decomposition of the rye, offsetting any potential yield drag, and rye captures and recycles the manure nutrients effectively to the future corn crop, reducing commercial fertilizer needs.
- Rye is **one of the best scavengers of nitrogen** and reduces leaching losses on both sandy soils and tile-drained land. The fast growing, fibrous root system can capture 25 to 100 pounds of soil nitrogen per acre. Seeding rye in late summer or early fall will allow it to scavenge nitrogen. When organic N (from manure or legumes) is still available. Rye can capture this nitrogen and recycle it to the following season. The actual amount of nitrogen that is recycled is highly variable. A presidedress soil nitrate test can help determine the amount of nitrogen credit to take for the upcoming corn crop.
- Rye should be allowed to **grow over the winter** to continue taking up N in the spring.
- Rye is the hardiest of cereals and **can be seeded later in the fall than other cover crops**, and it provides top growth and extensive root growth. It will germinate at cold temperatures—as low as 34 degrees F—and it will resume growing at 38 degrees in the spring. This makes it possible to seed rye after corn, sugar beet or bean harvest until the ground freezes.
- It is relatively **inexpensive to plant, and the seed is readily available** or easily grown.
- **Easy to establish**, rye can be aerial seeded in standing corn/silage and before leaf drop in soybean. Rye can be broadcast alone or with dry fertilizers, can be added to manure tanks for slurry seeding or drilled (which provides the most consistent stands).
- It outperforms most other crops on infertile, sandy or acidic soil. It is also **tolerant of a variety of soil types** and grows well on both poorly and well-drained soils.
- Rye can recycle **potassium** from deeper in the soil profile for future crop use.
- Rye is effective at suppressing weeds. It competes with winter annuals and inhibits growth of spring weeds. As rye residue decomposes, it releases allelopathic compounds that are harmful to the growth of weeds.
- The rapid fall and spring growth can **stabilize sandy soil, trap snow and improve infiltration**.
- Rye is utilized for **many cropping systems**, including fruits and vegetables, where it can be left in narrow strips to reduce wind erosion.
- Rye, and all cover crops, **build soil quality** over time by adding organic matter. Long-term benefits include improved soil structure, tilth, water infiltration and water-holding capacity.

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Management guidelines

Because rye can grow at temperatures as low as 38 degrees F, it grows quickly in the spring. This can create problems, but they are predictable and therefore manageable. Tall top growth can be difficult to plow down and may dry out sandy soil in the spring. An abundance of top growth that is poorly incorporated may cause poor seed-to-soil contact in the subsequent crop and may attract armyworms or cutworms. Growers using no-till planting immediately after burndown may experience the same issues.

A timely kill is key to maximum yields. Killing rye about 10 days before planting your summer annual crop will give residue time to desiccate. Early spring control is critical unless rye is planned to be green chopped and removed as a forage source. Rye is very forgiving at planting but can be unforgiving in the spring. Researchers have observed no yield reduction in soybeans following rye but have observed about a 5 percent reduction in corn yield in some years. There was no yield decline in corn following rye when manure was applied.[4]

Managing cereal rye successfully in the spring

Research indicates that rye takes up most of its nitrogen in the spring. The longer it grows, the more N will be removed from the soil. In all instances, adding manure to rye in the fall or spring increased N for the future corn crop and improved yields over non-manured trials.[4] In all instances, use a presidedress soil nitrate test to determine the appropriate N credit for your specific circumstances.

There are three strategies for balancing the benefits of rye while controlling it in the spring:

1. Kill the rye early while it is actively growing and growing conditions are good—generally, when it's 8 to 12 inches tall. This will conserve soil moisture. It can be accomplished successfully with either herbicides or tillage.
2. Allow the rye to grow to boot stage and green chop for forage. Researchers are discovering that there are about equal amounts of nitrogen in the roots and the shoots in the absence of manure, so even when the top growth is removed, nitrogen will be released from the root residue. There is little risk of regrowth to deal with when rye is harvested at this stage.
3. If the rye reaches maturity before it is killed by tillage or herbicides, additional nitrogen will be needed to make up for the N that the plant has used up. Seed the rye with a nitrogen-fixing crop, such as vetch or red clover[5], or combine the rye with a manure application. If not carefully managed, quick-growing rye may reach this stage before you know it.

Manure and rye: perfect companions

A cover crop provides many benefits for manure applications. Roots and top growth create an environment that improves infiltration, retains water and nutrients, and recycles them for the next growing season. The presence of a cover crop reduces the likelihood that manure will run off or move to tile drains.[1] Rye will help stabilize manure/wastewaters applied in the fall, winter or spring. In turn, the nitrogen in the manure will speed the decomposition of the rye residue and the eventual release of nitrogen and other nutrients from the residue to the corn crop.

Basics for planting

- Don't use rye as a cover crop just before growing other cereal grains. Volunteer rye may contaminate wheat, oats and barley.
- Plant in the fall. Earlier planted rye will capture more nitrogen and be more beneficial for manure applications than rye planted later. Late-planted rye will germinate in air temperatures as low as 34 degrees F.
- Drill rye in at 60 to 90 pounds per acre (1 to 1.5 bushels/acre). Broadcast it at 90 to 120 pounds/acre (1.5 to 2 bushels/acre).
- Broadcast alone or with potash before chopping cornstalks. Aerial seeding works well and generally produces good stands. Seed before silage harvest or before soybean leaf drop. Shallow disking or chisel plowing will improve germination.
- Drill seed less than 2 inches deep or use shallow incorporation. The goal of a cover crop is to cover and scavenge. A perfect stand is not necessary for positive results.
- In the spring, control rye early with tillage or herbicides. Use glyphosate at 0.75 pound ai/acre. Spring rains create challenges of rapid rye growth and inability to spray herbicides because field conditions do not allow equipment traffic; closely watch the spring growth and the weather forecast.

- If you choose not to use a herbicide, plow, chisel or disk after the rye is 12 inches tall but before it is 20 inches tall to avoid rye regrowth—usually **one to two weeks before planting**. Vegetable growers on sandy soils often leave strips for wind protection during the growing season. Organic growers often leave the rye on the surface for continued weed control, but most no-till growers prefer to avoid planting in green residue that may harbor insects. Controlling rye one to two weeks before planting helps to avoid these concerns. Glyphosate-ready crops provide an additional option to kill any surviving rye.

Successfully recycling N and achieving good corn yields hinge on planting rye as early as possible, combining rye with manure applications, allowing one to two weeks between controlling rye and planting, and effectively controlling the rye in the spring.

Producers with a conservation plan may consider signing up for program payments for cover crops at their local Natural Resources Conservation Service office. Sign up during the winter for best chance of being accepted.

Additional resources on manure management can be found at www.animalagteam.msu.edu, and additional cover crop information at www.covercrops.msu.edu.

References

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[2]Managing cover crops profitably (3rd edition). 2007. Beltsville, Md.. Sustainable Agriculture Network, USDA-SARE.

[3]Nyiraneze, J., and S.S. Snapp. 2007. Integrated Management of Inorganic and Organic Nitrogen and Efficiency in Potato Systems. Soil Fertility and Plant Nutrition Vol. 71: No. 5.

[4]Singer, J.W., C.A. Cambardella, and T. B. Moorman. 2008. Enhancing Nutrient Cycling by Coupling Cover Crops with Manure Injection . Agronomy Journal 100:1735-1739.

[5]Snapp, S.S. and H. Borden. 2005. Enhanced nitrogen mineralization in mowed or glyphosate treated cover crops compared to direct incorporation. Plant and Soil 270 101-112.

Cereal rye as a cover crop has three main advantages: erosion control, nutrient capture and recycling, and adding organic matter (carbon) to the soil. Control of this cover crop in the spring involves management practices that try to balance these benefits but rarely maximizes all three. In the chart below, assume about half of the N is in the rye shoots and half is in the roots. Tillage will burn up more carbon but creates faster release of the nitrogen from both roots and shoots. No-till retains more carbon but relies on weather conditions (heat and moisture) to add the nitrogen in the shoot back to the soil. Corn yield reductions that have been noted following rye have been shown to be offset by the addition of manure. The exact reason(s) are not known, but are probably due to adding additional nitrogen to speed the breakdown of the rye and releasing N at the peak time of corn demand.

Rye growth stage at incorporation	**Spring management**	**Comments**
Young (~8 in. tall)	Tillage to control rye	Herbicides plus tillage may be needed to control rapid growth of rye if spring weather is favorable. More carbon is lost, but N will recycle faster. Allow 1 to 2 weeks between killing and planting. Manure can be applied in the spring with sufficient tillage to incorporate the manure and also kill the rye. Without manure, there may be some N tie-up to future corn crop.
Young (~8 in. tall)	Herbicide burndown to control rye followed by no-till planting	Allow several weeks between the herbicide burndown and no-till or strip-tillage planting. Kill the rye early while it is actively growing and growing conditions are good—generally when it is 8 to 12 inches tall. This will conserve soil moisture.
Boot stage	Remove rye by green chopping or grazing	Nutrients from the roots will remain and contribute to the following crop. Planting can occur immediately following the green chop operation. There should be no regrowth at this stage.
Boot stage	Plow/Tillage	Plowing down mature rye will create an N deficit in corn seedlings unless manure was added; the majority of the N may be released too late for the corn crop to benefit. Sandy soils may be excessively dried out. Allow 1 to 2 weeks between tillage and planting.
Mature	Manure combinations: -Plow, then apply manure, OR -Harvest cover crop for seed and straw.	Plowing down mature rye will create dry soil and an N deficit in corn. Applying manure will partially offset the N deficit, but it may be too late to double crop. Summer alfalfa seeding can be timely. Will contribute the most to building soil organic matter. Seed can be harvested for next year, and the straw baled, and the rotation provides a site for manure applications.