Frost Seeding
A Technique for Interseeding Cover Crops and Improving Forage Stands

Frost seeding is a way to establish cover crops in the winter when an economic crop is still growing so that the cover crop is already established when the grain crop is harvested. Frost seeding can also be used to renovate pastures and forage crops. Frost seeding is the broadcasting of seed onto the soil surface during periods of freeze-thaw cycles. Because the density of ice is lower than liquid water, soil water expands upon freezing, expanding small pores and causing heaving of the soil surface. As the soil thaws, the frozen water disappears from the pores, leaving small openings where soil can fall back into the cracks left by the melting water. Soil typically goes through several freeze-thaw cycles in late winter and early spring, when the soil freezes during the night and thaws during the day. If small, round seeds are cast onto the soil surface just before a freeze-thaw cycle, the seed-to-soil contact improves. This increases the chance of a successful cover crop or forage establishment compared to broadcasting seed at other times of the year. The practice has been found to improve the success of broadcast seeding on loamy and clay soils that hold water, but it is not suited for use on sandy soils that dry out too fast.

Frost seeding is an economical no-till cover crop establishment technique that can be done in annual crops (primarily winter cereals) and to renovate pastures. The first scenario is broadcasting into winter wheat, cereal rye, or barley in late winter. The winter cereal plants will provide some protection to the cover crop seedlings and will keep the soil surface moist due to shading and reduction of windspeed near the ground. The second scenario is broadcasting into a pasture to increase the proportion of legumes in the stand or fill in bare spots with grasses and legumes. This is a cheap but not foolproof method, and it may need to be repeated for two years to get a catch. Frost seeding is a great opportunity to establish clovers in winter and early spring to fix atmospheric nitrogen and improve soil for a nitrogen-demanding crop such as corn planted the following year. If established in the summer after small grain harvest, species such as red, white, and sweet clover typically don’t put on enough growth to fix large amounts of nitrogen or add much organic matter.

Timing

In the northeastern United States, frost seeding should occur at the end of winter, when the soil freezes at night but thaws during the day. This causes the soil surface to look crumbly, which is often called “honeycombing” because there are many small crevices in the soil surface. Seed should be broadcast when the soil is frozen to avoid causing compaction. When the soil thaws during the day, seeds will find their way into the small cracks left behind by the thawing ice crystals and the surface will be moist, which encourages seed germination. Although some advocate frost seeding on a thin layer of snow, our experience with that has been negative, as there is often no honeycombing under the snow and runoff from melting snow can carry seeds away. Some also recommend frost seeding before snowfall in December, which may be successful.
if the snow does not melt or the soil stays frozen solid until spring, which is more common in northern parts of Pennsylvania or higher altitudes.

**Species**

The best species for frost seeding generally have small seeds, germinate quickly, and grow well in cool conditions. Red, white, and sweet clover are usually the most successful species, while alfalfa and birdsfoot trefoil often germinate too slowly. When seeding legumes, be sure to inoculate them with the appropriate rhizobium so symbiosis will take place to fix the nitrogen. For red and white clover, use true clover inoculum (*Rhizobium leguminosarum* bi var *trifolii*). For sweet clover, use alfalfa/medic inoculum (*Sinorhizobium meliloti*). A final stand of 7.5 plants per square foot is recommended to produce at least 90 percent of possible yield.

In pastures, some grass species such as ryegrass and orchardgrass may also be frost seeded. But frost seeding is not recommended for bromegrass, timothy, or reed canarygrass. Do not mix grass and legume seed for broadcast application, as the legume seeds will be thrown farther than the grass seeds due to their greater density, which leads to nonuniform seed distribution. Recommended species and seeding rates for the two scenarios discussed here are given in the table. Rates for seeding into small grains are higher because no repeat application is possible, while with pasture renovation frost seeding complements an already established (though "rundown") stand. Although yellow sweet clover can cause animal health problems due to its coumarin content (a blood thinner), it is not likely to cause livestock health issues if it is only a percentage of the forage stand.

**Species and seeding rates for frost seeding into winter small grains or for pasture renovation:**

<table>
<thead>
<tr>
<th>Species</th>
<th>In Small Grains</th>
<th>For Pasture Renovation</th>
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<tbody>
<tr>
<td>Red clover</td>
<td>10 pounds per acre</td>
<td>1–4 pounds per acre</td>
</tr>
<tr>
<td>Yellow blossom sweet clover</td>
<td>15 pounds per acre</td>
<td>2–8 pounds per acre</td>
</tr>
<tr>
<td>White clover</td>
<td>Not recommended</td>
<td>1–2 pounds per acre</td>
</tr>
<tr>
<td>Perennial or annual ryegrass</td>
<td>Not recommended</td>
<td>2–3 pounds per acre</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>Not recommended</td>
<td>2–4 pounds per acre</td>
</tr>
</tbody>
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**Equipment**

For small-scale applications, there are hand-cranked broadcast seeders that can be strapped onto one’s chest. Battery-powered broadcast seeders can be mounted on an ATV or small tractor, while larger, PTO-operated spreaders, often used for fertilizer applications, can also be utilized. A drop-box, such as a Brillion seeder, or no-till or conventional drills can also be utilized for frost seeding cover crops.

Most spreaders come with charts. To confirm the accuracy of a predetermined setting, you can load the spreader with a known amount of seed, set it according to chart specs, and, by knowing the length traveled and width of spread, calculate the
A pendulum spreader on tractor three-point hitch operated from the tractor PTO.

Repeated frost-thaw cycles cause the typical "honeycombed" soil surface that helps improve seed-to-soil contact from frost seeding.
area covered with the seed to check the seeding rate. Adjustments can then be made by changing the opening of the spreader or altering your speed. You can also walk or drive over a tarp of known dimensions with the spreader in operation and weigh the seed to calculate the seeding rate. For this technique, make sure the tarp is the same width as the spread pattern either by selecting the appropriate size tarp or folding a larger one under itself so you have the correct width for calculating the sample area.

One of the greatest challenges with frost seeding is poor coverage of the field. Care should be taken to ensure skips are not occurring due to passes that are too wide and that you are not overapplying from excessive overlap. Before you go to the field, know how far the seed is spread with your spreader so you can space your passes. Seeding should not occur when wind can alter spread patterns. Additionally, you may need to alter pass-to-pass width when spreading on a sidehill or spread up and down the slope to ensure uniformity.

In Small Grains

Frost-seeded legume cover crops are unlikely to compete with the small grain because the latter is already well established. Therefore, there is little concern about small grain yield reduction. The greater concern is no catch of the cover crop due to excessively competitive small grain crops. Frost seeding is less likely to be successful in high-yielding or excessively fertilized stands. After grain harvest in June or July, the cover crop will already be established under the small grain canopy and will begin to take off in full light. Typically, the cover crop will not be so tall as to interfere with grain and straw harvest. However, if you notice that red or sweet clover is growing too vigorously in late April or early May, the growth can be suppressed by applying a low rate of 2,4-D or MCPA herbicide. Harvest both grain and straw so that the cover crop is not covered by crop residue. It is important to have a chaff spreader on the combine and remove straw quickly after grain harvest. If you observe swaths of missing cover crop, fill them in with a crop like oats to prevent weeds from proliferating. Another management practice is to mow the stand to approximately 3 inches in height when summer weeds such as foxtail or lambsquarters start to break through the clover.

Pasture Renovation

Frost seeding is recommended on a field with bare spots or one that is overgrazed. If planning for frost seeding, heavily graze or mow the field down to 2 inches in the fall so that soil is exposed and regrowth is delayed in spring. This will help improve seed-to-soil contact and reduce competition from the existing sod. Another option is to allow cattle to trample the seed shortly after broadcasting in late winter. However, soil compaction is a concern in wet conditions. A thick thatch layer will compromise success of frost seeding due to little seed-to-soil contact. Mow or graze the field when the existing sod grows to 6 to 8 inches in height in the spring to help reduce competition and increase light penetration to allow the new plants to grow.

In Summary

Frost seeding is an economical method to establish legume cover crops into small grain stands or fill in rundown pastures. With proper attention to species selection and management, the level of success can be maximized.

Prepared by Sjoerd W. Duiker and Zachary M. Larson.
Photos on pages 2 and 3 courtesy of Sjoerd Duiker.

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