Michigan Technical Note

USDA-Natural Resources Conservation Service

AGRONOMY #52
Subject: Aerial Seeding of Cover Crops
Date: June 2010

Introduction

Aerial broadcast seeding is not the ideal method of establishing a cover crop – that honor falls to drilling, or broadcasting with a shallow incorporation of seed. But aerial seeding has enough positive aspects to merit consideration.

A big advantage of aerial cover crop seeding is that more acres can be seeded in less time than using ground equipment. Aerial application also allows seeding to be done when it is physically impossible to use ground equipment, such as when crops are present, or the soil is too wet for regular equipment. Seeding, germination, and growth of cover crops can begin even before the existing crop has been harvested. This is especially important in areas where there is a very small window of opportunity between crop harvest and the end of the growing season. Seeding a cover crop after crop harvest may result in poor stand establishment due to cold temperatures or moisture stress.

No till drilling is preferred to broadcast seeding especially late in the planting season or after the recommended planting date.

Aerial seeding is always more risky than drilling or incorporation of the seeds, so it's important to have the right soil surface and weather conditions at seeding time.

Ryegrass interseeded into corn.

Soil surface conditions

The surface soil must be moist and friable to enable the seed to settle into the surface and make good contact with the soil. A surface that is loose and rough, with cracks or ample residue cover, works best. The chances of a seed making soil contact and landing in areas with soil moisture

is enhanced and the residue cover conserves the surface moisture for seed germination. A flat, hard, dry soil surface is not conducive to aerial seeding success.

Soil moisture


Harvesting soybeans releases previously seeded cover crop.

Aerial seeding has much higher success in areas with good soil moisture and frequent precipitation in late summer or early fall. Broadcasting seed requires enough moisture in the top ½ - 1 inch of soil to ensure adequate moisture for the seed to germinate and establish. This moisture needs to be present at the time of seeding, or should be expected to occur within 10 days of seeding. If moisture is not present and germination is delayed, there is an increased chance of seed mortality from desiccation, insect damage, or animal predation. Seeding on hard, dry soil reduces the chances for germination and uniform establishment of the cover crop.


Ryegrass, hairy vetch, and crimson clover in collards.

Sprinkler irrigation can be used to start the cover crop in dry climates. One timing sequence could be flying on the cover crop seed just before the last irrigation for the crop and then wait for canopy to open up after harvest. A 30 day time lag between seeding and harvest is usually permitted, but longer periods could shade out young cover crop seedlings. Another sequence with irrigation can be to aerial seed the cover crop just before harvest, allow harvest traffic to provide better seed–to-soil contact, and then irrigate immediately after harvest to germinate the cover crop seeds.

Seed selection

Most species of cover crops will produce adequate stands for winter and early spring soil protection when broadcast on the soil surface, provided that the proper weather and soil surface conditions are present. Cereal grains (e.g. wheat, rye, oats, barley, triticale) will easily establish by aerial seeding. Do not use treated small grain seed into soybeans just prior to leaf

drop. *Any treated seed found in grain delivered to the elevator can result in rejection of the whole load.*

It's important to understand the characteristics of different types of plants when choosing a cover crop. Large-seeded legumes, like cowpea and vetch, establish better with good seed-to-soil contact obtained by drilling or incorporation following broadcast. When these seeds germinate, their young roots don't have the ability to penetrate the soil surface as well as other species. Legumes, like most dicots, germinate and establish better when they are in direct contact with the soil. Grasses are more adapted to germinate on the soil surface. Their young roots are smaller than those of legumes, so they can penetrate the surface crust easier. Grass roots multiply quickly once they enter the soil, creating a root mass that can absorb the water and nutrients the young plant needs.

Below are some general groupings of cover crop species, grouped by their suitability for aerial broadcast seeding. Small grains, grasses, and brassicas establish well by aerial seeding. Large seed legumes do poorly when broadcast, preferring the good seed-to-soil contact that comes from being drilled or incorporated into the soil. Small-seeded legumes are intermediate, and can establish when aerially seeded under good weather and soil conditions. Another reason adequate moisture and soil contact is important for legumes is the seed inoculum. Lack of soil contact and soil moisture will reduce the effectiveness of the soil inoculum.

Recommended species and seeding dates for aerial seeding of cover crops in corn or soybeans. *(MSUE Bulletin E-2646, 1998, Michigan Field Crop Ecology)*

Group 1 - Small grains (rye, wheat, barley, oats, triticale, spelt). Seed sources are plentiful and relatively inexpensive. Seeds germinate readily on the soil surface when soil moisture is present. *Do not use treated small grain seed in soybeans to be harvested for grain. One treated seed found in the grain at harvest can be rejected for sale by the local grain buyer. Oats can be Aerial seeded in corn, August 1 - September 5. Rye, triticale or wheat can be aerial seeded in corn, September 15- October 15.*

Group 2 – Ryegrass (annual, Italian, perennial) establishment is benefited by having rain shortly after broadcasting. Aerial seeding of ryegrass requires an additional 2-3 pounds of seed per acre over drilling or incorporating. *Aerial seed Group 2 in corn, June 1-July 1or August 1-September 5.*

Group 3a – Small seeded brassicas (mustards, rape, canola, turnips, or radishes). Establish early, about 4 weeks before the average date of a 28° F freeze. Soil temperatures needs to be greater than 45° F. Small seed size allows for good soil contact. *Aerial seed group 3a in corn, August 1- September 5*

Group 3b – Sorghum-sudan and millet requires warm, moist soil conditions with soil temperature > 65° F). *Aerial seeding is not recommended in Michigan!*

Group 4 – Small seed legumes (clovers, medics, trefoils, alfalfa) Best success if drilled ¼ to ½ inch deep into the seedbed. Will establish in late winter/early spring as "frost seeding" when the soil surface is moist and conditions allow freezing and thawing to provide good seed-to-soil contact. Best success with sweet and red clovers. *Aerial Seed Annual medic and Berseem clover in corn, June 1-July 1. Aerial seed all other clovers, June 1- July 1 and August 1-September 5.*

Group 5 – Large seeded legumes (vetch, and buckwheat). Best success if drilled or incorporated. Seeds are relatively expensive and would require nearly double seeding rates for aerial broadcasting. *Aerial seed group 5 in corn, June 1-July 1 and August 1-September 5.*

Aerial seed Groups 1-5 in soybeans, August 20-September 15. However, the following cover crops are not recommended for soybeans: Annual Medic, Berseem clover, or Buckwheat.

Brassicas for Cover Crops

The mustard family of crops (brassicas such as canola, turnips, rape, mustards and radishes) is being recommended for a cover crop for a number of reasons. Brassicas can suppress soil-borne diseases, nematodes, and some weeds. Brassicas have been shown to suppress diseases such as verticillium and root rots. They also increase infiltration, carbon content and percolation rates of the soil surface. They can supplement grazing for livestock in late fall and early winter. Be aware that mustards are sensitive to broadleaf herbicide carryover, particularly 2, 4-D. Some canola varieties are glyphosate-tolerant, while other non-resistant varieties of brassicas are very sensitive to the herbicide. The small size of seed, spherical shape, and ability to germinate under cool temperatures makes the brassicas well-adapted for aerial seeding. The small seed size means there is a large number of seeds sown per acre, and the seeds roll upon impact with ground, which increases the chance they will end up in a crack or crevice where the conditions for germination and seedling growth are better.

Oilseed radish cover crop (MSU photo)

When brassicas are seeded as bio-fumigants a mixture of brown, white, and yellow mustard should be planted and allowed to reach green pod stage before incorporation. The goal is to prevent the brassicas from producing viable seed and the soil should be sealed after incorporation to increase the effectiveness of the glucosinolates bio-fumigation.

To reduce sugar beet cyst nematode pressure, seed a fall seeding of oil seed radish after small grain. Only two varieties Adagio and Colonel are recommended for sugar beet cyst nematode trap crops. ***Do not use Common or Daikon varieties as they lack the sugar beet cyst nematode trap crop properties.***

Cover crop species shall be selected that have different maturity dates, attract beneficial insects, serve as a trap crop for damaging insects, and/or provide food and cover for wildlife habitat management. Pacific Gold Mustard and Dwarf Essex rape are the recommended brassicas before planting a cherry tree orchard or potatoes to reduce damage from root lesion, dagger or other herbivore nematodes.

Seeding rates

Seeding rates for aerial seeded cover crops need to be increased above rates recommended for drilled or incorporated seeding. An exception to this is the brassicas, which generally have the same recommendation rate for aerial seeding as for drilled or incorporated seeding. Generally, aerial seeding rates need to be 25 – 50% higher than drilled rates to achieve the same stand. Higher seed rates are required because there are greater risk of insect damage, or rodents and birds eating seeds on the soil surface. Bird and rodent predation is particularly bad around the edge of the field, where these pests can move in from field borders or neighboring non-cropland. Increasing the seeding rate around field edges and along headlands helps offset some of the expected damages. This increases seed cost, but that may be offset by the fact that more acres can be seeded in less time, and planted when growing conditions are more favorable. Use the high end of the seeding rate for a specific cover crop per the specifications in the MI 340 standard.

Timing of aerial seeding

Airplanes can cover large areas quickly.

As a general rule, aerially-seeded cover crops should be sown at least 7 – 10 days earlier than drilled cover crops, because they are somewhat slower to establish a stand. Seeding into standing soybeans should be done before the soybeans have dropped more than 10% of their leaves. The leaf fall that will occur after seeding will act as mulch and provide good soil protection and moisture conservation. Aerial seeding into standing corn should be delayed until the kernel milk line is at least 50% formed. For silage corn, do aerial seeding several weeks

before cutting silage, when the corn is in early dent stage. Sowing into other standing crops should consider the current weather and temperature. (See recommended dates by groups 1-5 for seeding into corn or soybeans)

Aerial seeding equipment

Fixed wing vs. rotary wing aircraft for seeding cover crops – which is best? Both types of aircraft are capable of quickly spreading seed above the crop canopy. Anecdotal evidence gives a slight advantage in cover crop establishment to helicopters, because the air turbulence from the blades shakes the crop canopy, preventing the seed from being caught on the leaves, and the downward pressure forces the seed onto the ground. Fixed-wing aircraft can carry heavier loads of seed and fly faster across the field. Helicopters are more maneuverable, and can do a better job on irregularly-shaped fields and along end rows and headlands. Optimum seed drop is from a height of 50 to 60 feet above the canopy.


Helicopters can maneuver better in irregular fields.

A third method of above-canopy seeding is a high clearance vehicle, such as a high clearance sprayer. These vehicles are slower than aerial seeding and will cause some crop damage when turning at the end of a field. Some may not have enough clearance for tall crops like corn, and their use is limited by wet soil conditions. The advantages are: many farms now own or can rent this equipment; it is available during the best time for seeding cover crops; the farmer can operate the equipment himself; and it is may be less expensive than custom aerial seeding. The main criteria for choosing between types of will probably be cost of rental and availability of the equipment. However, delaying seeding in order to get the cheapest seeding method may mean poor establishment due to moisture conditions or shortened growing season. Timing of seeding is a crucial aspect of cover crop success.

Further Reading

Clarke, A. (Ed.). 2007. Managing Cover Crops Profitably. Sustainable Agriculture Network handbook series; bk. 9.

Magdoff, F., and H. van Es. 2000. Building Soils for Better Crops (2nd Ed.). Chap. 10: Cover Crops. Sustainable Agriculture Network handbook series: bk. 4.

Singer, J., T. Kaspar, and P. Pedersen. 2005. Small Grain Cover Crops for Corn and Soybeans. Extension Publication PM-1999. Iowa State University.

Taylor, E., K. Renner, and C. Sprague. 2008. Integrated Weed Management: Fine Tuning the System. Chap. 2: Cover Crop Systems. Extension bulletin E-3065. East Lansing, Mich.: Michigan State University.