USDA
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TECHNICAL NOTE

Iowa Agronomy technical note 36: Interseeding of cover crops

ESTABLISHMENT BY AERIAL BROADCAST

A big advantage of aerial seeding of cover crops is that more acres can be seeded in less time than with 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, and for winter killed broadleaf species to get enough growth. Waiting to seed a cover crop until after crop harvest may result in poor stand establishment due to cold temperatures or moisture stress.

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.

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. With a loose and rough surface the chances of a seed making soil contact and landing in areas with soil moisture is enhanced. Residue cover conserves the surface moisture for seed germination. A flat, hard, dry soil surface is not conducive to aerial seeding success.

SOIL MOISTURE

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.

Cover crops show up in the fall prior to soybean harvest.

Harvesting soybeans shows previously seeded cereal rye cover crop.

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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) may be easily established by aerial seeding if moisture and soil conditions are suitable.

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, see group 5 below. 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 inoculant. Lack of soil contact and soil moisture will reduce the effectiveness of the soil inoculant.

A very general grouping of seed selections for aerial seeding of cover crops. Local conditions and species adaptation must be applied.

Group 1 - Small grains (cereal rye, wheat, barley, oats, triticale) Seed sources are plentiful and relatively inexpensive. Seeds germinate readily on the soil surface when soil moisture is present.

A multi-species cover crop mix helps control soil erosion and supplies livestock supplemental feed.

Group 2 – Ryegrass (annual, perennial) benefits by having rain shortly after broadcasting. Aerial seeding of ryegrass requires an additional 2 pounds of seed per acre over drilling or incorporating.

Group 3a – Small-seeded brassicas (mustards, rape, canola, turnips, radishes) must be established early, about 4 weeks before the average date of a 28° F freeze. Soil temperatures need to be greater than 45° F. Small seed size allows for good soil contact.

Group 3b – Sorghum-sudan and millet require warm, moist soil conditions with soil temperature > 65° F.

Group 4 – Small-seeded legumes (clovers, medics, trefoils, alfalfa) will succeed best if drilled ¼ to ½ inch deep into the seedbed. They 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.

Group 5 – Large-seeded legumes (beans, hairy vetch, peas, lupine, cowpeas) and buckwheat will succeed best if drilled or incorporated. **Large seeds are not recommended for aerial seeding.**

BRASSICAS FOR COVER CROPS

The mustard family of crops (brassicas such as canola, turnips, rape, mustards and radishes) are recommended as 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. This increases the chance they will end up in a crack or crevice where the conditions for germination and seedling growth are better.

A western Iowa organic farmer uses tillage radishes in a multi-species cover crop mix to help break soil compaction.

SEEDING RATES

For seeding rates of aerial-seeded cover crops, see Table 1. Higher seed rates are required due to a greater risk for 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.

Airplanes can seed large areas with seed quickly.

TIMING OF AERIAL SEEDING

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, conduct aerial seeding several weeks before cutting silage, when the corn is in early dent stage. Consider current weather and air temperature before sowing into other standing crops.

Table 1

Cool Season Cover Crop Seeding Rates *(minimum rates)*

Species Common Name	Winter Hardy?	Broadcast on Surface (Bulk lbs/acre)
Rye, Winter Cereal	Yes - all cultivars	45
Triticale, Winter	Yes - most cultivars	45
Wheat, Winter	Yes - many cultivars	45
Barley, Winter[1]	No	60
Oats	No	60
Ryegrass, Annual[2]	No/Sometimes	14
Mustard, Oriental	No	4
Radish, Oilseed	No	6
Rapeseed	No	4
Turnip, Forage type	No	4
Vetch, Hairy[3]	Usually/Slow Growth	14

Cool Season Cover Crop Recommended Planting Dates

Zone (See Map[4])	Winter Hardy Cover Crops	Non-Winter Hardy Cover Crops
Zone 1	October 21	September 9
Zone 2	October 28	September 16
Zone 3	November 5	September 23

[1]Winter barley is rarely winter hardy in Iowa.

[2]Some cultivars of annual ryegrass are winter hardy in Iowa.

[3]Hairy Vetch is somewhat winter hardy if enough fall growth occurs, but it grows slowly in both fall and spring. It benefits from an earlier fall planting. Soil incorporation is preferable.

[4]See "NRCS Technical Note 38: Cover Crop Management" for Zone map.

Broadleaf species should be seeded in a mix with grass. Cover crop mixes with broadleaf species should not be comprised of more than 50% broadleaf species.

This is not an all-inclusive list of species. See Midwest Cover Crops Council (MCCC)-Cover Crop Decision Tool – Cover Crop Selector for Iowa Counties.

Up to 20% of the seed mix can be other species not listed in the MCCC's-Cover Crop Decision Tool if approved by the ARC (Area Resource Conservationist). The ARC will determine the lbs. of the species needed to meet the % of seed mix up to the 20% limit.

It is recommended that you plant diverse cover crop mixes. The rates listed are for pure stand seedings. When developing a cover crop mix, take the percent desired by the pure stand rate to determine seeding rate by species.

(Example: 60% cereal rye + 40% radish would have a seeding rate of .6 X 45 = 27 lbs. cereal rye and .4 X 6 = 2.4 lbs. radish)

AERIAL SEEDING EQUIPMENT

Fixed-wing vs. rotary-wing aircrafts for seeding cover crops – which is best? Both types of aircrafts 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 aircrafts 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.

An airplane drops cover crop seed on a corn field.

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; consistently get more even seed coverage; 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 equipment will probably be cost of rental and availability of the equipment. However, delaying seeding 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.

A high-clearance sprayer is used by a northeast Iowa farmer to apply cover crop seed between corn rows.

Further Reading

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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.