

A COMPREHENSIVE GUIDE Aerial Seeding

Aerial seeding is the application of cover crop via a plane, helicopter, or drone, typically into standing cash crops. Aerial seeding is generally fast and easy and allows a farmer to establish a robust cover crop stand months before cash crop harvests. The article below will outline methods of aerial seeding, tips to optimize results, advice on how to establish a low-cost cooperative, and results summarizing its success.



Planes

Planes are the most widely used vehicle for aerial seeding and are suitable for large acreage farms and fields. Planes can cover many acres quickly and carry a large amount of seed. However, planes are the least precise method of seeding and must reload at a nearby airport, increasing the cost of fuel and time. A plane can seed about 500 acres per day.

SEVERAL OPTIONS EXIST FOR AERIAL SEEDING



Helicopters

Helicopters can cover large areas of land and can land close to fields for reloading, reducing fuel and time expenses. The rotor blades on helicopters can create turbulence that affects the evenness and predictability of seeding.



Drones

Because they can precisely place seeds, drones are ideal for small, irregularly-shaped fields with rough terrain. However, drones can only carry a small amount of seed and cannot cover large areas quickly.



BENEFITS TO AERIAL SEEDING

- Substantial winter coverage. Through aerial seeding, farmers can establish a cover crop months before cash crop harvest in the early fall. The cover crop will establish and grow under the corn and soy vegetation; when the grains and beans are harvested, the newly seeded cover crops will remain, protecting the soil from erosion throughout the winter. Early establishment allows the cover crops to accumulate substantial above and below-ground biomass before winter and therefore better prevent nutrient leaching and surface run-off during the winter.
- Multi-species Establishment. Through aerial seeding, farmers can establish a multispecies cover crop months before cash crop harvest in the early fall. Clovers, brassicas, and some grasses would not have time to establish if planted in late fall, after corn and soybean harvest.
- **Expedient!** Not only is aerial seeding extremely efficient (a single plan can seed over 500 acres/day), it is outsourced, and therefore one less thing for farmers to do in the fall.
- No Equipment Required. Lack of access to a no-till drill is a common impediment faced by many farmers. Specialized equipment is not necessary for aerial seeding.
- No Crop Damage. Other methods of cover crop application within standing cash crops (interseeding and high crop spreading) can cause substantial crop damage, particularly on the smaller unevenly shaped fields of the northeast.
- No Soil Damage. Farmers rushing to establish cover crops after cash crop harvest can damage soil structure when planting cover crops in wet fields.

DRAWBACKS TO AERIAL SEEDING

• Aerial seeding can be a gamble. Aerial seeding will always be less predictable and riskier than drilling cover. Seed to soil contact is difficult to achieve, and success depends on timely rainfall.

For more information on how well it works, and in what soils and crop rotation it is most successful, see "Where does Aerial Seeding Work Best"

- Expensive. Aerially application increases the costs by \$20 to \$30 per acre over seed costs. Depending on equipment and labor costs, it is often more expensive than using a no-till drill or spreader to establish a cover crop.
- Logistically Complex. Farmers will need to know exactly what acres they want to cover crop on weeks (or months) before beginning. Sometimes aerial seeding coordinators may be necessary to ensure efficient delivery of seed to airports.
- Weather Dependent. The low-altitude flight (50-60 feet above the crop canopy) is dangerous during stormy, foggy, or windy weather. A week or two of unfavorable weather can interfere with seeding and possibly cause farmers to miss seeding deadlines.



TIPS FOR SUCCESS WITH AERIAL SEEDING

North Jersey RC&D runs one of the most extensive cover crop aerial seeding initiatives in the country, seeding over 3000 acres a year on farm fields across Northern New Jersey. In our seven years running the program, we've picked up some valuable tips!

SEED SELECTION

SMALLER SEEDS WORK BETTER: Smaller, lighter seeds (clovers and ryegrass) can be applied at a lower lb/acre ratio. Therefore aerial applicators will be able to apply cover crop more rapidly with less need to re-fill, reducing the overall costs.

GRASSES WILL GERMINATE ON THE SOIL SURFACE: Grasses (such as annual ryegrass) 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.

CEREAL GRAINS AND BRASSICAS: Cereal grains may be quickly established by aerial seeding if moisture and soil conditions are suitable. Small seeded brassicas will also establish well so long as soil temperatures are above 45° F.

IMPROVE BALLISTICS BY COATING SEEDS: Small, irregularly shaped seeds (such as ryegrass) are prone to be blown by wind when broadcasted. Seed coating doubles the bulk density of the seeds, making them easier to manage. When aerially applying, this increases drop accuracy and greatly reduces the amount of wind drift once the seed leaves the plane or helicopter.

NORTH JERSEY RC&D FAVORITE SEED MIXTURE

The following mix works great aerially seeded, is low costs, and qualifies farmers for reimbursement through NRCS for multi-species cover crop.

- 38 lbs. Winter Rye
- 9 lbs. Annual Ryegrass (uncoated)
- 8 lbs. Crimson Clover
- 4 lbs. Coated Annual Ryegrass
- 3 lbs. Medium Red Clover

SEED PURCHASING

TALK TO SEED SUPPLIER ABOUT DELIVERY AND STORAGE It is essential to consider where the seed will be stored while the aerial seeding is taking place. Because the seeding is contingent upon weather, ideally, the seed supplier will have a warehouse locally and be willing to coordinate with aerial applicators and deliver the right amount of seed each day. Other options are to store the seed in an offsite warehouse and contact a trucking company to deliver the seed periodically or talk to the airport about the potential to store seed totes within an on-site warehouse or in a tractor-trailer parked at the airport.

SELECTING A FLIGHT COMPANY AND AIRPORT

The aerial applicators will generally base out of one or more small airports. They will handle most of the necessary logistics, including securing permits and submitting flight-plans. Before hiring a flight company, you should verify that the applicator performs dry pattern testing, has experience handling the seed species you will be using and applies the seed uniformly. TRY TO LOCK DOWN PRICES EARLIER Cover crop seed prices can fluctuate a lot throughout the year. Start talking with seed dealers in February and March (5 months before seeding).

Aerial applicators should have access to:

- Ag Nav Software
- Truck hopper with auger (typically designed for loading fertilizer into planes)
- Large Quantities of Appropriate Fuel: Many small airports may not have sufficient jet-fuel. The aerial applicator may need to bring a fuel truck to the airport to ensure efficient re-filling

PREPARING FOR THE AERIAL APPLICATION

Depending on the scope and location of the aerial seeding, consider proactively reaching out to equine operations and schools located adjacent to fields where aerial application is occurring. (Horse are easily spooked by low flying planes and many equine operations will be grateful for the notification.) In addition, consider calling local police stations to make them aware of the operation as they will likely receive complaints.

AERIAL SEEDING TIMING

BASE APPLICATION TIMING BASED ON CASH CROP MATURITY

The seed application needs to be timed with plant maturity. The overall goal is to apply seeds when (1) emerging cover crop will have adequate access to light, as crops lose leaves and dry-down, and (2) seeds will have seed to soil contact to improve germination and emergence.

- When planting into soy, seeding should occur when foliage first starts to yellow, before plants drop more than 10% of their leaves.
- When planting into corn, wait until plants have senesced up to the ear when leaves begin to close together and dry out. This allows sunlight before leaves drop and cover seeds.

TIPS TO REDUCE COSTS

HOW MUCH DOES IT COST?

In Northern New Jersey the cost to aerial seed a multi-species cover crop has ranged from \$60.75 to \$72 per acre from 2016 to 2021.

Within that range seed accounted for approximately 60% of the total cost and aerial applicator fees account for 38% of the total costs. The remaining 2% is designated for administration fees.

Funding Aerial Seeding Using NRCS - EQIP or state cost-share programs

Farmers can use NRCS-EQIP funds or state cost share funds to offset cover crop application costs; in many cases, aerial seeding may be the only tool to apply cover crop by program deadlines.

To learn more about how North Jersey RC&D uses EQIP to fund the bulk of aerial seeding expenses, see the following page.

IDEAL WEATHER CONDITIONS

- Aerial seeding must occur on a day with no cloud cover, wind, fog, haze, and with very little wind, especially when seeding light seed, like annual rye. To meet these conditions, you may need to set aside a 1 to 2 week window.
- Seed must be dispersed into ground with enough soil moisture to germinate the seed, or adequate moisture must be present within 10 days of seeding. Generally, germination is best when there are one or two rain events within 5-10 days of seeding.

AERIAL SEEDING COOPERATIVE

Farmers and soil conservation districts may find it worthwhile to organize an aerial seeding cooperative, wherein multiple farmers agree to use the same aerial contractor, along the same timeframe, applying the same seed. Increasing seeded acreage decreases overhead costs for farmers and is more cost-efficient than conducting aerial seeding as individuals.

Tip: Coordinating the Logistics

Consider designated a coordinator who can find seed, decide species mixes to use, and find a location for seed storage. To fund the coordinator's time consider charging a per-acre administration fee

Tip: Don't' Forget The Upfront Costs

The agency coordinating the aerial seeding will need to (1) purchase seed and (2) pay aerial applicator months before the NRCS reimbursement is processed. Depending on the scale and scope of the aerially seeding, this may mean that organizations may need to front hundreds of thousands of dollars. To fund the expense, organizations can consider recoverable grants or low-interest short term loans.

CASE STUDY North Jersey RC&D Aerial Seeding Initiative

North Jersey RC&D, a non-profit in Northern New Jersey, has administered an aerial seeding initiative, every year since 2016 averaging over 3000 acres a year.

Farmers enrolled in the program pay as little as \$0 or as much as \$10 per acre to have their land aerially seeded with a multi-species cover crop. The bulk of the costs are funded through NRCS EQIP Soil Health Initiative.

HOW DOES IT WORK

EQIP SIGN-UP: Farmers sign-up for NRCS EQIP for Multi-Species Cover Crop approximately one year prior to the aerial seeding implementation. NRCS planners will conduct a site visit, determine resource concerns, and submit the project for potential funding.

ENROLLING TRACTS: If funding is approved, an NRCS planner will visit the farm once more to select land to enroll in the program. Farmers will generally sign up tracts for three-year contracts.

FUNDING TRANSFER: Farmers sign an "Assignment of Payment" that gives North Jersey RC&D the right to collect the entire EQIP Payment. This "Assignment of Payment" format transfers farmers' EQIP payments to a third party that then carries out seeding and seeks reimbursement.

AERIAL SEEDING LOGISTICS: North Jersey RC&D facilitates purchasing seed, hiring a plane, and the planting and mapping logistics.

REIMBURSEMENT: NRCS planners gather cover crop application data and submit the information necessary for reimbursement after cover crop seed application. The aerial applicator can simply submit the flight path documentation as proof of cover crop seed application to streamline the process.

What to expect?

To help get a better sense of the level of coverage and growth one can anticipate following aerial seeding, we've included some photos from fields that were aerial seeded in the past.



Aerial Seeding versus Drilling Cover Crop

Because most cash crops in Northern New Jersey are not harvested until October or November, producers interested in improving soil health need to decide between either an early fall multispecies aerial seeded cover crop or a late fall single species drilled cover crop. To determine the pros and cons of both practices, North Jersey RC&D monitored experimental plots employing multiple type of cover crop application methods for 3 year using a combination of field visits, drone imagery, and satellite imagery.

IN THE FALL/ WINTER

North Jersey RC&D used drone imagery to compare experimental plots that had either been aerial seeded on September 13th with a multi-species cover crop or plots where cover crop had been planted with a no-till drill on October 21st. Based on the computer generated map of vegetative cover, there is greater cover crop coverage in the aerial seeded plot. See diagram to compare images.

Visualization of fall cover crop coverage following different application methods



CONCLUSION: Vegetative cover during the winter tends to be greater in fields where cover crop was aerially applied compared to fields were cover crops were drilled after cash crop harvest. Early establishment is key to prewinter growth.

IN THE SPRING

North Jersey RC&D collected biomass samples on May 15th from research plots that had either been aerial seeded on September 13th with a multi-species cover crop or plots where cover crop had been planted with a no-till drill on October 21st. Based on this data, cover crop that is established with a no-till drill in the late fall will produce significantly more biomass in the spring. See figure below.



CONCLUSION: Cover Crop biomass in the spring was significantly greater in fields where cover crop was drilled after cash crop harvest.

Soil health goals should inform decisions to drill or aerial seed.

The choice to establish cover crop via drilling or aerial seeding should depend particularly on soil health goals. For farmers interested in greater winter coverage for erosion protection or to prevent nutrient leaching, aerial seeding may better meet goals. For farmers interested in greater spring biomass production for soil organic matter building, drilling cover crops may be a better choice.

Where does aerial seeding work best? EVALUTING THE AERIAL SEEDING PROGRAM USING SATALLITE IMAGERY

North Jersey RC&D conducted an imagery analysis of 280 acres in Hunterdon and Warren County NJ which were enrolled in the Aerial Seeding Initiative from 2018 to 2020. The analysis used the Normalized Difference Vegetation Index (NDVI) – a measure indicating the presence of chlorophyll, which correlates with plant health – from satellite imagery to estimate cover crop following different cash crops and in different soils. The results are highlighted below.

EFFECTIVENESS FOLLOWING CORN AND SOYBEANS

Average (mean) NDVI values within a field was significantly higher in fields where cover crop was aerial-seeded after a soybean crop than after corn (grain) crop.

Likely the corn residue smoothers emerging cover crop after harvest. Farmers should consider prioritizing aerial seeding on ground coming out of soybeans. Not only is ground coming out of soybeans more at risk of erosion during winter as a result of low residue, but the aerially seeded cover crop will establish better.



Figure 3. Mean monthly Normalized Difference Vegetation Index (NDVI) were calculated across 280 acres (35 fields) aerially seeded with cover crop during the first two weeks of September. Significant difference between plots which contained either corn (grain) or soybean during aerial seeding were calculated with a t-test; significant difference (a=0.05) is indicated by and asterisk (*) above the month.

EFFECTIVENESS IN DIFFERENT SOIL DRAINAGE CLASSES

According to the analysis, Soil hydraulic class and farmland classification did impact cover crop NDVI values. However, anecdotally, high clay soil tends to form crusts which respond poorly to aerial seeding.



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