



Integrating Drone Technology into Cover Cropping Systems

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Introduction

The use of aerial applications in agriculture dates back to the 1920s when “crop dusters” were known to apply mostly pesticides, herbicides, fungicides, or fertilizers over fields. Now, a century later, the use of drones for cover crops has emerged as an important tool for soil health. Drones, or unmanned aerial vehicles (UAVs), are cutting-edge tools being used to scout and spray crop fields and also to seed cover crops across a growing number of farms. They offer new possibilities for labor savings, reduced compaction, and better timing—but also come with technical and policy constraints farmers need to understand.

Drones have become a versatile modern agriculture tool being used for stand counting, spray applications of crop protection products, crop yield estimations, irrigation management, numerous stress assessments (e.g., plant disease, water availability, nutrient deficiencies, and weed pressure), field topography evaluations, and soil mapping. An emerging use of drones has been cover crop seeding—the focus of this fact sheet. Cover cropping can address many farm management challenges, and numerous tools are available when selecting aerial or ground seeding methods. Planting methods are generally divided into two categories: broadcast seeding where seed is scattered over the soil surface, including aerial seeding, or drilled where seeds are planted in rows at a controlled depth.

Drones used in crop fields fall into two classifications: imagery drones, which capture data to monitor crop health and field conditions, and application drones, which are typically larger and equipped to carry and dispense cover crop seeds efficiently over farmland. Most application drones used in cover cropping come equipped with a spreader and spray system or offer the option to easily add interchangeable attachments,

allowing versatile use in seeding, fertilizing, and applying crop protection products. The swath covered is the strip of land sprayed or seeded as the drone flies its programmed flight path and is affected by the nozzle or spreader types, flow rate or seed size/ weight, flight speed, altitude, and environmental conditions like wind and humidity. For best results, drone seeding should be done in winds under 10–15 miles per hour, as higher speeds can reduce accuracy, seed-soil contact, and flight safety. Understanding swath settings is critical for optimizing efficiency, accuracy, and input savings in drone-based applications.



Figure 1. A farmer loads a payload drone with a cover crop seed mixture that will be interseeded into a soybean field prior to harvest.

Photo Credit: Olivia Caillouet

Benefits and limitations of drone cover cropping

There are many benefits to using drones for cover cropping such as accessing difficult-to-reach terrain (e.g., steep slopes or narrow strips) and when field conditions are wet. Drones can also be an effective approach for interseeding cover crops into standing crops (e.g., corn or soybean before harvest) to get quicker establishment when time is limited in the fall and eliminate soil disturbance, unlike heavy ground-based planting equipment.

Many species tend to germinate well when aerially planted and are lightweight enough to be broadcast effectively by drone including grasses such as annual ryegrass, cereal rye, oats, and triticale. Legumes such as crimson clover, balansa clover, and hairy vetch have also been shown to do well when drone-seeded. Other cover crops, like tillage radishes and turnips with small seed sizes and fast germination, are popular additions in mixes for drone seeding.

Although there are many benefits of utilizing drones for cover cropping, farmers face barriers such as financial investment, operator certification requirements, and equipment knowledge. In addition to these challenges, there are also payload restrictions limiting the cover crop species that will work well due to their seed shape and weight. Furthermore, a con of aerial seeding is the poor seed-to-soil-contact which can result in variable establishment. Aerially seeding cover crops with drones just before rainfall or into moist soil can dramatically improve establishment and stand uniformity.

Most cost-share opportunities, like [Farmers for Soil Health](#), that follow USDA's Natural Resources Conservation Service (NRCS) 340 cover crop standards allow a variety of seeding methods—including aerial options—though some, such as drone seeding, may have limitations depending on the state's 340 standard due to concerns about seed-to-soil contact. It's a good idea to check with your local NRCS or cost-share representative to ensure your seeding method aligns with program requirements.



Figure 2. A payload drone interseeding a cover crop mixture into a soybean field with rain in the forecast.
Photo Credit: Olivia Caillouet

Hiring a drone applicator

If available, farmers might consider hiring a drone applicator for a modest number of cover crop acres or as a low-risk way to try this relatively new approach. The cost of hiring a drone applicator typically ranges from \$10 to \$30 per acre, depending on factors like field size, location, seed type, and whether specialized Federal Aviation Administration (FAA) waivers are needed. Farmers should also consider the applicator's experience, drone capacity, and availability, especially during peak seeding windows. In most cases, the farmer provides the seed while the drone operator supplies the equipment, labor, and flight planning. It's important to coordinate closely on seed type, application rate, and field conditions in advance.

Also, keep in mind that when hiring an applicator, you may have to wait on other clients that take priority, and the applicator might not be available at the optimum time for seeding, such as before a rain is forecasted or the proper stage for interseeding. Conversely, some applicators have techniques to work more efficiently than someone with a single payload drone. Swarms refer to the use of multiple drones flying simultaneously. For example, a drone swarm can seed cover crops over a large area more efficiently through synchronized algorithms that divide a field into sections without overlapping flight routes. Swarms are sometimes used by professional applicators and require advanced flight planning tools and FAA authorization, especially for operations beyond the visual line of sight (BVLOS).

Purchasing a drone system

There isn't an exact equation for determining the return on investment (ROI) from investing in a traditional drill planter compared to drones because of the versatility they offer. However, when evaluating the full cost of drone cover crop seeding, it's important to account for more than just the payload drone itself. A comprehensive setup typically includes a payload drone for seeding, which can range from \$20,000 to \$40,000 depending on payload capacity and features. An imagery drone used for site mapping for precise terrain-following ability may cost \$2,000 to \$10,000, depending on sensor quality and Real-Time Kinematic (RTK) capabilities.

A utility trailer is often required to safely transport drones, batteries, seed, and support equipment to remote field locations—this can cost \$2,000 to \$8,000, depending on size and customization (e.g., shelving, tie-downs, weatherproofing). A generator (typically gas-powered) is necessary for on-site battery charging, especially in larger operations where many flights are needed per day; expect to pay \$500 to \$2,000, plus ongoing fuel costs. Extra drone batteries (often \$500–\$1,000 each with three batteries recommended per payload drone) are critical for maintaining workflow, along with chargers. You'll also need to factor in insurance coverage for liability and equipment (often required by state or FAA regulations), software subscriptions for flight planning and field mapping, and training or certification costs (including FAA Part 107 certification and potentially Part 137 for aerial application). Lastly, maintenance supplies like replacement parts add to operational costs. Altogether, the initial investment for a full-functioning drone cover crop system can range from \$30,000 to \$60,000+, with ongoing costs for labor, fuel, software, maintenance, and seeds to consider annually. Well-maintained payload drones typically cover 30+ acres an hour and drone batteries have been rated for around 1,000 charge cycles (roughly 5 years, depending on use) in addition to needing regular part replacements (e.g., motors, arms, and nozzles). Imagery drone batteries typically have a longer lifespan due to the lighter payload stress.

Insurance: Protect your operation

Operating drones on the farm—especially for commercial use like seeding or scouting—comes with risks and responsibilities. Most farmers and drone professionals recommend carrying insurance coverage (e.g., liability insurance, hull insurance, payload and/or theft coverage). Check with your farm liability provider or ag-specific insurer for UAV policy add-ons. Coverage may be required for drone use under cost-share programs or if flying over public roadways or near property lines.

Summary

Choosing whether to aerial seed or drill cover crops should be determined in part by the farmers' soil health goals. An experiment conducted in the northeast region of the U.S. found that cover crop biomass in the spring was significantly greater in fields where cover crops were drilled after harvest in October compared to fields aerially seeded before harvest in September. Aerial seeding with drones may be a better choice for farmers with difficult terrain, with little time for post-harvest seeding, or with a focus on winter coverage for erosion prevention and/or reducing nutrient leaching.

Whereas drilling cover crops might be a better option for farmers focused on getting consistent cover crop stands and building soil organic matter. While a tractor and drill planter generally have a longer lifespan in hours, drones can be used for multiple purposes, making the lifetime value more about how each fits into a farmer's goals. Farmers who were early to adopt drone cover crop seeding have cautioned others when investing in a drone system. Working with a reputable drone retailer that provides FAA training guidance, technical support, and repair services has been touted as the most critical consideration for ensuring farmer confidence, efficiency, and FAA compliance.

Additional resources

1. [Seeding cover crops with drones](#)
2. [An overview of drones in agriculture](#)
3. [A comprehensive guide to aerial cover crop seeding methods](#)
4. [Drones continue to grow in popularity as cover crop seeding methods](#)
5. [Federal Aviation Administration \(FAA\) Drones](#)



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Farmers for Soil Health is a collaborative initiative led by the Soy Checkoff, Pork Checkoff, and National Corn Growers Association in partnership with state commodity groups and conservation organizations.

