Sampling of Drone Interseeded Cover Crops

Study Overview

This data collection and demonstration project will investigate drone interseeded cover crops and collect data on cover crop establishment, biomass accumulation and farmer's perceptions across a wide range of conditions throughout the state. The objectives of this protocol are 1) to measure cover crop establishment and biomass accumulation from drone interseeded cover crops across the state, and 2) determine realistic expectations for cover crop performance from drone interseeded cover crops and recommendations for effective implementation using data from a network of farms. This is a relatively low effort, collaborative project that offers an opportunity for wide engagement across DATCP's Producer-led Watershed Protection Grant Program and will provide results that can complement ongoing and future research efforts.

Rationale

Using drones for cover crop seeding is a relatively new approach in Wisconsin that provides opportunities to plant cover crops even when conditions would otherwise prevent larger equipment from getting in the field. Planting into standing crops (such as early season into corn or late season prior to corn silage or soybean harvest) can extend narrow windows for cover crop planting and make cover cropping more accessible.

However, there are some limitations to in-season drone seeding that might ultimately inform when this practice is most valuable and what producers can expect based on the field conditions, management and growing conditions. Concerns with seed to soil contact, adequate moisture at the time of seeding, and timely harvest of the cash crop can all impact cover crop establishment and biomass accumulation.

This collaborative effort to collect data on cover crop biomass and farmer's experience with drone-interseeded cover crops can provide individual farms with information on their cover crop performance, while also providing on-farm insights and recommendations into the conditions and management factors for successful implementation.

About collaborative producer-led protocols

This project is a collaborative effort of DATCP's Producer-Led Watershed Protection Grant Program, UW-Madison Division of Extension, and many local partners and collaborators to support producer-led research, demonstration and education. Protocols are designed with producers to support farmer-driven conservation solutions, farmer-to farmer mentorship, and local data on conservation practice performance across Wisconsin.

Read more about this collaboration, potential partners, and how to receive support and technical assistance in implementing this protocol in the Supplemental Information.

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Outcomes

Why participate? Through collaborative research and demonstration projects, participating farmers will receive:

- Insights into how conservation practices perform for their fields, cropping systems and growing conditions.
- Individualized report of their results (cover crop biomass, nutrient uptake and forage quality) and what they might mean for soil erosion protection, weed control, and forage inventory.
- A statewide summary report: as producers complete this protocol, individual results will be anonymized and aggregated to increase our understanding of this practice across Wisconsin farms.
- If interested, receive technical assistance with research implementation, including laying out the trial, sampling cover crop biomass, collecting yield data, etc. Consult the PLWPG Program Partner Guide or reach out to UW-Madison Extension or DATCP's conservation agronomist (DATCPProdLed@wisconsin.gov) to connect with partners.
- Learn from others! As part of a collaborative demonstration and research project, learn from others participating in this project, or similar projects, and gain insights into what others are finding.

Results from this Collaborative Research & Demonstration project will support learning around conservation practices throughout producer-led watershed groups and among Wisconsin farmers and stakeholders more broadly. Results will be anonymized and shared on *UW-Madison Extension's On-Farm Research Results* page and at various educational events throughout the state. Interested participants are encouraged to share their findings or host a field day as part of their producer-led watershed group's educational events.

Protocol: Sampling of Drone Interseeded Cover Crops

The following protocol will measure cover crop biomass of drone seeded cover crops into standing corn or soybeans. This document will walk project participants through: 1) field criteria, 2) cover crop drone seeding protocol, and 3) cover crop sampling protocol.

1. *Field criteria*

- Participants are required to evaluate drone-seeded cover crops into standing corn (silage or grain) or soybeans. No requirements for soil types, management, cover crop species, etc.
- While not required, selecting a field with lower weed pressure and less residue will allow for more successful cover crop establishment.
- Participants will be required to submit relevant field and management data to interpret results (Field Management Data Sheet).

2. *Cover crop drone seeding*

- Participants are required to drone seed cover crops into standing corn or soybeans. Participants can choose whether to seed an entire field or a portion of the field.
- Cover crop species, seeding rate, and timing is entirely up to participants. When selecting cover crop species and other management factors, consult the following University of Wisconsin resources (Interseeding Cover Crops in Row Cultivated Corn (A4175), Cover Crops 101, Cover Crop Options After

Small Grains). Or reach out to UW-Madison Extension or DATCP's Conservation Agronomist to learn more and tailor the trial to best meet your interests and goals.

- Drone interseeding commonly occurs early in the season for corn (V3-V7, prior to full corn canopy) or prior to harvest in corn or soybeans (typically at corn dry down or before soybean leaf drop).
- To improve chances of success at drone interseeding, the field should be weed free, have adequate soil moisture, and precipitation should be forecasted following interseeding to improve seed to soil contact.

3. Fall cover crop sampling protocol

- Sample the drone interseeded cover crops prior to a killing frost. Follow the Cover Crop Sampling Protocol in the Supplemental Information for instructions on how to collect fresh cover crop biomass weights, photos to determine percent green cover, and submit samples to the lab for nutrient uptake and forage quality.
- Cover crop sampling summary: For each field or area, you will measure fresh cover crop biomass in three random locations and take a photo. Cover crop biomass samples are combined, and a subsample will be submitted to labs for the appropriate analyses (nutrient uptake, basic forage quality analysis).

4. Spring cover crop management & cover crop sampling (for overwintering cover crops)

- For overwintering cover crops, participants can manage cover crops in the spring however works best for their cropping systems and growing conditions. Cover crops can be harvested, tilled, or terminated with an herbicide. Termination timing is up to the discretion of the farmers based on their goals and concerns. Cover crop termination timing is an important factor that can impact total cover crop biomass, forage tonnage and quality, nutrient uptake, weed suppression, cash crop yield and soil health. When considering termination timing, you can reach out for assistance, or reference Spring Cover Crop Termination Considerations.
- Prior to cover crop harvest or termination, sample cover crops using the same protocol as the fall. Follow the Cover Crop Sampling Protocol in the Supplemental Information for instructions on how to collect fresh cover crop biomass weights, photos to determine percent green cover, and submit samples to the lab for nutrient uptake and forage quality.

Data Collection

Required sampling and data collection for this protocol are necessary to address the study objectives and provide context to interpret results. Field history, field and cover crop management information, and any observations during the trial will help understand trial results and provide insight so other farmers can gauge how practices might perform under their own field and growing conditions.

Required data and sampling:

- Cover crop sampling: including cover crop biomass, nutrient uptake & forage quality (fall and spring, if applicable)
- Photos to determine percent green cover via Canopeo (fall and spring, if applicable)
- Field Management Data Collection Sheet

Recommended data:

- Recent routine soil test (past 3 years): If unavailable, it is recommended to take a soil sample prior to upcoming nutrient applications.

Additional optional sampling: Select any additional metrics of interest

- Slug monitoring: Visit https://slug-net.com/ to learn more about protocols and sign up. Recommended budget is $30 for supplies.
- Spring soil coverage: Visual estimate of soil coverage (including both green material and dead residue) prior to cover crop termination or harvest.
- NRCS Soil health assessment: Reach out DATCP's Soil Health Program Manager to learn more (randy.zogbaum@wisconsin.gov)

Data collection & submission: Data collection sheets are provided in the Supplemental Information. At the end of the season, participants will submit this information to UW-Madison Extension's on-farm research team so they can analyze results and provide participants with individual trial results. Individual trial data will not be distributed or shared without consent of participating farmers. However, participants are encouraged to share findings from their trial within their producer-led groups, at local events, and on UW-Madison Extension's On-Farm Research Results page, with the option to have results anonymized.

For the *Cover Crop Sampling of Drone Interseeded Cover Crops Protocol*, participants will submit the following information: Field Management Data Sheet, Cover Crop Biomass Data Sheet, cover crop photos, nutrient & forage quality lab analysis results, and any other relevant information or data from additional metrics.

Please reach out to Extension's on-farm research coordinator with any questions on data submission or data use.

Budget

Participants should include in their grant application budget money for cover crop nutrient uptake and forage analyses for fall and spring. A nutrient uptake analysis at AgSource will cost $50 per sample and forage analysis at Dairyland Labs will cost $30/sample, but participants are free to use the lab of their choice (cost per sample are subject to change with annual price increases and participants should consult their lab of choice when budgeting for lab analyses). Since drone seeding is prone to be very variable, this protocol requires three fresh cover crop biomass weights per field, and one composite that is sent to the lab. *Note: recommended cover crop sampling falls across two grant cycles.*

Additional costs include shipping of cover crop samples, mileage, cover crop sampling equipment (if needed), and the costs for any additional measurements or sampling you wish to add on. Producer-led groups can decide whether to include cover crop seed, drone seeding costs, and a farmer stipend in their grant proposal.

Example Budget:

Category	Item					Total Cost
Cover crop biomass sampling			Cost per sample*	Reps	Sampling time**	
	Nutrient Uptake		$50	1	2	$100
	Forage quality		$30	1	2	$60
	Sampling equipment					$100
Misc	Shipping					$40
	Mileage					
	Any additional metrics or measurements					
Optional	Seed (based on cover crop species selected and trial acreage)					
	Seeding cost (based on application method and trial acreage)					
	Farmer stipend					

*Cost per sample is subject to change with annual price increases and participants should consult their lab of choice when budgeting for lab analyses

**If investigating a cover crop that winterkills, there will just be one sampling time (fall) for this project.

Supplemental Information

The following supplemental information includes 1) cover crop sampling protocol, 2) data collection sheets, and 3) rationale for recommendations in this protocol and additional resources.

Sampling of Drone Interseeded Cover Crops Protocol

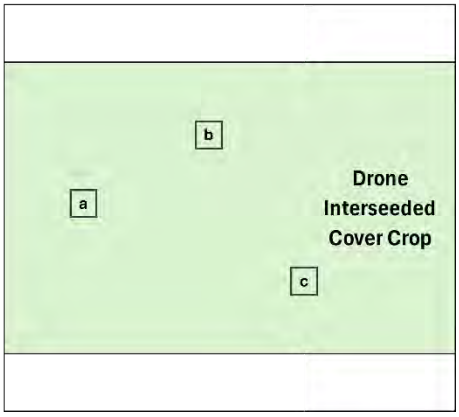
Includes instructions for fresh biomass collection, percent green cover (photo), height, and sample submission for moisture, nutrient uptake & forage quality. Read more about these metrics and what we learn from them at the end of the protocol.

***Cover Crop Sampling Protocol Summary*:**

Since cover crop establishment and performance can be variable within the field due to seeding inconsistencies, field conditions, and other sources of in-field variability, this protocol takes multiple samples per field to best obtain representative data for the entire area. For each field, you will have three random sample locations where you measure and record the fresh weight of cover crop biomass and percent green cover (photo). These samples will be combined and one sample will be submitted for nutrient analysis and one sample submitted for forage analysis. This method provides an accurate estimate of cover crop biomass across the trial, while minimizing analysis costs.

Example cover crop sampling map

☐ Boxes indicate subsample locations: a, b, c



Example Cover Crop Sample Labels:

1. Name_Field ID_Fall 25
2. Name_Field ID_Spring 26

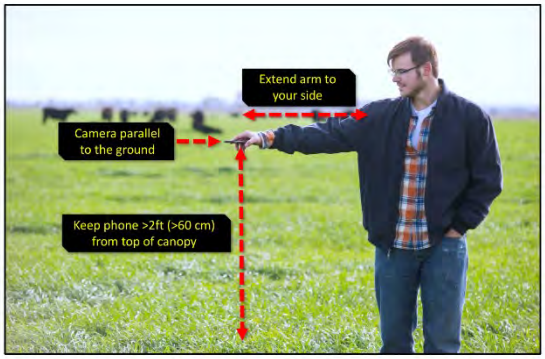
Supplies:

- 2, 5-gal buckets: 1 for weighing individual biomass samples, 1 for collecting biomass per replicate
- Sampling area: recommend 2x2 foot quadrat, but other sizes can be used (record on datasheet)
- A battery operated, portable scale (ex: hanging scale)
- Scissors or pruner to cut the cover crop
- Sampling bags for appropriate lab analyses
- Tape measure
- Smart phone or camera
- Data collection sheet
- Pen or pencil

Sampling protocol

1. Collect all the necessary supplies & label the sampling bags.
2. Weigh the empty bucket, then use the TARE button to account for the bucket weight. You can also write down the weight and subtract it from your sample total.

3. Find a random area in the field. Toss the quadrat and make sure the square is laying flat on the ground.
4. Use scissors or pruners to cut the above-ground cover crop inside the square or sampling area and flush with the soil surface. Place the above-ground cover crop inside the empty bucket after sampling.
5. From your cover crop sample remove any soil, crop residue, and weeds.
6. Weigh the bucket with the cover crop biomass. *Ensure the bucket weight is not included!*
7. Record fresh cover crop biomass weight on the data collection sheet. Transfer biomass to second bucket, which will be used to collect cover crop biomass for the entire replicate.
8. *Collecting percent green cover:* In each biomass sample location, take a representative photo of the cover crop. Hold your phone out to the side, parallel to the ground, and avoid including your feet (see image). Label the photo with the appropriate rep (ex: "Field ID_Fall 25 CC1"). Participants can submit photos to be analyzed in Canopeo, or, if they are comfortable, determine percent green cover directly in the Canopeo phone app and record in the data sheet.



Reference: Canopeo

9. Repeat steps 3-8 in a second and third random location in the field.
10. From the bucket with all three fresh biomass samples, mix the cover crop sample thoroughly. Place a representative sample of cover crop biomass (0.5-1 lb is sufficient for most lab packages) into an appropriately labeled bag to send to the lab for nutrient analysis and another representative sample in a labeled bag for a basic forage quality analysis.
    - For nutrient analysis, this protocol recommends submitting samples for a comprehensive nutrient package (ex: AgSource Cover Crop Package). When submitting samples to AgSource for their cover crop package, record the average weight of the three samples on AgSource's sample submission sheet.
11. Empty any remaining biomass in the bucket.
12. Record any other observations of note, including field and soil conditions, cover crop variability, weeds or volunteer plants throughout the trial area, etc.
13. Immediately after sampling, deliver cover crop biomass samples to lab drop-off locations or ship (preferably overnight or expedited shipping). Timely drop-off is important for accurate moisture readings and biomass measurements.
14. Submit cover crop biomass datasheet and lab analyses with other research trial data to UW-Madison Extension.

As you navigate this protocol, reach out to UW-Madison Extension for additional guidance or clarification.

Cover Crop Sampling Protocol

Why measure cover crop biomass, percent green cover, nutrient uptake and forage quality?

Cover Crop Biomass: Cover crop biomass is an important metric to link cover crop performance to important outcomes such as soil protection from erosion and runoff, weed suppression, nitrogen uptake and nitrate leaching mitigation, potential forage inventory, crop yield and many others. While biomass is the amount of plant material a cover crop produces, both aboveground shoots and belowground roots, measuring aboveground plant material provides an accessible way to measure cover crop growth that can be compared to research-based biomass benchmarks and research outcomes.

This protocol requires percent green cover, nutrient analysis and forage quality, which provide additional context to evaluate cover crops relative to agronomic and conservation goals and research outcomes.

Percent green cover: Percent green cover, measured using Canopeo, is a useful metric to evaluate soil protection and runoff risk.

Forage quality: Forage quality provides additional information about the forage potential of your standing cover crop for harvest or grazing.

Nutrient analysis: A comprehensive nutrient analysis offers insights into nutrient uptake and cycling that may impact productivity and water quality, such as nitrogen leaching risk and nutrient availability in the soil.

Why sample cover crop biomass in the fall & spring?

Cover crop sampling often occurs prior to a killing frost in the fall and/or prior to termination in the spring. Fall biomass measures on fall cover crop growth and nutrient uptake provide insight into winter coverage, soil protection and nitrate leaching mitigation. In addition, since some cover crop species do not overwinter, it is valuable to understand their performance prior to winterkill. For cover crops that overwinter, sampling in the spring will provide insights into the maximum growth of the cover crop, forage tonnage, and agronomic and conservation implications.

Project Overview

Project Information	
Project Title	
Protocol *(if applicable)*	
Year	
Preferred Point of Contact	
Producer-Led Watershed Group *(if applicable)*	

Participants: List the farmers, collaborators and partners participating in this project.

Contact Information				
Farm / Organization Name	**First & Last Name**	**Phone**	**Email**	**Preferred Method of Contact** *(Check one)*
				☐ Text ☐ Phone Call ☐ Email
				☐ Text ☐ Phone Call ☐ Email
				☐ Text ☐ Phone Call ☐ Email
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Cover Crop Biomass Data Collection Sheet

Project Name		**Participant Name**	
Field ID		**People collecting data**	
Sampling Time *(select one)*	☐ fall ☐ spring	**Sampling date:**	
Sampling Method *(select one)*	Quadrat: ☐ 2ftx2ft ☐ Other (include sample area): _____ ☐ 3ftx3ft		
Data collected *(select all)*	☐ photos ☐ height ☐ forage quality ☐ moisture ☐ nutrient concentrations		

- When recording fresh biomass weights, record to as many decimals as the scale allows to provide for greater accuracy.
- Submit data collection sheets, photos, and lab analysis results at the end of season.

COVER CROP BIOMASS DATA					
Required				**Optional**	
Field ID	**Sample**	**Fresh biomass weight (lb)**	**Average fresh biomass weight (lb)**	**Green Cover (%) (Estimate using Canopeo or submit photo)**	**Height (in) by species**
	a				
	b				
	c				

Observations, notes & in-field variability: Record any observations around in-field variability of cover crop establishment and performance. If helpful, indicate on map.

Field Management Data Collection Sheet

FIELD INFORMATION	
Farmer Name	
Field Name	
GPS (Lat / Long)	*Recommended to retrieve soils and weather information*
Field description	*Include known sources of variability, slope, etc.*
Pattern tile drainage	☐ Yes ☐ No
Irrigation	☐ Yes ☐ No

SOIL BACKGROUND					
Predominant soil name *Ex. Plano silt loam*					
Soil texture *Check one*	☐ Sand ☐ Loamy sand ☐ Sandy loam	☐ Loam ☐ Silt loam ☐ Silt	☐ Sandy clay loam ☐ Clay loam ☐ Silty clay loam	☐ Sandy clay ☐ Silty clay ☐ Clay	☐ Muck ☐ Unknown
Recent routine soil test (past 3 years)?	☐ Yes ☐ No				
Date of most recent soil test	*Record month and year*				

SOIL LAB ANALYSIS *Complete information below or submit a copy of lab results with data collection sheets.*	
Lab *Ex. AgSource*	
Analysis Method (for P and K) *Ex. Bray*	
pH	
OM (%)	
P (ppm)	
K (ppm)	

Field Name: **Year:**

FIELD HISTORY	
Estimate the number of years this field has been in crop production	
Rotation description *Ex. corn grain (1 yr) – soybean (1 yr) – alfalfa (3 yrs)*	*Include typical number of years in each phase of rotation. Specify if corn is for grain or silage.*
Crop(s) planted in the past 2 years *Specify if corn is for grain or silage.*	2 years ago: Last year:
Did you remove the crop residue after last year's crop?	☐ Yes ☐ No
If alfalfa is in the rotation, include a description of the most recent alfalfa crop.	*Include termination management (month and year), termination method, whether it is incorporated, stand density (poor, fair, or good), and regrowth (in).*
In the past 10 years, how many years has a cover crop been planted?	
Historical tillage *Check one*	☐ Conventional tillage (<15% residue) – *Ex. chisel plow, moldboard, disc* ☐ Reduced tillage (15-30% residue) ☐ Conservation tillage (>30% residue) – *Mulch/vertical tillage* ☐ Conservation tillage (>30% residue) – *Strip tillage* ☐ Rotational no-tillage – *Alternating no-tillage and conservation tillage depending on crop rotation phase* ☐ No-tillage – *Continuous*
How many years has the current tillage practice been used in this field?	
What is the typical tillage timing? *Check all that apply*	☐ Fall ☐ Spring
In the past 10 years, how many years has manure been applied?	
Additional field history details that may influence trial results	

Field Name: **Year:**

CROP DETAILS	
Crop planted *(if corn, specify grain or silage)*	
Planting date *(MM/DD/YYYY)*	
Relative maturity	
Row spacing (in)	
Seeding rate	Rate: ☐ lbs/ac ☐ seeds/ac
Percent residue at planting	☐ 0-15% ☐ 15-30% ☐ 30-50% ☐ >50%
Field conditions when planted *Ex. very wet*	
Harvest date *(MM/DD/YYYY)*	
Cropping season description and other observations	*Include notes about general weather trends, extreme weather events, pest outbreaks, or other observations that you'd like to share.*

Field Name: **Year:**

Cover Crop Management: Sampling of Drone Interseeded Cover Crop Protocol

COVER CROP MANAGEMENT *Complete the following information for the interseeded cover crop you are investigating*				
Cover crop species *List all species or cover crop mix name*	***Example species*** *Cereal (winter) rye* *Winter wheat* *Annual ryegrass* *Oats* *Red clover* *Crimson clover* *Berseem clover* *Hairy vetch* *Radish* *Turnip* *Other (Be specific)*	**Species** *See list of examples or write mix name*	**Seeding rate** *(Per species)*	**Rate units** *(lbs/ac, bu/ac, seeds/ac)*

Cost ($/ac) *Include cost per seed and planting (required to conduct economic analysis)*	
Planting date *(If known, MM/DD/YYYY)*	
Planting date category	☐ Frost seeded ☐ Late season interseeded into standing crop ☐ Early season interseeded into standing crop ☐ After crop harvest
Planting method	☐ Drilled ☐ Broadcasted & incorporated ☐ Plane / helicopter ☐ Broadcasted ☒ Drone ☐ Other
Growth stage at interseeding and approximate height	
Soil conditions at time of planting	☐ Dry ☐ Somewhat dry ☐ Neither dry or wet ☐ Somewhat wet ☐ Wet
After seeding, within how much time did you receive rainfall?	☐ <2 days ☐ 2-7 days ☐ 1-2 weeks ☐ >2 weeks
If you had rain within a week, approximately how much rain did you receive?	☐ <1 in ☐ 1-2 in ☐ >2 in
Was manure or fertilizer applied to the cover crop?	☐ No ☐ Manure ☐ Synthetic fertilizer If yes, describe:
How uniform is the cover crop?	☐ Very uniform ☐ Fairly uniform ☐ Somewhat variable ☐ Very variable

Field Name: **Year:**

Termination date *(If known, MM/DD/YYYY)*	
Termination timing	☐ Fall / winterkill ☐ Early spring ☐ <2 weeks before planting ☐ At / after planting
Termination method	☐ Winterkill ☐ Herbicide ☐ Harvested ☐ Tillage ☐ Roller crimper ☐ Other
Approximate height at termination *(in)*	
Percent ground cover at termination	☐ 0-20% ☐ 21-40% ☐ 41-60% ☐ >60%
Additional cover crop details / notes	
How satisfied were you with the results from this cover crop? *Share any observations around establishment, growth, overwintering, uniformity, etc. that contributed to your degree of satisfaction.*	

Supplemental Information: Rationale & Resources

Sampling of Drone Interseeded Cover Crops Protocol

About Collaborative Research & Demonstration Projects

Collaborative research and demonstration projects are designed to be simple and comprehensive so that any interested producer can implement the project on their own. However, for those interested, DATCP's Conservation Agronomist, UW-Madison Extension's on-farm research team, and local collaborators, including county conservation departments, UW-Madison Extension regional educators & outreach specialists, nonprofit organizations, Wisconsin Department of Natural Resources, and agronomists, may be available to provide support and technical assistance to facilitate implementation.

DATCP's Producer-Led Watershed Protection Grant Program and UW-Madison Extension's On-Farm Research team are available to support farmers and local collaborators navigate the protocol: from designing the trial layout for specific fields and implementing the protocol, to submitting data and sharing out results.

Protocols are available for *all* of Wisconsin's producers and partners, regardless of their involvement with a producer-led watershed group. For those interested in conducting any of the Collaborative Research & Demonstration projects outside of the Producer-Led Watershed Grant Protection Program, reach out to UW-Madison Extension's On-Farm Research Coordinator (aaugaten@wisc.edu) with any questions or to receive assistance.

- DATCP's Conservation Agronomist (DATCPProdLed@wisconsin.gov) is available to assist those implementing this protocol as part of their producer-led group. They can help with plot layout, agronomic support (ex: navigating fertilizer and herbicide programs), clarify questions about the protocol, or connect you to the best person for your question or request.
- UW-Madison Extension's On-Farm Research Team provides support with data analysis, interpretation and statewide outreach. UW-Madison Extension has a network of regional educators and outreach specialists who can provide technical assistance with on-farm research trials and share research results and related content at local events. Connect with Extension's On-Farm Research Coordinator (aaugarten@wisc.edu) with any questions.
- Local partners, including Extension regional educators & outreach specialists, county conservation departments, nonprofit organizations, Wisconsin Department of Natural Resources, and agronomists may be available to provide assistance with laying out plots, sample collection throughout the season (ex: cover crop biomass, soil samples, yield, etc), in-season scouting, recording and submitting any data, and coordinating any relevant outreach activities like field days. If you are interested in collaborating with partners, make sure to reach out to them in advance to see if they can provide support.

Not sure who to reach out to or are having trouble finding someone available to support your research efforts? Consult the PLWPG Program Partner Guide or reach out to DATCP's conservation agronomist (DATCPProdLed@wisconsin.gov).

Interseeding: Species, Timing, and Seeding Rate

Why does this project focus on interseeding?

The small amount of growing season that remains after corn and soybean harvest in Wisconsin can create many challenges when trying to successfully integrate cover crops into a rotation. Interseeding cover crops is one potential way to overcome these challenges associated with a shorter growing season. It allows cover crops to establish earlier in the season to maximize soil health benefits and provides opportunities for fall and/or spring forage. The competitiveness of the corn crop and environmental stress (heat, drought, flooding, etc.) will affect the potential for success, fall biomass, forage quality, and potential interseeding management.

Common interseeding methods - Why apply with a drone as opposed to other broadcast method?

Common cover crop interseeding methods include modified grain drills (removal of row units to avoid damaging the main crop); fertilizer spinners; air spreaders; tractor-mounted seed spreaders; and aerial applications, including airplanes and helicopters. Modified grain drills (i.e. direct seeding) generally result in the best stand establishment as compared to broadcast application methods but often times equipment access is a problem for some growers. With most of these methods, excluding planes and helicopters (which can be relatively expensive methods, especially for smaller farms), driving equipment through the actively growing cash crop is required for seeding to occur. With this comes the risk of crop damage and contributing to soil compaction (pending soil conditions).

Using drones for cover crop seeding is a relatively new approach compared to other common seeding methods in the state. By using a drone, cover crop seeding can occur even when field conditions would otherwise prevent larger equipment from getting in the field. This is especially advantageous when the target seeding window happens to occur while soil conditions are excessively wet, for example. With the drone application, rutting the field and/or inducing compaction is no longer a risk and the cover crop is getting seeded at the right time. In addition to overcoming field-soil condition barriers, drones do not pose the threat of damaging the actively growing cash crop, unlike traditional seeding methods. Drone-seeding cover crops potentially results in enhanced seed-to-soil contact compared to traditional broadcast methods due to the down pressure of the "prop-wash" of the drone's propellors.

The use of drones also comes with a few things to be aware of. Operation of a drone requires several licenses to be attained and several regulations and restrictions to be aware of. Drones also have a limited payload capacity (i.e. relatively small amounts of seed on board) generally due to drone-battery life and drone size, although technology is advancing rapidly in this space. Flight path planning is another logistic that must be considered ahead of time. For many growers, these realities lead them to partnering with service providers that offer drone services for hire. In summary, drones are a great option for interseeding cover crops early in the growing season (i.e. V3-V7 corn) and later in the season (i.e. R6 corn) to give the covers a head start in growth. As with any surface broadcast method, adequate moisture around the time of seeding remains a critical component for effective germination and establishment.

Cover Crop Seeding Details

When selecting cover crop species to investigate and appropriate seeding rate and timing, consult the following resources (Cover Crops 101, Cover Crop Options After Small Grains, Interseeding Cover Crops, Spring Cover Crop Termination Considerations). Reach out to UW-Madison Extension or DATCP's conservation agronomist to learn more and tailor the trial to best meet your interests and goals.

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