

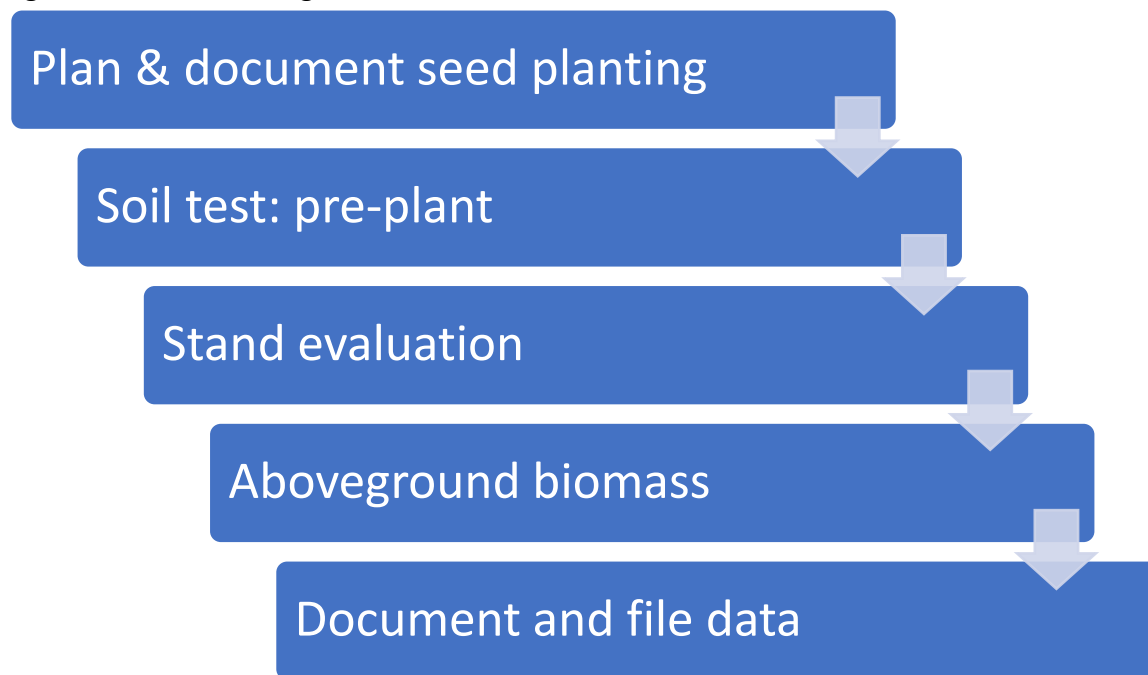
On-Farm Cover Crop Trial Protocols

Procedure: Workflow for On-Farm Trial

Background: Tracking cover crop plantings and results systematically will inform variety selection and reduce risk for producers wishing to include cover crops in rotations. Unlike a traditional replicated trial, the emphasis is on multiple trials that are likely unreplicated. Results from replicated trials can still be included.

The Workflow diagram illustrates how to plan, track, and register a cover crop trial. The analyses included herein are a recommended minimum data set. Additional data can be collected and documented.

Figure 1. Workflow Diagram



The workflow diagram is supported by the following list of protocols and data sheets:

ExperimentDetailsProtocol

SoilSamplingProtocol

CoverCropBiomassSeparationProtocol

StandEvaluationProtocol

CoverCropTrialDetails&Results

On-Farm Cover Crop Trial Protocols

Procedure: Cover Crop Trial Planning

Calendar date: Prior to initiating experiment

Brief Description: Capture important details of the experiment and plan ahead

Safety:

Detailed Procedure: Planning prior to initiating the trial will ensure that data gathered can be utilized in future decision making. To include a trial in the PNW Cover Crop Database, a minimum of 14 parameters are required. These cover the basics: Where was the trial planted, When was it planted, How was it planted, and what was the above-ground biomass and general stand evaluation. Other parameters can be included if time and resources allow.

This Procedure captures the required parameters that should be collected on the day of seeding (Table I). Associated protocols cover soil sampling, stand evaluation, and data entry.

The database is set up to track up to 3 cover crops seeded together. If only one cover crop is seeded at a time, then information for cover crops 2 and 3 is ignored.

A sample datasheet is provided.

Table I. Parameters that should be collected on the day that the trial is planted.

Parameter	Description	Required*
Project	Are these data part of a larger cover crop research project? Enter the project title, funding source, Pis, and Institution.	FALSE
Contact	Likely the person who oversaw the project and data collection	TRUE
Farm Name	Farm where the trial was held	TRUE
Plot Name	Sometimes plots are numbered or named.	FALSE
Latitude, Longitude	Location of the plot, centered	TRUE
Treatment	If variations were trialed, such as planting rate, planting date, etc.	FALSE
Planting date	Day when this treatment was planted	TRUE
Cover Crop 1 Name	e.g. "cereal rye", "hairy vetch"	TRUE
Cover Crop 1 Variety	Variety name	TRUE
Cover Crop 1 Source	Seed company	TRUE
Cover Crop 2 Name	e.g. "cereal rye", "hairy vetch"	FALSE
Cover Crop 2 Variety	Variety name	FALSE
Cover Crop 2 Source	Seed company	FALSE
Cover Crop 3 Name	e.g. "cereal rye", "hairy vetch"	FALSE
Cover Crop 3 Variety	Variety name	FALSE
Cover Crop 3 Source	Seed company	FALSE
Planting rate target crop 1.lbs.a	Target rate	TRUE
Planting rate target crop 2.lbs.a	Target rate	FALSE
Planting rate target crop 3.lbs.a	Target rate	FALSE
Planting rate actual crop 1.lbs.a	Was actual seed rate quantified	FALSE
Planting rate actual crop 2.lbs.a	Was actual seed rate quantified	FALSE
Planting rate actual crop 3.lbs.a	Was actual seed rate quantified	FALSE
Drilled or Broadcast		TRUE
Planting Equipment comments		FALSE

*Required parameters are highlighted

Sample data sheet

PROJECT _____ CONTACT NAME _____

FARM NAME _____ PLOT NAME (optional) _____

LATITUDE _____ LONGITUDE _____

TREATMENT (optional) _____

PLANTING DATE _____

COVER CROP 1 NAME _____ (e.g. "cereal rye", "hairy vetch")

COVER CROP 1 VARIETY _____ (If unknown, write VNS-variety not specified)

COVER CROP 1 SOURCE _____

COVER CROP 1 TARGET PLANTING RATE (LBS/ACRE) _____

COVER CROP 1 ACTUAL PLANTING RATE (LBS/ACRE) _____

WERE SEEDS DRILLED OR BROADCAST? _____

ADDITIONAL COMMENTS ON SEEDING (OPTIONAL.. Include notable seeding conditions or bed preparation) _____

IF MORE THAN ONE COVER CROP IS TRIALED ENTER DETAILS BELOW

COVER CROP 2 NAME _____ (e.g. "cereal rye", "hairy vetch")

COVER CROP 2 VARIETY _____ (If unknown, write VNS-variety not specified)

COVER CROP 2 SOURCE _____

COVER CROP 2 TARGET PLANTING RATE (LBS/ACRE) _____

COVER CROP 2 ACTUAL PLANTING RATE (LBS/ACRE) _____

COVER CROP 3 NAME _____ (e.g. "cereal rye", "hairy vetch")

COVER CROP 3 VARIETY _____ (If unknown, write VNS-variety not specified)

COVER CROP 2 SOURCE _____

COVER CROP 3 TARGET PLANTING RATE (LBS/ACRE) _____

COVER CROP 3 ACTUAL PLANTING RATE (LBS/ACRE) _____

Sketching a plot map to accompany the data sheet is extremely helpful. Include farm name, date, landmarks, N arrow, dimensions, locations of plots, and other information that may be helpful to track results.

Equipment:

Clipboard	Data Sheet
Plot map sketch	Soil sampling protocol and equipment

On-Farm Cover Crop Trial Protocols

Procedure: Basic Soil Analysis

Calendar date: Generally sample on the day of planting. Mid-season or post incorporation sampling can also be done.

Agronomic considerations: Recent tillage can affect some nutrients.

Depth: 12 inches, 8-15 cores per plot

Location in plot: If there are multiple cover crop treatments sample each plot/treatment

Treatments: all

Safety: Metal soil probes they can be heavy and have exposed metal slivers. Wear gloves when sampling.

Detailed Procedure: Pre-label paper bags prior to sampling. Use either a hand push probe or a lightweight hammer probe. Push or hammer the probe into soil 12 inches deep marked with tape. Samples from whole plot avoiding tire tracks. Reverse procedure and using a screw driver put soil sample in bucket. When finished sampling samples should be placed in the soil drier to dry. Soil analysis OM, P, NH₄, NO₄, K, Mg, Ca, pH, CEC. [micronutrients could be added]

Equipment:

Push in soil probes	Screw drivers
Hammer probes depending on soil conditions	4 gal buckets
Pencil box	Notebook or data sheet
Plot map	Gloves
Marking tape	Measuring tape
Soil sample bags	Soil drier

On-Farm Cover Crop Trial Protocols

Procedure: Thorough Stand Evaluation and Quick Stand Evaluation

Calendar date:

1. 4 to 6 weeks after planting and/or prior
2. Mid to late February (for overwintering cover crop)
3. Prior to mowing/termination

Brief Description: Estimate the coverage and abundance of plant species. The Thorough Stand Evaluation uses a scale from 1-10, while the Quick Stand Evaluation uses a 5 part scale from “very poor” – “very good”. The Quick Stand number can be derived from the Thorough Stand Evaluation.

Sample/Target: Can be done with a biomass square or estimated for a larger area. The reading is not based on a count per known area, so a specific area for the assessment is not required.

Location in plot: Look at several areas within the plot. Subsamples can be done if using a square, or estimate an average if not using a square. Disregard irregular areas.

Safety:

Detailed Procedure:

The percent coverage for dominant plants and bareground is estimated on a decimal scale (adopted from Londo, 1975):

Scale for Thorough Stand Evaluation

Symbol	Coverage
1	10%
2	20%
3	30%
4	40%
5	50%
6	60%
7	70%
8	80%
9	90%
10	100%

Decimal symbols can be used if necessary (e.g. 1.5, 2.5, etc.)

Notes: NRCS is starting to use this app to evaluate canopy cover: <https://canoepoapp.com/#/login>

NRCS uses this app for data collection: <https://excellenceinbreeding.org/toolbox/tools/field-book>

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Sample Thorough Stand Evaluation data sheet:

Plot	Treatment	Buck wheat	Sudan grass	Clover	Grass weeds	Broad leaf weeds	Bare ground	Dominant BL weeds
1	Buckwheat/ Clover mix	4		4	0.5	1.5	0	Lambs quarter
2	Sudangrass / Clover mix		7	0.5		0.5	2	Unknown

Scale for Quick Stand Evaluation:

Symbol	Cover Crop Coverage
Very poor	<20%
Poor	20.1 – 40%
Fair	40.1 – 60%
Good	60.1 – 80%
Very Good	80.1 – 100%

Sample Quick Stand Evaluation data sheet

Plot	Treatment	Estimated cover crop coverage				
		<20%	20.1 – 40%	40.1 – 60%	60.1 – 80%	80.1 – 100%
1	Buckwheat/ Clover mix	Very poor	Poor	Fair	Good	Very good
2	Sudangrass / Clover mix	Very poor	Poor	Fair	Good	Very good

Equipment:

Clipboard	Weed ID book
Square (optional)	

On-Farm Cover Crop Trial Protocols

Procedure: Cover crop biomass and separation

Calendar date: Before termination or mowing, i.e. in spring, following a fall-planted cover crop or, in fall, following a spring- or summer-planted cover crop. Biomass could also be taken multiple times if the crop is mowed such as summer-planted Sudangrass.

Brief Description: Biomass subsamples are taken from all plots. Tissue is dried and weighed. Optionally, tissue can also be analyzed for total N and total C.

Sample/Target: Above ground biomass

Location in plot: Not in tire tracks or on edges. Randomly choose a location from a representative area of the plot.

Safety: Shears or sickles are sharp and can cut skin easily. Wear gloves when sampling and consider Kevlar gloves.

Detailed Procedure: Label paper bags prior to sampling with Farm Name, Date and Treatment (i.e. cover crop variety). Walk the field or plot to identify representative areas to sample. Use a square of known dimensions to sample above-ground biomass from a specific area, e.g. 2 ft X 2 ft (4 ft²) or 0.5 m X 0.5 m (0.25 m²). Squares can be fabricated from different materials, including plastic pipe, bamboo, or lumber.

1. Cut above-ground biomass from a known area. Squares can be fully enclosed or have one side open in a “C” shape (see figure 1). Each type has pros and cons. Enclosed squares are rigid and can be worked through some non-viney cover crops (figure 2) or used to knock down tall or viney cover crops for sampling (figure 3). If knocking down a stand, be sure to place the frame beyond the tip of the first plants being knocked down to ensure you are sampling biomass accurately. The C type is preferred in some situations such as for tall, erect grasses (e.g. cereal rye, winter wheat, barley) where the square can be slid in among the cover crop at the soil. The 4th side of the square is visually estimated.

For tall, tangled cover crop stands (e.g. cereal + vetch), the cover crop can be knocked down and sampled beyond the tip of the first plants being knocked down. Using either a shear, sickle or harvest knife, cut biomass samples from the inside of the squares about 1 inch above the soil surface. Whatever sampling method you use, be consistent in all plots on a farm.

Interseeding Trials. Some planting arrangements may require irregular or rectangular sampling frames. For example, when cover crops are interseeded between cash crops.

Use a sampling frame that matches the width of the area seeded but has the same area used for biomass sampling (e.g. 4ft² or 0.25m²).

Sample and measure the biomass as described above

Measure the portion of the total area seeded (row spacing) and multiply the results by that fraction to calculate cover crop biomass per acre.

2. Separate cover crop biomass from weeds. Cover crop biomass will be separated from weed biomass; it is generally easier to cut all biomass, including weeds, and take material out of the plot to separate cover crop from weeds, though sometimes the separation can happen while cutting. If separating out of the plot, gather the biomass and spread out on a tarp or large table. Carefully separate the cover crop species from each other and from weeds.
3. Determine dry weight of each cover crop and weeds.
 - a. Dry the entire sample. This method likely requires a large plant dryer. If one is available and there is sufficient space, dry the entire sample at 56 C (133 F). Wet weight can be recorded before drying if plant moisture is desired.
 - b. Dry a subsample. Weigh the fresh weight of each component of the field sample. This step requires a larger tripod scale or bench scale. Subsample the different fractions (e.g. cover crop 1, cover crop 2, weeds) in an appropriately-sized bag. Weigh and record the wet weight and record the wet weight with a more accurate scale, then put in a plant drier to dry. Weigh and record the weight when dry with the more accurate scale. If you don't have a more accurate scale, weigh the fresh sample, record the weight, and send a wet subsample to a testing lab for moisture and nutrient analysis. Fresh weight, % dry matter and total % nitrogen can be used with the [OSU Organic Fertilizer and Cover Crop Calculator](#) to predict PAN release or immobilization 4 and 10 weeks after cover crop incorporation.

Equipment:

Harvest squares	Short serrated sickles or harvest knives
Garbage cans (for carrying multiple samples)	Notebook or data sheet and labels
Pencil box	Kevlar gloves, disposable gloves
Plot map	Battery operated "field sample" scale with approx. 20lb capacity and 0.02lb accuracy. Market scales at most farms are normally sufficient.
Sampling bags various sizes	Battery operated "sub-sample" scale with 0.1 gram accuracy if drying your own samples.
Clippers	Plant dryer

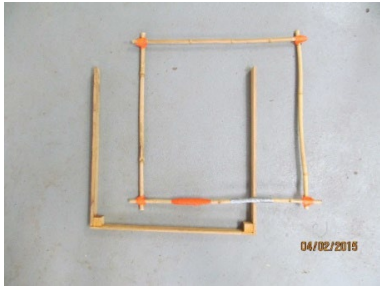


Figure 1. C type sampling square (left) and enclosed sampling square. Could get photos of rebar C type sampling squares from Corvallis PMC or when Clint and I make some.



Figure 3. Knocking down a cover crop canopy to sample the cover crop. Photo by Nick Andrews (Box / Photo Archive / 2021-05).



Figure 3. Working a sampling frame through a standing cover crop canopy. Photo by Nick Andrews (Box / Photo Archive / 2021-05).