

Evaluating Ecosystem Services from Cover Crops: A GUIDE FOR INSTRUCTORS

Tara P. Gareau and Richard G. Smith
The Pennsylvania State University

This instructors' guide is meant to accompany the *Evaluating Ecosystem Services from Cover Crops* activity hand-out.

Background

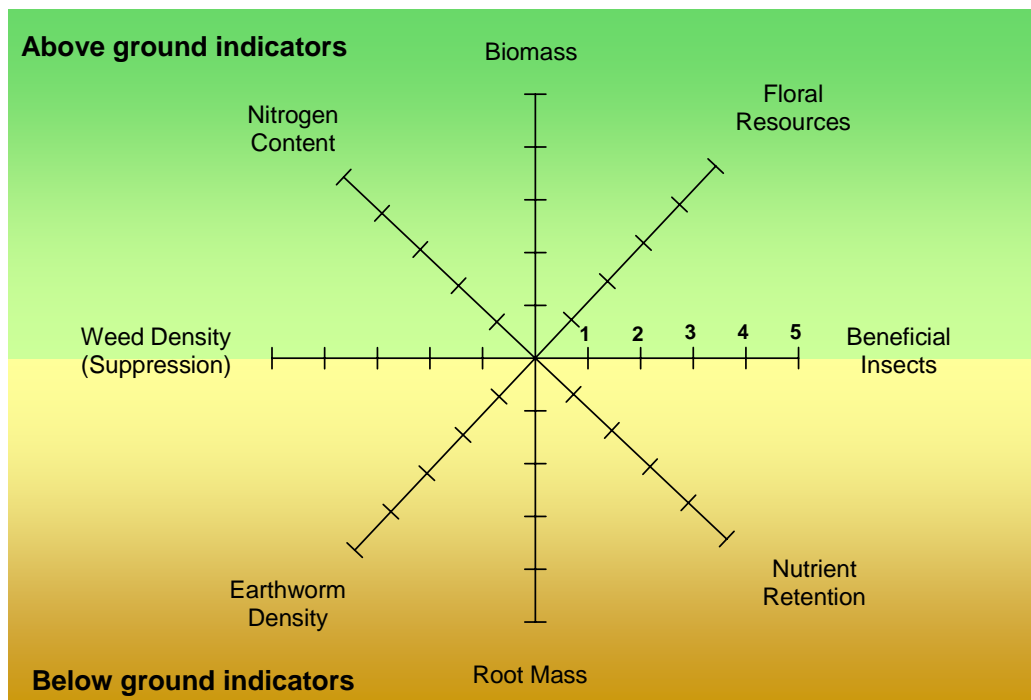
Cover crops provide multiple services for farming systems. They can be used to suppress weed populations, add organic matter to the soil, revitalize a compacted soil, prevent leaching, reduce soil erosion, break up pest cycles, and provide resources for beneficial insects. However, typically cover crops do not provide all of these services to an equal extent. Thus, there are trade-offs when choosing between different cover crops. How then can we select cover crops to meet the needs of particular agroecosystems (i.e. soil conditions, topography, and climate)?

Description of Exercise

Using ecological indicators, teams of people evaluate different cover crop systems for beneficial insect habitat, weed suppression, nitrogen contribution, nutrient retention, and general soil health. The teams compare their results using spider plots.

Objective

- To learn how to use a multi-criteria decision-making tool (a spider plot) to compare the ecosystem services from different cover crops.



Spider plot used to evaluate ecosystem services from a cover crop system

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Preparation

This activity requires several preparatory steps carried out well before the actual exercise is conducted in the field. The first step is to decide upon the cover crop treatments you would like to compare. We chose five different cover crop systems common to central Pennsylvania: two fall-planted (wheat and a mixture of rye and hairy vetch) and three spring-planted (buckwheat, mustard, and a mixture of pea and triticale). We suggest selecting cover crops that will provide contrasting ecosystem services, so as to ensure that when participants plot their data on the spider plots, they will be able to observe clear differences between the different cover crops. The second step is to determine how the cover crops will be planted. Depending on the quality of data desired, cover crops can be planted either in replicate plots (in a randomized fashion) or in single plots without replication. While having only one plot per cover crop simplifies the exercise both conceptually and logistically, a replicated field trial design can produce data that can be analyzed statistically. We used a single plot design. In early spring, we cleared three 8 ft x 20 ft areas within a fall-planted wheat stand growing adjacent to a fall-planted rye/hairy vetch stand. The grass stands served as our two fall-planted cover crop systems. We planted each of the three spring-sown cover crops into one of the three cleared areas. The three cleared areas were each separated by two-foot wide wheat buffers, which were intended to reduce the amount of insect movement across plots. If the field day activity is planned for the late spring or summer, and insect-related variables are to be measured, the spring cover crops should be planted with enough time to allow them to develop and flower.

You will notice that this activity requires participants to measure the root mass of the cover crops. This step in the activity may be difficult depending on the soil conditions specific to your site. Our soils were quite clayey, making it difficult to remove soil from the roots. Therefore, we collected the root samples prior to the field day. We washed and dried the samples, and placed them in a zip lock bag so that participants could accurately weigh them. We recommend assessing the conditions of your soil and your ability to remove soil from the root samples in the field prior to the field day, and adjusting the protocol as necessary.¹

Timeline

6 – 8 months prior

- Choose a site
- Choose cover crops appropriate to your area
- Obtain and plant cool season cover crops

1 – 2 months prior

- Obtain and plant warm season cover crops

One week prior

- Conduct 1-2 dry runs of exercise to test field conditions and adjust protocol as necessary
- Collect and process root samples

Two days prior

- Install pitfall traps¹

¹ We recommend a simple design using a quart-sized plastic deli container as the permanent cup, a 4.5 oz specimen cup half-filled with salty, soapy water and inserted inside the larger container, and a plastic funnel fitted inside the deli container and over the specimen cup. Without a preservative agent these traps are for short-term use only (2 -3 days).

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Logistics

This activity works well with a group of 30 – 40 individuals. The group can be split up into smaller research teams of three to four people. Assign each team one cover crop system to evaluate. If there are multiple teams investigating a particular cover crop system, and there is only one plot for each cover crop, assign each team to different areas of the plot. If there are two or more plots per cover crop system, each team can conduct the evaluation in separate plots. We found that it takes 30 – 40 minutes for a team to complete an evaluation of one cover crop system.

Materials

Have available at the site:

- A long folding table for weighing and sorting activities
- Field scale for weighing plant biomass (1 or 2)

For Each Team

- White plastic bowl for emptying pitfall contents
- A square or rectangular quadrat of known area. The worksheet assumes an area of 0.25 m² (2.69 ft²) for assessing plant densities and floral areas. If a different size is used, adjust the formula on the worksheet and make sure that each team has identical quadrats.
- Insect field guide²
- Shears or clippers (non-electric)
- Shovel or spade
- Paper bag (grocery size)
- Marker (permanent)
- Calculator
- Paint bucket (for holding the equipment)

For Each Participant

- *Evaluating Ecosystem Services from Cover Crops* handout/worksheet
- Pencil
- Clipboard (optional)

² Gardiner, M., DiFonzo, C., Brewer, M., and Noma, T. 2007. *Identifying Natural Enemies in Crops and Landscapes*. Michigan State University Extension Bulletin E-2949

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Procedure

Detailed instructions for measuring each ecosystem service indicator are provided in the hand-out, *Evaluating Ecosystem Services from Cover Crops*. Participants are likely to have questions while they conduct the activities in the field. We suggest assigning a field assistant to each cover crop system to be available for questions and guidance. As part of the activity, each team will place a 0.25 m² (2.69 ft²) quadrat in a representative area of their cover crop. This is the area of study for evaluating floral resources, weed suppression, biomass, nitrogen content, and earthworm density. Participants should make observations on the beneficial insect community prior to placing the quadrat and making plant measurements, so as not to disturb the insects. Depending on the conditions of the soil, the measurements of cover crop root mass may have to be made on samples that were collected, cleaned, and dried, prior to the field day.

An important component of this activity involves summarizing and discussing the data that each team collects on the different cover crops. To facilitate this discussion, we suggest printing a blank spider plot for each cover crop system on a large poster board. Have each team plot their data and the spider plot corresponding to their cover crop system and connect the data points to attain a “spider web”. If there are two or more teams per cover crop, distribute different colored markers to each team (we used red and black) and have them plot their values on the same cover crop graph. This way you can compare results within each cover crop as well as between different cover crops.

After all the teams have plotted their results, it is time to reconvene as a larger group and discuss the results. Below are some suggested questions to help guide the discussion.

Discussion questions

1. How are the spider-plot “webs” shaped differently for each crop?
2. What might this suggest about the potential benefits and limitations of each cover crop?
3. How might these “webs” change over time for each cover crop? What if we had conducted this activity a month from now, or in the fall versus the spring?
4. Are there other potential ecosystem services that you are concerned about that we did not discuss today?
5. How do you envision using this information to help guide your decisions regarding selecting and managing cover crops for ecosystem services within your cropping system?
6. Was this approach to assessing the multi-functionality of cover crops useful? Do you have suggestions for alternate approaches?

Suggested Resources

Bowman, G. Shirley, C., & Cramer, C. (1998). *Managing cover crops profitably* (2nd ed). Sustainable Agriculture Network Handbook Series, Book 3. Beltsville, MD: Sustainable Agriculture Network.

Sarrantonio, Marianne. 1994. *Northeast Cover Crop Handbook*. Emmaus, PA: Rodale Institute

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Contacts

If you try this activity with a class or other group of people, please let us know about your experience! Questions or comments about this instructional activity can be directed to:

Tara P. Gareau
Department of Entomology
The Pennsylvania State University
University Park, PA 16802
tlp19@psu.edu

Richard G. Smith
Department of Crop and Soil Sciences
The Pennsylvania State University
University Park, PA 16802
rgs14@psu.edu

Mary E. Barbercheck
Department of Entomology
The Pennsylvania State University
University Park, PA 16802
meb34@psu.edu

Dave A. Mortensen
Department of Crop and Soil Sciences
The Pennsylvania State University
University Park, PA 16802
dam37@psu.edu