

Soil Health Education Recommendation Report

Business Development Centre
University of Guelph Ridgetown Campus

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PURPOSE

The purpose of this report is to provide recommendations on the next 4 -5 plus years of education on soil health. The recommendations are based on feedback from pilot participant evaluations and input from the working group.

OVERVIEW

The Business Development Centre at the University of Guelph Ridgetown Campus, in consultation with the working group, have developed six courses covering various soil health topics. The material was divided into phases based on priority; Phase 1, 2, and 3. Phase 1 and 2 materials have been developed. Phase 3 content has been proposed but not yet developed.

The focus of the education material is improving skills to describe and interpret key soil properties and forms of degradation in the field and improving knowledge of soil health and Best Management Practices (BMPs).

This recommendation report will outline various topics for offering the education material to the target audiences.

AUDIENCE

The target audience for the education material includes:

- Certified Crop Advisors (CCA)
- Producers (Farmers)
- Agri Business consultants
- Conservation Authority (CA) staff

It is worth defining the groups within these broad audiences based on existing knowledge of soil health topics to ensure education material matches their needs.

- **Beginner**
 - farmers, non-soil oriented CCAs, students, consultants and agronomists, farm organization staff, CA staff
 - material should provide an understanding of the basics of soil degradation and soil health BMPs
- **Advanced**
 - expert farmers, soil oriented CCAs and consultants, agronomists, soil health service providers, soil specialists
 - material should provide participants with the ability to diagnose soil degradation types, interpret soil health laboratory results and match suitable BMPs to address them
- **Expert**
 - provincial soil health experts, soil health research consultants, and soil health trainers
 - material should provide expert knowledge regarding soil degradation, field and laboratory techniques, soil health assessment processes, BMP suite implementation, and efficacy of soil health practices

EDUCATION PLAN

COURSES

A needs assessment was completed to determine the topics of most interest and need for the selected target audiences within the agricultural sector. The response rate was 60% with Farmers and Certified Crop Advisors (CCAs) contributing half of the responses. The respondents were presented with a variety of soil health topics to rank their interest in and provide feedback on their current knowledge of soil health. As well, they were given the opportunity to share other soil health related topics they were interested in learning more about. 40% of respondents took the time to share their interests. Training format and time commitment was also addressed in the needs assessment to aid in the development of the material. Most respondents stated they preferred an in-field component to be a part of the training with a combination of online and in-field the most preferred format.

With input from the working group (comprised of 7 people with a range of expertise in soil health) and the results of the needs assessment, the following education material have been developed and piloted.

	Course Title	Learning Objectives
1	<p>Growing Your Knowledge of Soil Health</p> <p><i>Consists of five modules</i></p> <p>Format: Asynchronous online</p>	<p>Lesson 1: Introduction Lesson 2: Biological Properties Lesson 3: Chemical Properties Lesson 4: Physical Properties Lesson 5: Soil health Recap</p> <ul style="list-style-type: none"> • Define in their own words what soil and soil health are • Understand the basics of soil biological properties • Identify management practices to improve levels of OM and biological diversity • Understand the chemical properties of healthy, fertile soil. • Assess how biological properties overlap with chemical properties in the maintenance of soil health. • Relate soil chemical properties to forms of soil degradation. • Identify physical properties and how they relate to soil health • Identify physical properties and understand how they combine with chemical and biological properties for desirable soil • Describe how key soil properties relate to some forms of soil degradation • Discuss what makes soil healthy and assess why soil health is important <p>Define steps for a Soil Health Plan and associate BMP types with functions</p>
2	<p>Soil Management Refresher</p> <p>Format: Asynchronous online</p>	<ul style="list-style-type: none"> • Explain the role of soil management as part of a cropping and tillage system • List the key components of a soil management system • Recognize how certain soil management practices lead to soil degradation • Identify at least three types of soil management BMPs and describe their respective influence on soil health
3	<p>Advanced Soil Biology and Organic Matter</p>	<p>Lesson 1: Soil Biology Lesson 2: Best Management Practices for Soil Life</p>

	Course Title	Learning Objectives
	<p><i>Consists of four modules</i></p> <p>Format: Asynchronous online</p>	<p>Lesson 3: Soil Organic Matter Lesson 4: Best Management Practices for Soil Organic Matter</p> <ul style="list-style-type: none"> • List the key functions of the soil life ecosystem • Specify how food for soil life forms drives this ecosystem • List key factors that impact population abundance and diversity • List key attributes of a healthy soil – with respect to soil biology • List forms of humus types • Identify which humus type is most stable • Identify how soil organic matter (SOM) impacts physical properties • List key properties of organic amendments as food sources for soil life • List the risks to soils of low SOM levels • Identify three best management practices (BMPs) for improving levels of SOM and enriching soil life
4	<p>Soil Health Indicators and Testing</p> <p>Format: Asynchronous online</p>	<ul style="list-style-type: none"> • Review concepts and definitions • Identify the benefits and limitations of soil health testing and indicators • Discuss the components of a comprehensive assessment
5	<p>Soil Health: Making It Pay</p> <p>Format: Asynchronous online</p>	<ul style="list-style-type: none"> • Describe economic risks and benefits of implementing soil health BMPs • Discuss measures used to assess economic impact of soil health BMPs
6	<p>Introduction to Soil Health in the Field</p> <p><i>Includes nine online prerequisite modules</i></p> <p>Format: Online modules with 1 field day</p>	<p>Prerequisite Online Modules:</p> <ol style="list-style-type: none"> 1. Soil Biology and Organic Matter <ul style="list-style-type: none"> ○ (Lesson 1 and 3 of Advanced Soil Biology and Organic Matter Course) 2. Bulk Density and Compaction <ul style="list-style-type: none"> ○ Identify what constitutes soil compaction and bulk density ○ Understand why the physical properties of soils are important ○ Review how soils are compacted ○ Expand your knowledge of bulk density and other ways soil compaction is measured/estimated 3. Diagnostics for Degradation <ul style="list-style-type: none"> ○ Define degradation diagnostics ○ Understand causal factors ○ Assess key soil degradation types ○ Match soil degradation types to corresponding BMPs 4. Introduction to Soil Health Assessment <ul style="list-style-type: none"> ○ Define soil health assessment and cite at least two benefits ○ Identify relevant examples of the 5 types of factors affecting soil degradation ○ Complete the Soil Health Assessment Sheet and identify suitable best management practices ○ Identify key interactions between types of factors and forms of degradation

	Course Title	Learning Objectives
		<p>5. Soil Health Indicators and Testing (Full module above)</p> <p>6. Soil Management Refresher (Full module above)</p> <p>7. Soil Materials and Soil Moisture</p> <ul style="list-style-type: none"> ○ Determine soil texture, soil particle sizes and soil texture ○ Contrast between hands-on and field sampling methods of estimating soil texture. ○ Use particle size composition and the soil textural triangle to determine soil textural class. ○ Use the finger assessment tests and flow-charts to estimate soil textural class in the field. ○ Use two examples to explain why and how soil texture is a key inherent factor when assessing soil degradation and health. <p>8. Soil Moisture</p> <ul style="list-style-type: none"> ○ Describe the nature of soil water. ○ Distinguish between the types of soil water. ○ Explain the connection between soil health and soil water. ○ Distinguish between and explain the significance of the two key soil water-related colour features: mottles and gley colours. ○ Determine soil drainage class using the drainage class flowchart. <p>9. Soil Structure and Porosity</p> <ul style="list-style-type: none"> ○ Understand its importance to soil health and crop production ○ Assess factors affecting formation and degradation ○ Identify types of structure and pores ○ Described key approaches to measurement <p>In-Field Workshop:</p> <ul style="list-style-type: none"> ○ Identify key soil features in the field – such as texture, drainage, soil structure and density - as well as other key soil health diagnostics ○ Discern the nature and extent of key soil degradation types based on observations in the field, with crops and the impacts of past management ○ Distinguish between soil health indicators and in-field diagnostics for soil degradation – while recognizing how these features may interact on some sites ○ Interpret key results from past management, farmer records and in-field diagnostics using SH Assessment rating sheets ○ Use a soil health assessment card as basis for soil health recommendations for an actively cropped field

LEARNING OUTCOMES

Learning outcomes and suggested course selection to achieve those outcomes for each target audience group.

Audience	Medium Term (1-3 years) Outcomes	Suggested Material	Long-term (3 + years) Outcomes	Suggested Material
Beginner	<ul style="list-style-type: none"> • Demonstrate awareness of key concepts 	<ol style="list-style-type: none"> 1. Growing Your Knowledge of Soil Health (Phase 1) 2. Soil Health Assessment – Rating Sheet (Phase 3) 	<ul style="list-style-type: none"> • Apply soil health knowledge to management advice and decisions 	<ol style="list-style-type: none"> 1. Soil Management Refresher (Phase 2) 2. Soil Health Indicators and Tests – Part 1 (Phase 2)
Advanced	<ul style="list-style-type: none"> • Diagnose key degradation types • Recommend suitable soil health BMPs 	<ol style="list-style-type: none"> 1. All Beginner Soil Health material 2. Introduction to Soil Health in the Field (Phase 2) 3. Soil Health: Making it Pay (Phase 2) 4. Advanced Soil Biology and Organic Matter (Phase 2) 	<ul style="list-style-type: none"> • Diagnose most soil health degradation types • Effectively interpret soil health test results • Recommend suites of suitable soil health BMPs 	<ol style="list-style-type: none"> 1. Describing Soils in the Field (Phase 3) 2. Advanced Soil Degradation Diagnostics (Phase 3) 3. Advanced Soil Health Assessment (Phase 3) 4. Soil Health Indicators and Tests – Part 2 (Phase 3 +)
Expert	<ul style="list-style-type: none"> • Identify key soil properties related to soil degradation • Diagnose soil degradation types • Assess soil health in the field • Interpret soil health results and make recommendations • Develop comprehensive soil health plans • Conduct introductory soil health workshops 	<ol style="list-style-type: none"> 1. All Advanced material 2. Advanced Soil Health Assessment (Phase 3) 3. Train-the-Trainer: Intermediate level (Phase 3+) 	<ul style="list-style-type: none"> • Develop comprehensive soil health management zone maps for clients • Conduct advanced-level training programs • Develop educational materials to further soil health practice in Ontario • Advise and conduct relevant field research on soil degradation and health • Advise on policy development for soil health 	<ol style="list-style-type: none"> 1. Field Scale Mapping (Phase 3) 2. Train-the-Trainer: Advanced level (Phase 3+)

RECOMMENDATIONS

IMPROVING AND ADVANCING DEVELOPED EDUCATION CONTENT (PHASE 1 AND 2)

- Explore opportunities for enhanced online learning:
 - learners to interact with each other via online discussion panels or sessions
 - live online sessions with subject matter experts for Q & As
 - if interest/demand warrants, scheduling in-person workshops
- External review of technical content
- Improvements to design and visuals
 - Seeking alternative high quality visual media that depicts the specific topic
- Detailed guidance and lesson plans for trainers
- Ideas to alter content and design for other audiences or levels of learners
 - Example: creating a beginner level version of Introduction to Soil Health in the Field. Current format is appropriate for advanced level learner.
- Create screening questions at time of registration to determine knowledge level of learner and match desired learning outcomes with material.

RECOMMENDATIONS FOR PHASE 3 COURSES

**See attachment for more details on proposed Phase 3 course outlines*

Title	Audience Group	Learning Objectives
<p>Soil Health Assessment – Rating Sheet</p> <p>Format: Online modules and Field day course / 1 day</p> <p>Pre-Requisite: <i>Growing Your Knowledge of Soil Health – Online module</i></p>	<ul style="list-style-type: none"> • Farmers • CCAs <p>Beginner to Advanced</p>	<ul style="list-style-type: none"> • Define and explain key terms and concepts related to soil health and degradation diagnostics • Define and cite examples for the primary factors affecting soil degradation diagnosis • Apply the soil health assessment independently • Identify suitable BMPs to address key types of soil degradation
<p>Describing Soils in the Field</p> <p>Format: Online modules and 2 Field day course</p> <p>New online module on <i>Soil Horizonation and Soil Degradation</i></p> <p>Pre-Requisite: <i>Soil Health in the</i></p>	<ul style="list-style-type: none"> • CCAs • Other professional staff • Advanced to Expert 	<ul style="list-style-type: none"> • Describe a range of soil particle sizes and soil textures in the field • Describe a broad range of soil drainage classes in the field • Identify key soil horizons in the field • Describe slope % and slope positions • Link all of these features to soil capability and soil degradation

Title	Audience Group	Learning Objectives
<i>Field</i>		
<p>Advanced Soil Degradation Diagnostics</p> <p>Format: Online modules and 2 Field day course</p> <p>Pre-Requisites: <i>Soil Health in the Field, Describing Soils in the Field</i></p>	<ul style="list-style-type: none"> • CCAs • Other professional staff <p>Advanced to Expert</p>	<ul style="list-style-type: none"> • Apply field-level diagnostic description skills for soil, site, field and crop features to the assessment of key soil degradation types; • Apply skills required for in-field soil measurements to the assessment of key soil degradation types; • Demonstrate the ability to interpret past management practices, BMPs in place and soil analyses results to the assessment of key soil degradation types; • Discern the nature and extent of key soil degradation types based all 5 types of degradation factors • Recognize the impact of BMPs and systems approach to managing soil degradation types observed
<p>Advanced Soil Health Assessment</p> <p>Format: 2 Field day course</p> <p>Pre-Requisites: <i>Soil Health in the Field, Describing Soils in the Field; Advanced Soil Degradation Diagnostics</i></p>	<ul style="list-style-type: none"> • CCAs • Other professional staff <p>Advanced to Expert</p>	<ul style="list-style-type: none"> • Demonstrate and apply skills learned in `Describing Soils in the Field` • Demonstrate and apply skills learned in `Soil Degradation Diagnostics` • Develop Soil Health Assessments and complete Plans to Address Soil Health Challenges
<p>Field Scale Mapping</p> <p>Format: 2-3 days, scheduled over several weeks of on-line modules – with embedded videos where appropriate plus field demo day during late summer fall</p> <p>Pre-Requisites: <i>Soil Health in the Field, Describing Soils in the Field; Advanced Soil Degradation Diagnostics; Advanced Soil Health Assessment</i></p>	<ul style="list-style-type: none"> • CCAs • Other professional staff <p>Advanced to Expert</p>	<ul style="list-style-type: none"> • List 3 key principles and practices of cartography • Contrast the advantages and disadvantages of 3 key agronomic applications of detailed mapping technologies • Describe how zone mapping can be applied to impact management decisions • Describe how soil features and degradation types vary across the landscape • List 4 type of proximal sensing technology that show promise and justify your choices • List 4 type of proximal sensing technology that show promise and justify your choices

RECOMMENDATIONS FOR ADDITIONAL MATERIAL

Based on feedback from pilot sessions, the following are recommendations for additional material that has not been discussed.

- Advanced versions of existing material
 - Making it Pay: Advanced
 - Add more case studies and advanced economic analyses
 - Soil Health Indicators and Testing: Advanced
 - Request further research and development work on Soil Health Indicators to create the advanced module
- Soil Health Diagnostic Mobile Apps/Guides
 - Work with specialists and educational materials experts to develop mobile apps/guides for Soil Health diagnostics. Add these new tools to existing courses or create new courses for them.
- Work with subject matter experts/Soil Health experts to provide input into appropriate courses about length of time needed to see changes from BMP implementation and how to help growers overcome the challenges of implementing BMPs for Soil Health (e.g., OMAFRA Soil Team)
- Develop a train-the-trainer session
- Develop skills assessment tests

FACILITATOR SELECTION

Suitable facilitators are required for course implementation. There are several essential areas of core competency that need to be met when selecting suitable facilitators, including: intimate knowledge of technical content, demonstrated field and teaching skills and technology transfer experience with target audiences. The following are specific criteria to consider when selecting a facilitator.

For in-field instruction, the ideal participant to facilitator ratio would be one facilitator to 4 – 5 participants.

Knowledge areas:

- Soil Management:
 - Soil properties and interactions with soil management
 - Soil plant-relations
 - Soil fertility and plant mineral nutrition
 - Soil conservation and environmental quality
 - Expert comprehension of soil BMPs
 - Soil degradation and soil health
 - Systems approach to soil degradation, health, and management
- Soil Resource:
 - Soil description and interpretations
 - Soils in the landscape
 - Soil features – interactions with degradation and BMP suitability
- Agronomy:
 - Growth requirements for common field crops
 - Cropping systems
 - cropping and tillage systems
 - conservation systems

Extension and Technology transfer:

- Principles and practices of adult education and technology transfer
- Training methods

Skills:

- Crop diagnostics
- Soil diagnostics for degradation (i.e., identification, causes, risks, implications)
- Matching BMPs to degradation types
- Soil description and interpretation (i.e., applied pedology)
- Soil analyses methods, sampling, and interpretation of results
- Demonstrated communication and extension plus technology transfer skills.

Experience:

- 5-10 years with technology transfer role in soil management and soil health
- 2-5 years experience in training farmers and other key target audiences

SITE SELECTION FOR IN-FIELD TRAINING

The best outdoor classroom will effectively demonstrate soil degradation and soil health features in the landscape. It can take considerable time to find the best location(s) for the course and the best sites within the chosen location(s) to accomplish this.

Site considerations:

- Variety of soil degradation and soil health features
- Distance between site locations
- Accessible location (i.e., signage, access to field by vehicle, walkable)
- Covered shelter availability

EVALUATION OF EDUCATION MATERIAL

It is recommended to do a follow-up survey to measure the learner's knowledge retention and application, satisfaction with material, and suggestions for new material development. Follow-up surveys should be conducted once a year and sent to learner's that completed the material in the previous year. The results should be used to:

- improve current material (e.g., updates based on latest research, enhance learning experience, etc.)
- inform development of new education material (if need exists)

DELIVERY AGENT

It is recommended that the Business Development Centre (BDC) at Ridgetown Campus deliver the soil education courses.

Ridgetown Campus operates as a satellite campus of the Ontario Agriculture College (OAC), University of Guelph. The University is ranked as one of Canada's top comprehensive research universities and OAC provides innovative life sciences education and research for agriculture, food, the environment, and rural communities. Ridgetown Campus provides certificate and diploma programs in agriculture, horticulture, environmental management, and veterinary technology, has an extensive crops and livestock-based research program, and offers continuing education courses to the agri-food sector for professional development and skills training.

The Business Development Centre (BDC) at Ridgetown Campus has provided custom training, project management, professional development, and technology transfer services for over 30 years. We develop and deliver high quality programs relating to agriculture, food, and environmental sustainability at the request of and in collaboration with farm organizations, industry, and government.

BDC is distinctly qualified to deliver the developed soil health courses. BDC currently delivers several online and in-person training and education programs for various agricultural sectors including the pesticide safety education program, nutrient management, food safety and traceability, livestock, drainage, and soil erosion. They have a well-established reputation for delivering exceptional training and support to the target audience.

COST RECOVERY OPTIONS

RECOMMENDATION FOR ONLINE COURSES

Course fees to be charged to cover the cost of each online course offering. The going rate for a Certified Crop Advisor CEU credit course is between \$35 - \$50 per credit. For the CCA CEU program, one hour equals one CEU credit. Depending on the duration of the course, a fee of \$35 - \$50 per hour is recommended to be charged.

RECOMMENDATION FOR IN-PERSON TRAINING

The costs associated with offering in-person training are higher than asynchronous online offerings. Charging a full cost-recovery fee to the participant will likely discourage registration due to the high cost. To off-set the cost to the participant, it is recommended to secure sponsorship or a partnership agreement for funding in-person offerings.

INCENTING PARTICIPATION

CCA CEU PROGRAM

CCAs need to obtain a minimum of five soil and water credits every two years. By ensuring the courses offer CEU credits, CCAs will be incentivized to participate.

COST SHARE FUNDING OPPORTUNITIES

It is recommended to explore opportunities for cost-share funding assistance. Cost-share programs that align with the Province's [Agricultural Soil Health and Conservation Strategy](#) to support skills development and training for producers and agribusiness. Programs such as Growing Forward 2 and Canadian Agricultural Partnership have cost-shared up to 50 percent of costs for training programs.

MASTERCLASS CERTIFICATION

The suite of courses that have been developed in Phase 1 and Phase 2, along with suggested Phase 3 content, work together to bring the learner to the advanced knowledge level. By completing the masterclass, learners will achieve mastery knowledge on soil health.

Suggested format:

- Two years to complete
- Enrolled in all material (in-person and online)
- Online discussion panel with leading questions
- Scheduled live online sessions with experts (2 – 3 times/year)
 - Each session will focus on one topic
 - Open Q & A period
 - Opportunity to connect with other learners

Participants would be awarded a Certificate of Completion after successfully completing all material.

Offer participants the option to demonstrate existing knowledge for course credit. Assessment material would need to be developed for each course to facilitate credit process.

FORMAL SOIL HEALTH CERTIFICATION PROGRAM

Analyze industry need and stakeholder interest for a formal soil health certification program.

Possible formats:

- Soil Health specialty for CCAs (using 4R NMS specialty as framework)
- Certificate accredited by the University of Guelph Ridgetown Campus

RELATIONSHIPS/PARTNERSHIPS

To ensure long term sustainability of the education material, it is recommended to form working relationships, and where appropriate partnerships, with organizations, associations, conservation authorities, government, and other agribusinesses that have a shared commitment to soil health.

These relationships could be leveraged to promote and deliver courses and collaborate on new educational material development.

Possible relationships/partnerships:

- College, University
- Farm organizations
- Ag Industry
- Professional Agricultural Associations

COLLABORATION WITH RIDGETOWN CAMPUS DIPLOMA PROGRAMS

Opportunity to collaborate with Ridgetown Campus Diploma program. Soil Principles is a required course for the Associate Diploma in Agriculture. The developed soil health education courses could be incorporated into the course curriculum.

MARKETING PLAN

The marketing and communication plan for the soil health education courses will need to be intentional. Recommendation to hire professional marketing company to develop branded material and messaging. Message should highlight the connection to themes within the [provincial soil strategy](#). Marketing should be tailored to each target audience (e.g., CCAs interest in material will be different than farmers).

PROPOSED PLAN FOR TRAIN-THE-TRAINER SESSION

Facilitators for the training material will be required to participate in a train-the-trainer session. Train-the-trainer sessions are designed to ensure that facilitators can successfully facilitate training sessions.

- develop list of competencies
- address adult learning principles and classroom management topics
- ensure breadth of knowledge, experience and skills are addressed
- candidates participate in existing modules and prototypes
- follow up with multiday field course to reinforce content