

Assessing Rates of BMP Adoption

Understanding Cover Crop and Soil Testing Use Ontario

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Summary

Cover crop use and regular soil testing are two key Best Management Practices (BMP) recommended to build and strengthen soil health. These BMPs also represent key actions on agricultural lands necessary to help address the Phosphorus challenges facing Lake Erie. Yet because these actions are behavioral in nature and must be incorporated into a farm business' annual planning process, adoption can be challenging and barriers significant. Furthermore, assessing the adoption of these practices is difficult, as practices vary significantly across jurisdictions and over time. Through this project we sought to better understand the rate at which producers in the province are utilizing cover crops as well as determining how regularly Ontario producers are soil testing. Data is limited and fragmented on this topic, requiring significant synthesis across a variety of sources of information. While extensive research exists on the nutrient transport impacts, water quality, crop yields, and overall soil health implications of these BMPs, comprehensive studies assessing the overall scale of adoption of these practices at the provincial scale are currently not available.

The Agricultural Census offers an overview of cover crop practices across the province, showing that the percentage of farmers using cover crops is highest in Huron, Perth, Waterloo, Haldimand/Norfolk, Lambton and Chatham/Kent, however the percentage of farms using cover crops is never higher than 50%. Within the eastern focal region adoption was very low, with the majority of counties reporting less than 10% of farms using cover crops. The Central region has an average of 18.6% adoption, and the southwest region ranged from 21% in LaSalle to 42.9% in St. Clair, for an average of 33.5% of farmers reporting that they planted cover crops in 2016. In addition, Certified Crop Advisors suggested that on average 41.41% (range of 5% to 100%) of customers were using cover crops. Producers in the southwest focal region had the highest average of customers using cover crops. CCA responses align with the Ag Census results. Participating CCAs suggest that cover crop adoption is increasing, with 86.68% identifying a growing trend. Cover crop seed dealers also agreed, with three out of four respondents indicating that they sensed cover crop adoption rates were increasing. Cover crop seed dealers were asked to estimate the percentage of clients that planted cover crops, which revealed a very broad range of estimates from 5-60% (33% average) across the four businesses.

Of the nine Conservation Authorities operating in the focal regions, six offer financial support for farmers interested in soil testing or implementing cover crops. Two of the six recently began supporting soil testing and have had very limited uptake. The most intensive programs were able to achieve 20% cover of an entire sub-watershed, and the Grand River Conservation Authority program resulted in participants planting 20% of farm fields in cover crops. Most stewardship staff did not feel comfortable offering observations on overall cover over winter in their watersheds, but those that did generally indicated that less than 20% of the watershed was currently using cover crops.

The Agricultural Census does not provide information on soil testing in the province. One representative from a soil lab estimated that only 20% of producers in the province soil test regularly. However, those who soil test remain very committed to the practice, with labs suggesting that up to 100% of their clients regularly soil test. Seed dealers who offer soil testing

as part of a package indicated that the service was underutilized. CA staff supported this claim, as watersheds that had funding available generally had limited uptake. The GRCA conducted a survey which found that of the stewardship program participants, 69% were soil sampling at least every five years whereas 9% were never sampling. CCAs indicated that in general the adoption of soil testing is increasing, yet to a much lesser degree than cover crop adoption.

It is evident that more work needs to be done to better understand cover crop and soil testing adoption rates. The AAFC satellite data may provide geographic specific insight into crop growth on a provincial scale, as indicated within the analysis, yet further work is necessary to provide proof of concept. In addition, models like the USDA's cover crop survey could be explored in the province to regularly establish protocol and develop a stronger sense of changes in adoption over time. The focus on environmental outcomes that relate to broad behavioural action requires strong understanding of baselines, adoption rates and trends which are currently absent.

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The Reducing Barriers to BMP Adoption – Soil Testing and Cover Crops is a three-year applied research initiative that began in 2019. The initiative supports improving soil health, productivity, and water quality on farms across Ontario. The Ontario Ministry of Agriculture, Food and Rural Affairs identified the need for the project and the Ontario Soil and Crop Improvement Association is delivering it. This project is funded by the Canadian Agricultural Partnership, a five-year federal-provincial-territorial initiative.

Introduction

Best Management Practices (BMP) like conservation tillage and tree planting have long been championed and supported by conservation organizations and governments aiming to assist agricultural producers in growing food sustainably on the landscape. But the relatively recent rise in interest in the concept of soil health has shed additional light on key practices that contribute to sustainable food production which also provide significant water quality benefits for broader watersheds. Years of algal blooms and broad water quality challenges have directed the focus of decision makers and scientists alike to seek out solutions that address widespread issues of runoff and nutrient loading from privately owned agricultural landscapes. Cover crops are those crops planted in addition to the production crop, generally after harvest, in order to protect soil from erosion over the non-growing season. The science surrounding cover crops is complex, but they can also help with weed suppression, building organic matter, enhancing soil microbiology and reducing compaction. While the practice of planting cover crops goes back several millennia (Groff 2015), with the move to more industrial models of production and reliance on fertilizers and herbicides, adoption of cover cropping practice declined. By the post-war period, cover crops were considered a marginal practice, associated only with organic producers. However, as knowledge of soil health has increased in recent decades, renewed interest in the practice has grown. According to the 2012 US Agricultural Census, an estimated 10 million acres of cover crops were planted that year (Groff 2015). In Canada, 66% of reporting census divisions saw an increase in the proportion of farms using winter cover crops between 2010 and 2015 (Statistics Canada 2016).

An additional practice that promotes soil health is to sample soil and analyze it for nutrients and pathogens. Broad understanding of the degree to which soil testing as a core agricultural practice is occurring severely limited, since there are no systematic sources of data on soil testing. Soil testing has several benefits for promoting soil health and sustainable agriculture; reduced and more refined nutrient inputs, protection of soil resources, ability to precisely enhance soil biology, and having a better understanding of what you have and could effectively grow in terms of specific crops and rotations.

Through this report we aim to provide a deeper understanding of the adoption of cover crops and soil testing in Ontario. These BMPs are longstanding actions that offer significant benefits for soil health, Phosphorus loss and water quality. In response to OSCIA's request to examine the adoption of cover crops and soil testing in three priority areas (see Figure 1), we have collected data from a variety of sources to understand adoption in these focal areas, and to a lesser extent the wider Ontario agricultural context. Firstly, we review recent research from academic, conservation authorities, government, and non-profit sources related to cover crop and soil testing adoption in Ontario. Reviewing these reports provides a baseline and context for interpreting results from our own data collection and analysis that follows. Secondly, we reviewed relevant questions from the most recent Agricultural Census, reporting results at the census division level in southern Ontario. Third, we conducted primary data collection to fill gaps in knowledge from key stakeholders: phone interviews with industry experts such as seed dealers and soil testing labs, a detailed survey administered to Ontario's Certified Crop Advisors, and interviews with stewardship staff from Conservation Authorities who deliver

programming and work directly with producers. Through this multi-pronged approach to information collection and synthesis, we aim to draw preliminary conclusions about the status of cover cropping and soil testing in Ontario agriculture, focused on our identified focal regions; southwest Ontario, central Ontario, and eastern Ontario.

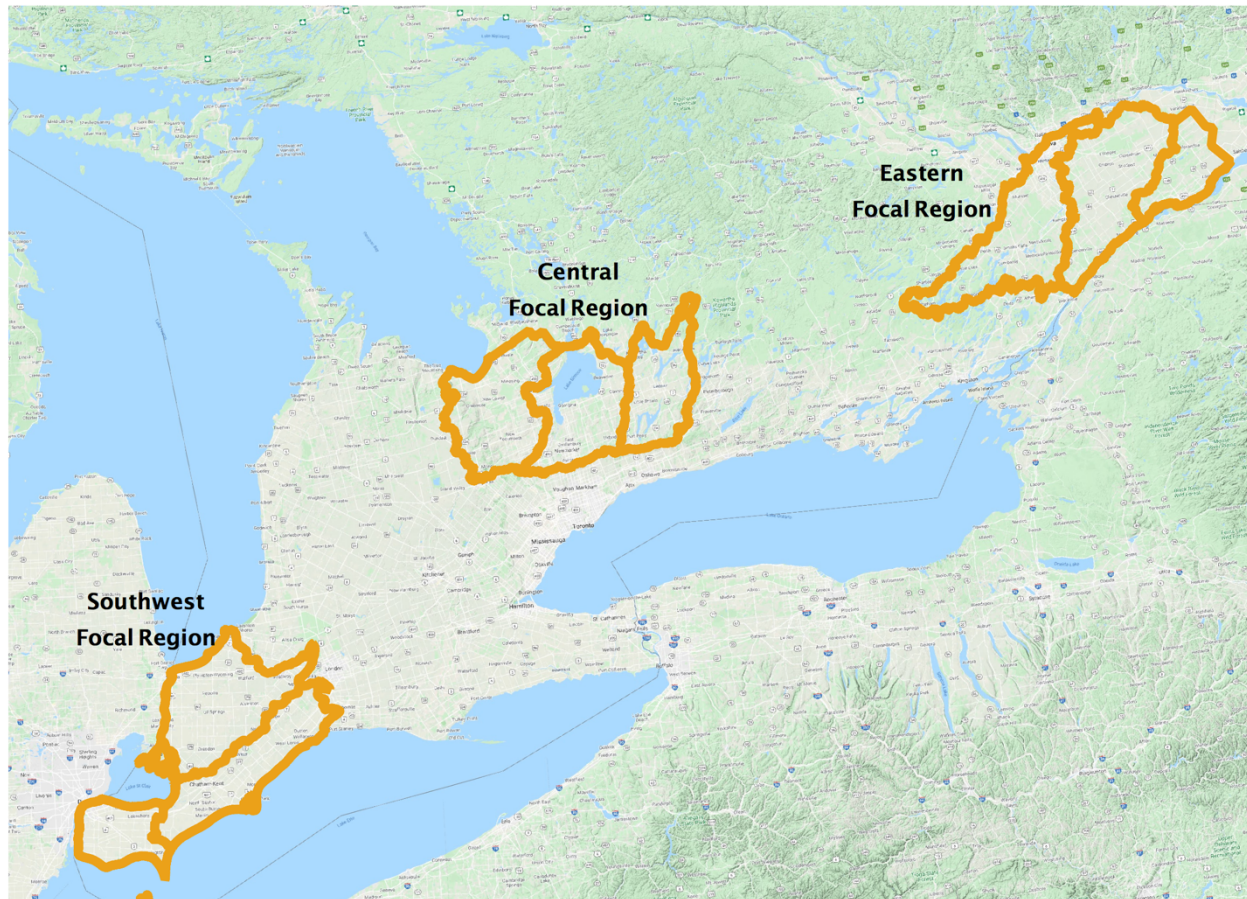


Figure 1 Study area with three focal regions identified by their conservation area boundaries. The Eastern Focal Region is composed of Raisin, South Nation, and Rideau Valley Conservation Areas. The Central Focal Region is composed of Kawartha, Lake Simcoe, and Nottawasaga Conservation Areas. The Southwestern Focal Region is composed of St. Clair, Lower Thames, and Essex Region Conservation Areas.

Academic Literature Review

Several academic sources were found with broad coverage of the science of cover crop and soil testing use in Ontario. Few articles addressed adoption rates in detail, with several examining broader aspects of BMP uptake, and predictors of environmental decision-making for farm businesses. In a highly relevant study, Smit and Smithers (1992) surveyed 176 farmers in Kent and Oxford counties, aiming to measure overall conservation effort at the farm-level. Among other findings, they identified that 38% of 176 respondents used cover crops. Given that this study was conducted over 27 years ago, it presents an interesting baseline to measure our current analysis in these areas against. Knowler and Bradshaw (2007) reviewed over 30 studies on adoption of ‘conservation agriculture’ practices (including cover crops and soil testing), and

through extensive meta-analysis were not able to find any conclusive generic factors related to the adoption of practices. In summary, the authors note that efforts to promote conservation agriculture will likely need to be tailored to particular conditions of individual locales. The study does cite the Ontario Environmental Farm Plan, noting its success

“is ascribable to farmer pride and interest in ‘doing the right thing’. Both pride and peer pressure may motivate conservation agriculture adoption, and government policies may be able to contribute on this front through targeted promotions and educational programs” (Knowler and Bradshaw, pg. 44).

The EFP itself has been identified as a predictor of environmental decision-making on farms in the Ontario context. Lamba et al. (2009) examined factors effecting the adoption of BMPs in several Ontario watersheds (Raisin, Maitland Valley, and Lake Simcoe). Their study surveyed a sample of 164 farmers finding that farm size was positively linked to adoption of certain BMPs, such as conservation tillage/planting, nutrient management planning and regular soil testing. Regular soil testing was also positively associated with having an EFP. Positive association between BMP adoption and farm size has been found in several studies examined (Filson et al. 2009; Knowler and Bradshaw 2007). An Ipsos-Reid poll cited in Filson et al 2009, taken in 2006 with a nation-wide sample size of 1,000 farmers found that soil testing (75%) and minimum tillage (73%) were the most commonly used BMPs nationally. In a recent study, Marr and Howley (2019) conducted semi-structured interviews with 54 industry stakeholders, identifying a series of internal psychological orientations that factor in to how on-farm decisions related to environmental BMPs are actually made. This research, comparing Ontario to the English context, suggests that in Ontario a certain fraction of farmers are inclined to make decisions that benefit the environment to their own financial detriment, while others may make decisions for purely financial reasons that can have environmental benefits. Being able to target these internal decision-making orientations is key to changing behaviours. In a technical review of cover crops in the US context, Groff (2015) concludes that despite increasing awareness and adoption, core research and data on benefits of cover crops, which can validate benefits and optimize management for farmers, is currently lacking. With investments in additional research, such hard data could then be useful for targeting different types of decision-making, as outlined by Marr and Howley (2019).

Trade Magazines and Articles

Several trade magazine articles were reviewed to see how topics of cover crops and soil testing were being presented to producers in industry literature. No information about rates of adoption or acreage were found in these sources. These articles tended to cover individual farmer experiences, such as with specific crop and cover crop rotations, their results, and more advanced techniques like interseeding. Given the relatively widespread coverage in these sources (especially of cover crops), there appears to be growing interest in the practice. However no hard data were discernible from these sources. In addition, conservation authority websites were combed for research on local adoption rates, but no sources were identified.

Methods

Agricultural Census and Inventory Analysis

The Canadian Census of Agriculture is conducted by Statistics Canada every five years, with the most recent census results released for the year 2016. The key variable of interest from the Census was the percentage of farms that reported using cover crops. Unfortunately, no variables related to soil testing were identified in the census data. Trends in cover crop use were examined across southern Ontario and within the three focal regions. In addition, specific crops associated with cover crop rotations were identified in the AAFC Agricultural Inventory and mapped for selected focal regions.

Conservation Authorities

Nine conservation authorities located within the three focal regions (Figure 1) were contacted to provide insight on practice uptake. Cover crop and soil testing uptake through existing local programming was discussed. Stewardship staff were also asked to provide their personal perspective on cover crop rates in the watershed based on a visual assessment, conversations and any additional feedback received. Some individuals felt more comfortable offering this opinion than others. Upper Thames River Conservation Authority and the Grand River Conservation Authority were also contacted for feedback due to their heavy involvement in agricultural stewardship over the past several decades.

Surveys

For this component of the project we sought to gather information from independent businesses working directly with farm businesses to better understand existing adoption rates. Three surveys were prepared, one for each key focal group.

Certified Crop Advisors (CCA)

CCAs work directly with producers in the province to offer agronomic insight for producers making production decisions for the farm business. There are over 650 CCAs in Ontario today, and accredited individuals can be hired directly by a seed dealer or work directly with clients independently. Many seed dealers in the province employ CCAs to provide direct support services to clients over and above the traditional discussions that occur when purchasing seed and inputs. Independent CCAs build their own client bases, with some working with a very limited number of clients, while others derive their primary source of income from their CCA business. All CCAs are required to earn credits regularly to maintain their accreditation and ensure they have up to date knowledge to share with clients.

A detailed survey outlining 33 questions was shared with the full CCA membership thanks to the help of the Executive Director Susan Fitzgerald. The survey was open for a period of one week to gather input. 53 responses were received from CCAs across the province, representing a response rate of 8.2%.

Soil Labs

Soil labs represent a key voice in the conversation on soil testing. Drawing from the OMAFRA accredited soil labs list, each business was contacted through multiple emails and telephone calls to generate responses to this information request. We prepared 13 questions to discuss with these businesses, providing a deeper understanding of soil testing frequency, client retention rates, and client generation rates. Ultimately, we received input from four soil labs, out of the list of eight within Ontario, representing a response rate of 50%.

Seed Dealers (cover crops)

Seed dealers work directly with every business growing crops in the province and offer significant insight into practices and barriers faced by those ordering seed. Drawing from the OMAFRA list of cover crop seed dealers in the province, we contacted each business via email and telephone to generate responses to the survey. The survey itself was made up of 19 questions addressing both cover crops and soil testing. Ultimately four responses were received from seed dealers on OMAFRA's cover crop list of 18, for a response rate of 22%. We also contacted several general seed dealers within the key geographies, but were not able to secure input from any, all cited being too busy to comment at this time.

Results

Agriculture Census

We obtained data from the Canadian Agricultural Census from Statistics Canada. We extracted data describing the proportion of farms reporting field crops that used winter cover crops by census division (CD), represented below (Figure 2). There was a fairly consistent gradient in the pattern of cover crop adoption, being greater in the southwest of the study area in the agricultural landscape of southwest Ontario, while being less common in northern and eastern parts of the study area. Note that the variable reported in Figure 2 is the proportion of farms, which may represent highly varying actual land-bases devoted to agriculture. To provide some context, we mapped the total land area devoted to crop agriculture in each division, presented in Figure 3. The higher cover cropping regions in the southwest mirror the areas with more agricultural land, however it is interesting to note that nowhere does the percentage of farms using cover crops exceed 50%. This suggests that even in southwestern Ontario there is considerable potential to expand the practice of cover cropping with potentially significant effects on soil health in the region.

Examining the focal regions in more detail, the trends locally mirror those above although some important variation is found as well. In the Eastern focal region, there is by far the lowest use of cover crops of the three regions (Figure 4), with over 75% of counties reporting less than 10% of farms using cover crops. The county of East Hawkesbury reports the highest, with 18 of 108 farms using cover crops (Appendix 1 Table 1). The Central region had higher rates of cover crop adoption, with an average of 18.6% of reporting farms using cover crops, up to a maximum of 34.6% (New Tecumseth). The Southwest region had cover crop adoption ranging from 21.0% (LaSalle) to 42.9% (St. Clair), with an average of 33.5%.

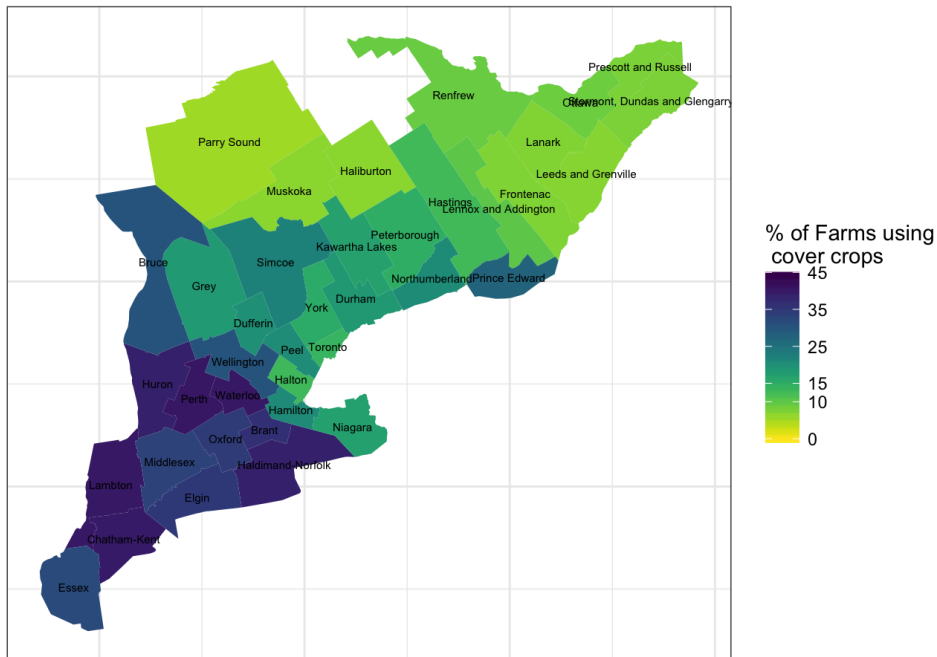


Figure 2 Percentage of reporting farms using winter cover crops, Agricultural Census 2016.

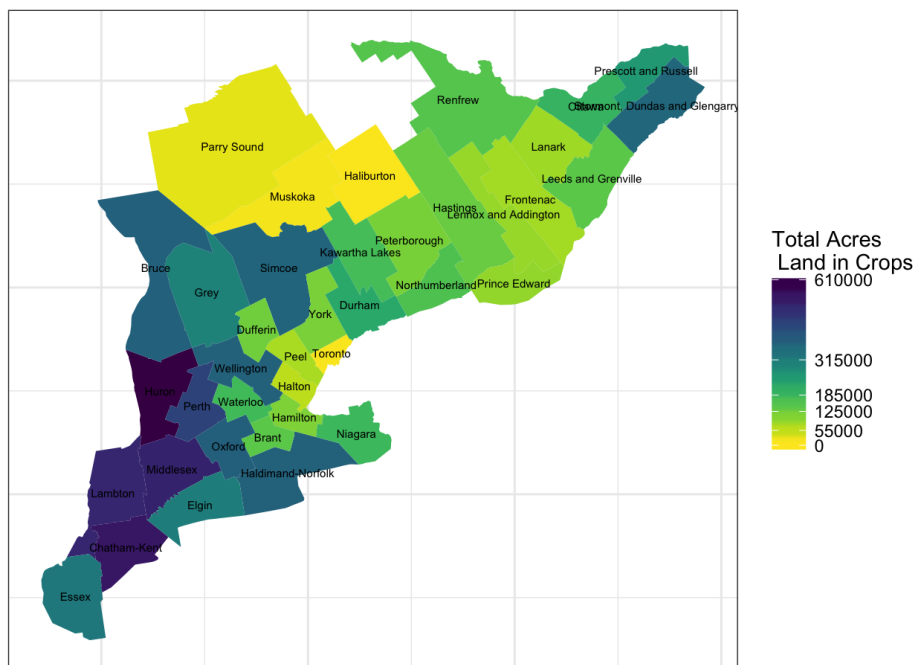


Figure 3 Total land devoted to crop agriculture, Agricultural Census 2016

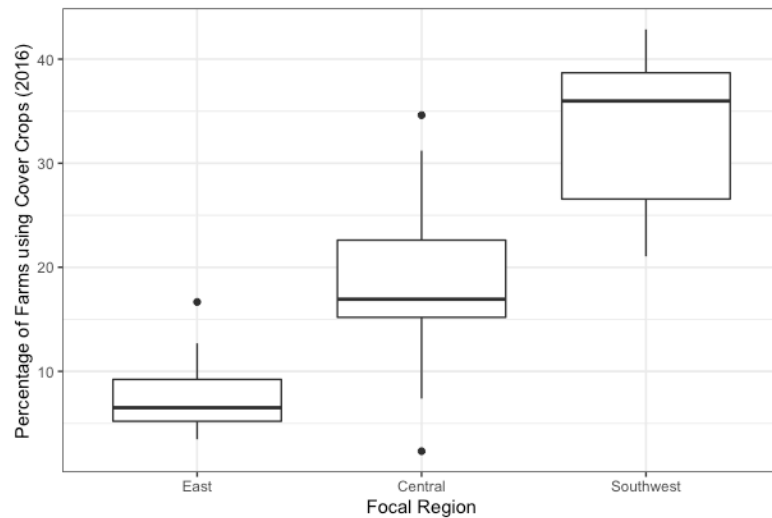


Figure 4 Distribution of percentage of farms reporting the use of cover crops in the 2016 Agricultural Census at county level in three focal regions

AAFC- Crop-Inventory Mapping

As a proof of concept for working with a newer source of data in crops on the landscape, we extracted data from the AAFC Annual Crop Inventory from 2019. This is a satellite-based crop classification product that classifies crops at a 30 m scale across Canada. The reported accuracy for the crop inventory is 85%. Since crop classifications are taken during the growing season, we focused on winter wheat as the variable of interest, since surveys and interviews indicated it was strongly linked to cover crop use.

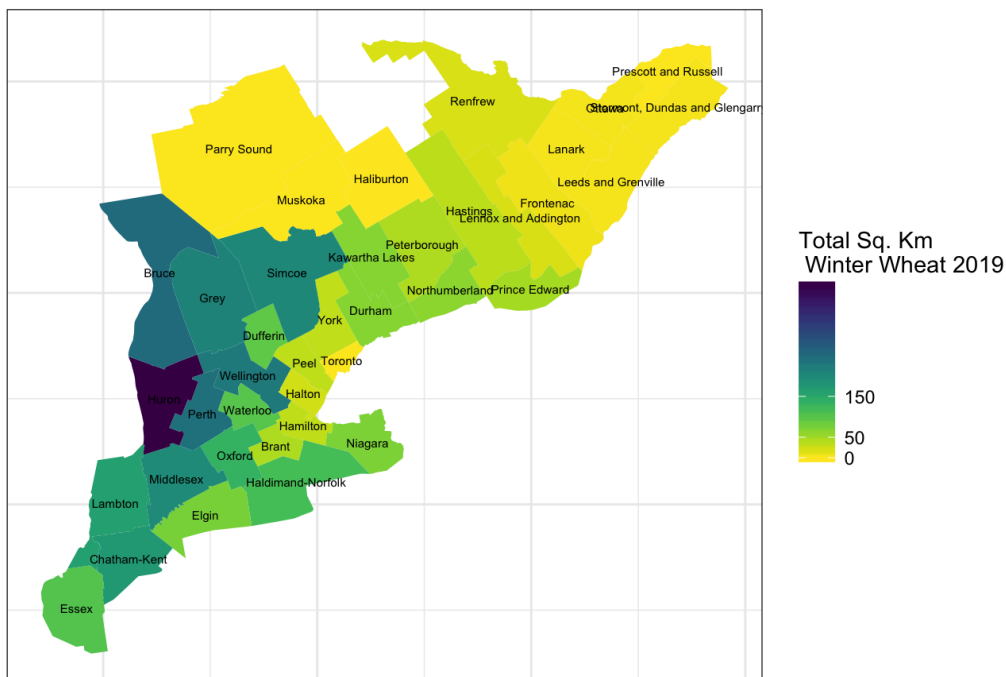


Figure 5 Total area (sq. km) of winter wheat, as reported in 2019 AAFC Annual Crop Inventory

Figure 5 presents the distribution of winter wheat at the census division scale for southern Ontario, showing higher acreages in Bruce, Gray, Simcoe, Huron, Perth, and Wellington counties relative to other areas. Note that these figures have not been standardized for the scale of each county. A more in-depth view of the actual mapped data, reported for the Chatham-Kent county in the southern focal region is presented in Figure 6. Given the ability to finely map crops at an annual scale, and relatively common crop and crop/cover crop pairings used in southern Ontario, there may be an opportunity to use these newer supplemental data sources to improve our understanding of the adoption of cover crop practices at finer scales than that afforded by the Agricultural Census.



Figure 6 Winter wheat areas (blue) for Chatham-Kent derived from the 2019 AAFC Annual Crop Inventory

Conservation Authorities

Southwestern Ontario

Essex Region Conservation Authority

The Essex Region Conservation Authority (ERCA) supported cover crops and crop nutrient plans, including soil testing, through their GLASI (2015-2017) and GLPI (2018-2019) programs. During GLASI five cover crop projects were completed and 15 crop nutrient plans were prepared. During GLPI 14 cover crops were completed totalling 816 acres and 21 crop nutrient plans were prepared covering 3,218 acres. Stewardship staff estimated that ERCA programming likely funds 50-100% of the cover crops planted in the watershed, indicating over winter cover is very limited. In addition, producers applying to the program for soil testing regularly indicate that they have not previously sampled fields, suggesting that the program may also be funding a large degree of the soil sampling occurring in the watershed.

St. Clair Region Conservation Authority

The St. Clair Region Conservation Authority does not include cover crops or soil testing through their stewardship programs so figures were not available.

Lower Thames Valley Conservation Authority

The Lower Thames Valley Conservation Authority offers support for cover crops and soil sampling, but financial incentives are not available consistently across the watershed. Through the Rondeau Bay Cover Crop Pilot Project (2016-2017), 2,216 acres of cover crops were planted (total subwatershed of 38,300 acres), representing approximately 6% coverage of the entire watershed covered. GLASI PSP Jeannette's Creek project (2015-2018) funded 888 acres of cover crops, representing approximately 18% cover of the entire watershed. In addition, 13 fields were grid or zone sampled. The McGregor & Jeannette's Creek Phosphorus Reduction Program (2019-2022) has supported the planting of 2249 acres of cover crops within the first program year, representing approximately 1% coverage of the entire subwatershed. In addition, 2,495 acres were grid or zone sampled. An estimate of cover overall based on observation was not available, though stewardship staff identified this as a gap that needs to be addressed in the future.

Information Provided	ERCA	SCRCA	LTVCA
Cover crop projects supported # of projects(acres)	19 (816 - of data available)	Does not fund	(5,353 acres)
Soil test projects supported # of projects(acres)	36 (3,218 – of available data)	Does not fund	(2,495 – of data available)

Estimated watershed-wide use of cover crops	Very limited	Unavailable	Unavailable
Estimated watershed-wide soil testing rates	Very limited	Unavailable	Unavailable

Table 1 Southwestern focal region cover crop and soil testing activity summary.

Central Ontario

Nottawasaga Valley Conservation Authority

The Nottawasaga Valley Conservation Authority (NVCA) recently began supporting cover crops as a BMP through incentive programs. As a result, data was not yet available on uptake. Soil testing is not a practice that NVCA funds. Stewardship staff reported observing that approximately 20% of the fields in the watershed are growing cover crops overwinter.

Lake Simcoe Region Conservation Authority

The Lake Simcoe Region Conservation Authority (LSRCA) has included cover crops within local programs since 2013. Across the watershed 6,280 acres have been supported during this time, spanning 58 projects, with one of the key areas of interest being the Holland Marsh. A steady increase in participation was identified, however it was also noted that several farmers are using cover crops without applying to programming, suggesting that figures are not inclusive of all cover crops in the watershed. LSRCA recently added soil testing as an eligible BMP, but the program has had very limited uptake in this category to date. Stewardship staff plan to study the hesitation this year and focus on communications efforts to ensure producers are aware of the opportunity and that additional barriers are removed wherever possible. An estimate of percentage of cover from stewardship staff observation was not available.

Kawartha Conservation

Kawartha Conservation does not offer financial support for cover crops or soil testing, but the CA does have an open category within programming where producers can request funding for a stewardship action, suggesting that these BMPs may be considered eligible. Numbers of projects funded or general observations from stewardship staff were not available for this report.

Information Provided	NVCA	LSRCA	KC
Cover crop projects supported # of projects(acres)	Recently began funding	58(6,280 acres)	Does not fund
Soil test projects supported	Does not fund	Recently began funding	Does not fund

# of projects(acres)			
Estimated watershed-wide use of cover crops	20%	Unavailable	Unavailable
Estimated watershed-wide soil testing rates	Unavailable	Unavailable	Unavailable

Table 2 Central focal region cover crop and soil testing activity summary.

Eastern Ontario

South Nation Conservation Authority

The South Nation Conservation Authority supports both cover crops and soil testing, but figures were not available for this report.

Rideau Valley Conservation Authority

Rideau Valley Conservation Authority supports cover crops and nutrient management planning through the Rural Water Quality Program, but numbers of projects funded or general observations from stewardship staff were not available for this report.

Raisin Region Conservation Authority

Observations and program figures were not available from the Raisin Region Conservation Authority.

Information Provided	SNCA	RVCA	RRCA
Cover crop projects supported # of projects(acres)	Funds – numbers not available	Funds – numbers not available	Does not fund
Soil test projects supported # of projects(acres)	Funds – numbers not available	Funds – numbers not available	Does not fund
Estimated watershed-wide use of cover crops	Unavailable	Unavailable	Unavailable
Estimated watershed-wide soil testing rates	Unavailable	Unavailable	Unavailable

Table 3 Eastern focal region cover crop and soil testing activity summary.

Other

Grand River Conservation Authority

The GRCA has been a long-standing supporter of agricultural BMPs and in particular cover crops. The practice has been included in local Rural Water Quality Programs (RWQP) since 2014. 366 cover crop projects have been funded, representing 10,500 acres. Participants were also asked to identify additional acres planted that were not eligible for the program. In total 21,050 acres of cover crop were planted by participants on the 101,000 acres they farmed, suggesting that approximately 20% of fields farmed by program participants are actively engaged in growing cover crops. A further survey of participants demonstrated that nearly all planned to continue using cover crops in future years, even though they were no longer eligible for incentive opportunities.

Soil testing is eligible as a practice within a broader Nutrient Management Planning category through the RWQP. Numbers on uptake were not available, but are assumed by staff to be somewhat limited. However, in 2016 participants of the RWQP were surveyed and of the 178 responses received 69% of participants reported sampling every 1-5 years, 22% indicated five years or more, and 9% said never. Producers responding to the survey are already implementing stewardship practices broadly, so the assumption can be made that these responses represent the early adopters and innovators who are stewardship minded, and is not representative of the producers in the entire watershed. When asked how soil test results were used, responses were as follows: Soil test results were typically used to calculate fertilizer and manure application rates (82%), and a small group of respondents used them to decide what crops to plant (10%), while interesting 2% said they do not use the results.

Upper Thames River Conservation Authority

Comments on program participation and general staff observations were not made available from the Upper Thames River Conservation Authority.

Survey Results

Certified Crop advisors

Of the 53 responses received, 11 CCAs were independent, 27 were not-independent and 15 were unstated. In terms of the number of years respondents have been a CCA, 20.8% have been CCAs for 5 years or less, 28.3% for 6-14 years, and 50.9% for 15 or more years. We excluded from further results, any CCAs that worked with 5 clients or less and/or less than 100 acres, in order to investigate what we consider to be full-time working CCAs. Applying these constraints to our survey results reduced the survey sample size to 50.

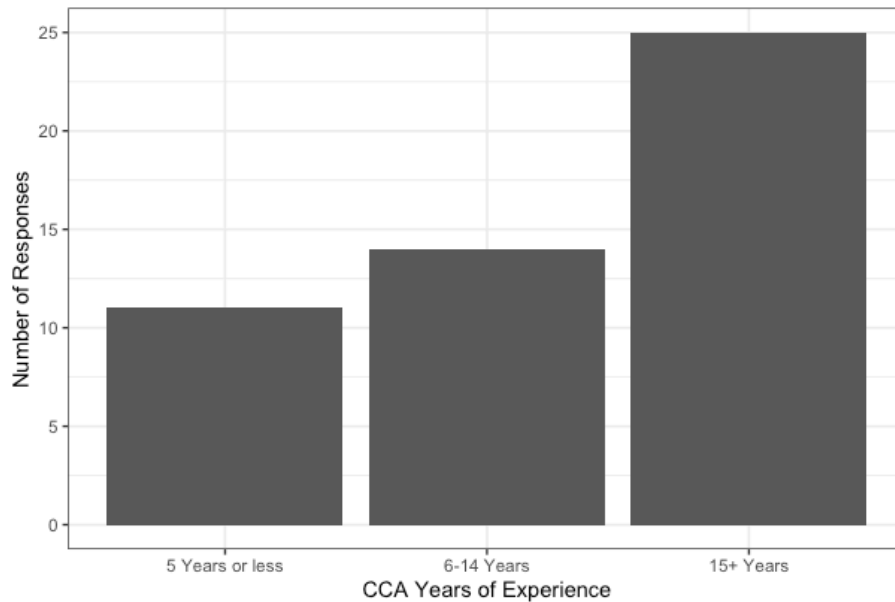


Figure 7 Years of experience of surveyed CCAs

When asked about the number of clients respondents work with, 10% have 5 or less clients, 4% have 6-10 clients, 4% have 11-15 clients, 8% have 16-25 clients, 8% have 26-35 clients, and 66% have 36 or more clients (Figure 8).

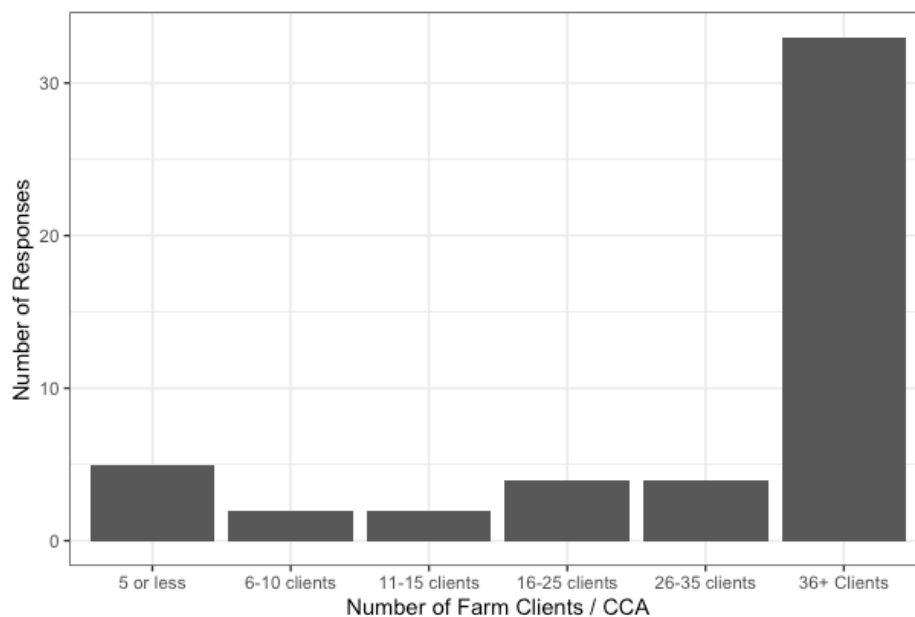


Figure 8 Number of farm clients for CCAs that responded to the survey

We asked CCAs what counties they were active in. Responses represent the large majority of counties in southern Ontario, with Huron, Bruce and Middlesex being the counties CCAs responding to the survey worked in most often.

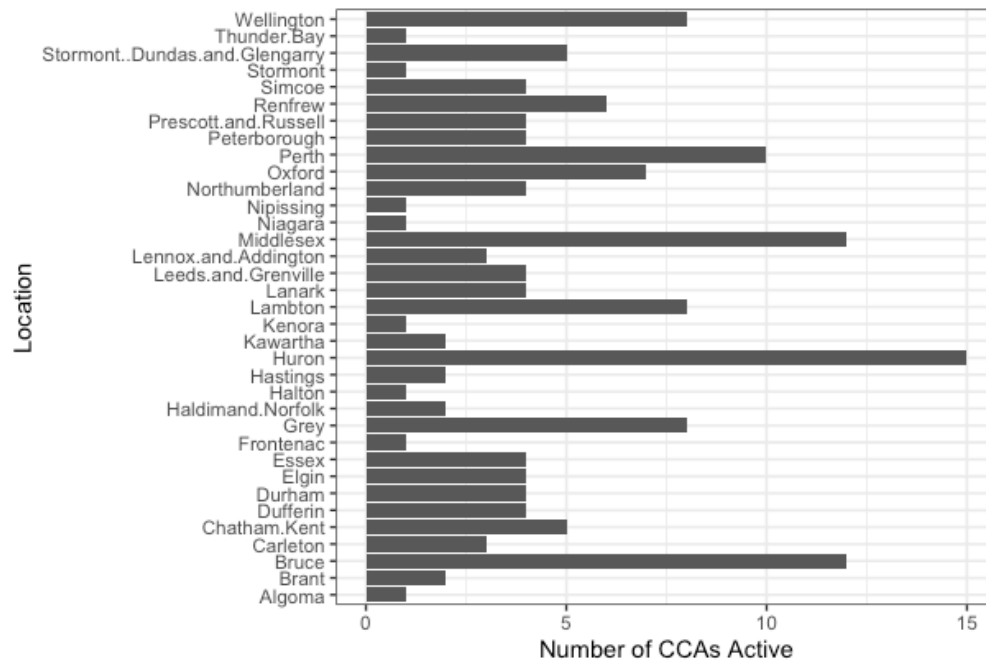


Figure 9 Reported counties responding CCAs were actively practicing in.

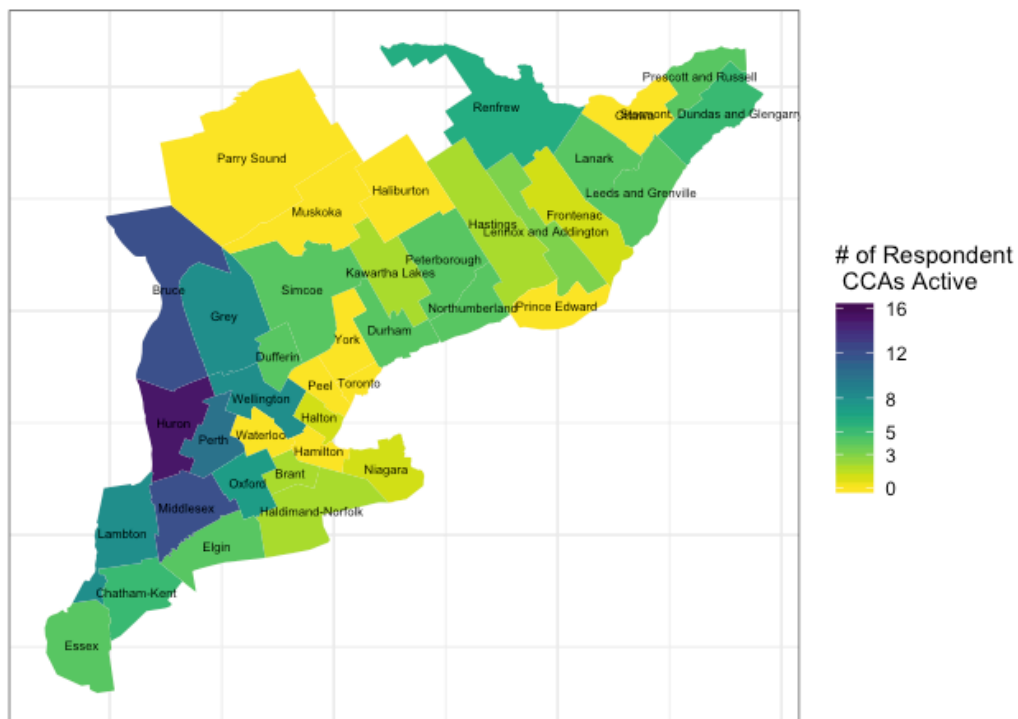


Figure 10 Map of counties where respondent CCAs were active

Cover Crops

When we asked CCAs about estimating the total acreage using cover crops among their clients, the responses varied. A total of 28% did not respond or indicated the question was too difficult to identify. The average estimated total acreage was 5314.31 (red line on Figure 11), with a range of estimates from 10 to 40,000 acres.

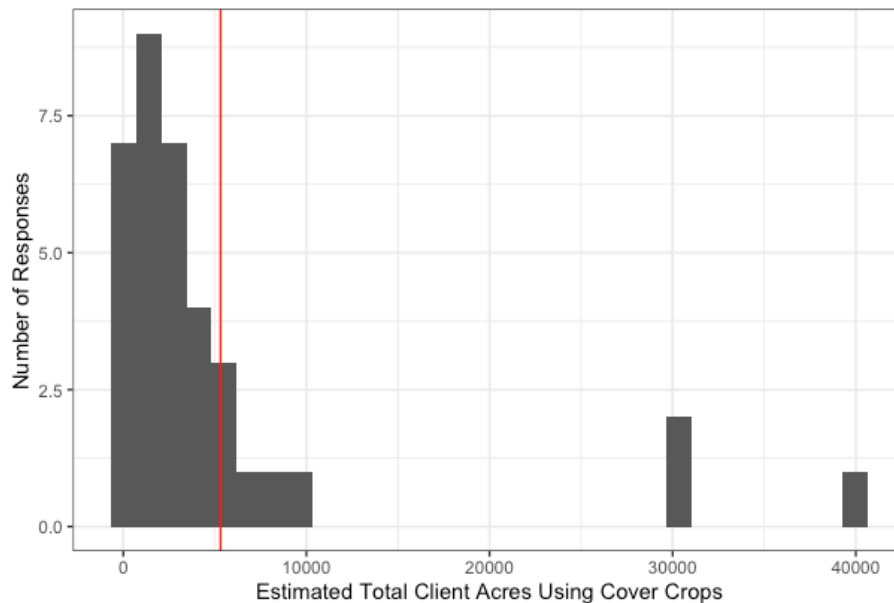


Figure 11 Estimated total acreages for client farms using cover crops

We graphed the estimated acres spatially based on focal regions. Central Ontario has significantly more acres identified than the other two regions. When standardized for number of responses, central Ontario continues to represent a larger number of acres based on responses.

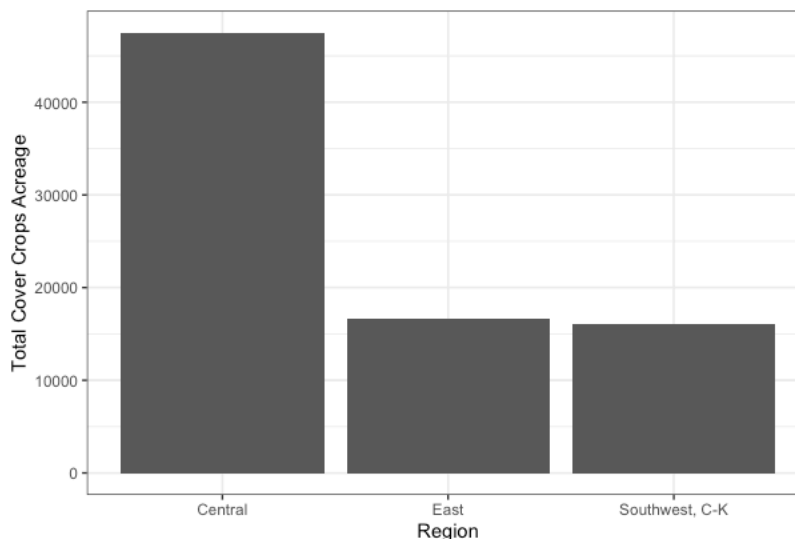


Figure 12 Estimated acreage of clients that use cover crops by focal region including the southwestern Lake Erie region

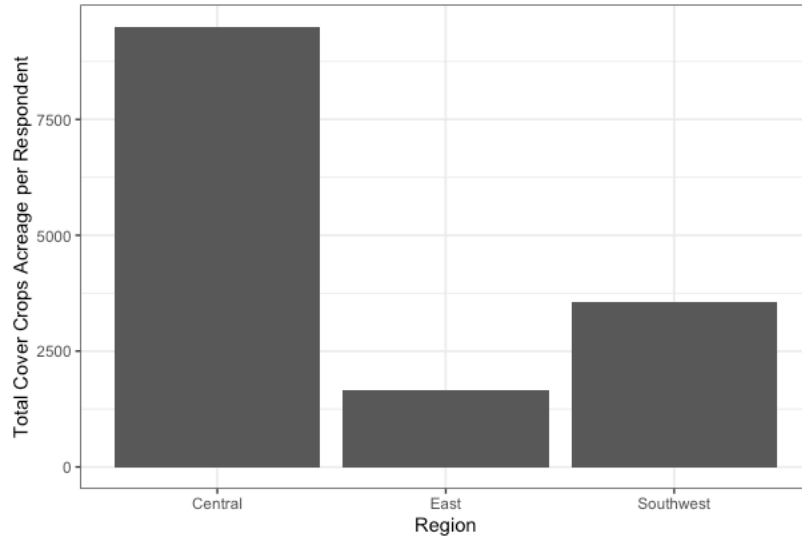


Figure 13 Cover crop acres per region standardized based on number of responses

In terms of the percentage of CCA clients that used cover crops, the responses ranged from 5% to 100% with an average of 41.41% (red line on Figure 14).

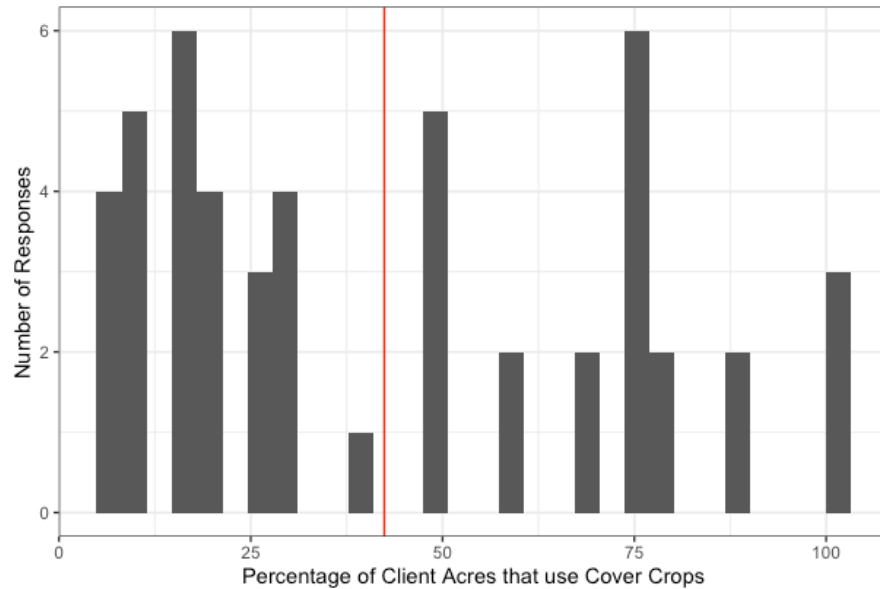


Figure 14 Estimated percentage of clients that use cover crops

Percentage of clients using cover crops was also analyzed spatially, using responses from CCAs who work in only one of the key focal regions. In figure 15 Southwest includes all respondents working in that area, whereas in Figure 16 Southwest is focused on the southwest Lake Erie

basin. The percentage of CCA clients using cover crops is significantly higher in southwest, and the southwest Lake Erie region when compared against central and eastern Ontario.

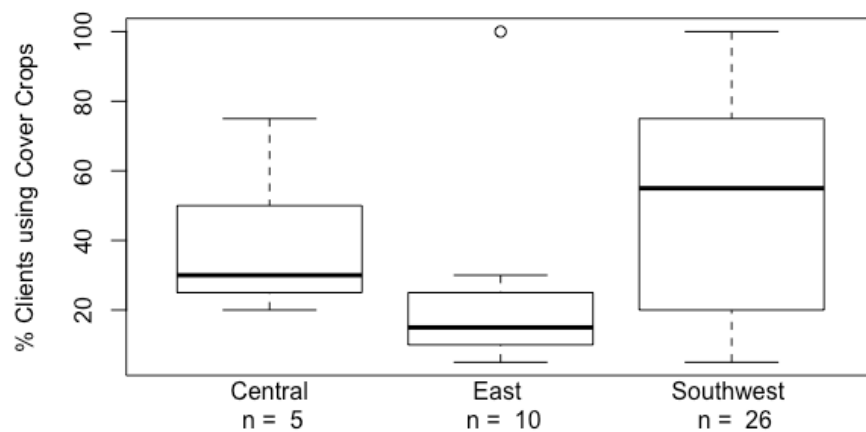


Figure 15 Estimated percentage of clients that use cover crops by focal region, including all CCA responses that identified working in Southwestern Ontario

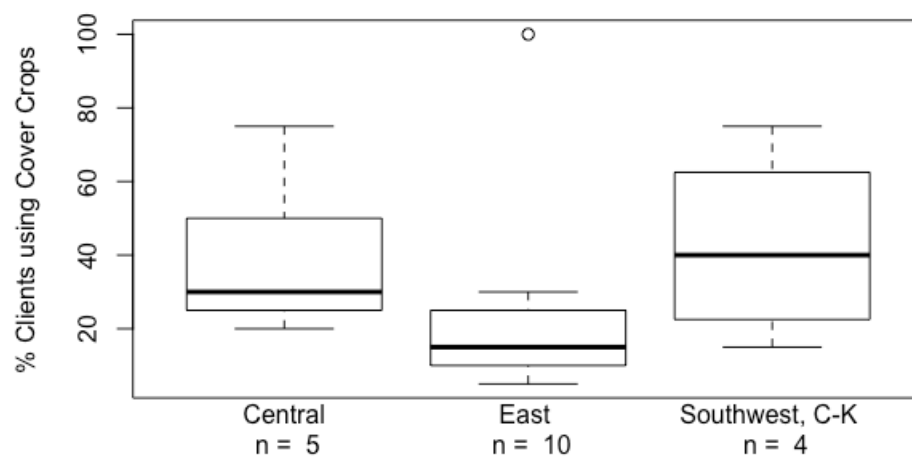


Figure 16 Estimated percentage of clients that use cover crops by focal region only including the southwestern Lake Erie basin

We also compared the estimated total acres and percentage of clients using cover crops for independent and non-independent CCAs. In general, acres were not different, but the

percentage of clients was statistically different, with independent CCAs having a higher percentage of clients using cover crops.

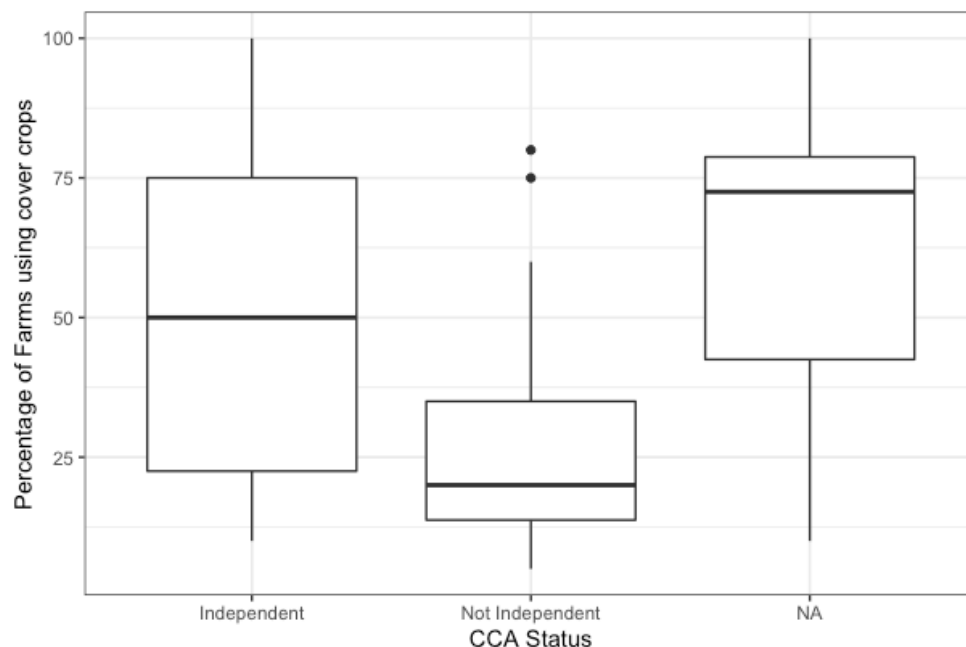


Figure 17 Percentage of clients using cover crops by CCA status

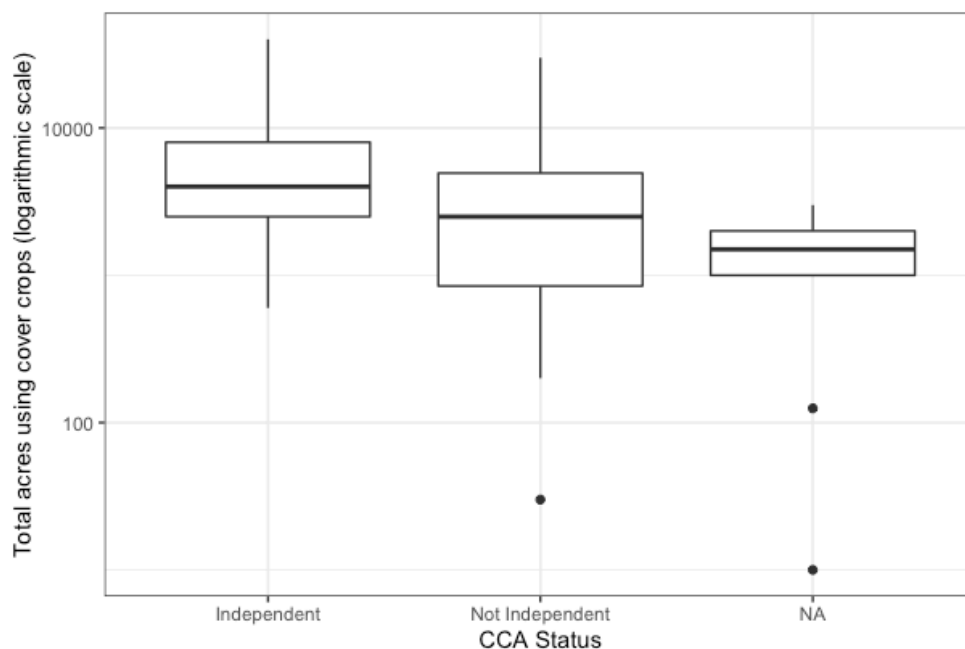


Figure 18 Total acreage of client farms using cover crops by CCA status

We asked CCAs whether a discussion about cover crops is a regular component of their annual review with all clients. Most independent CCAs responding to the survey agreed that cover crops were discussed annually. Non-independent CCAs did not agree as strongly, with many

indicating they neither agreed nor disagreed. A small portion of CCAs who were not identified indicated that cover crops were not a component of their annual review with clients.

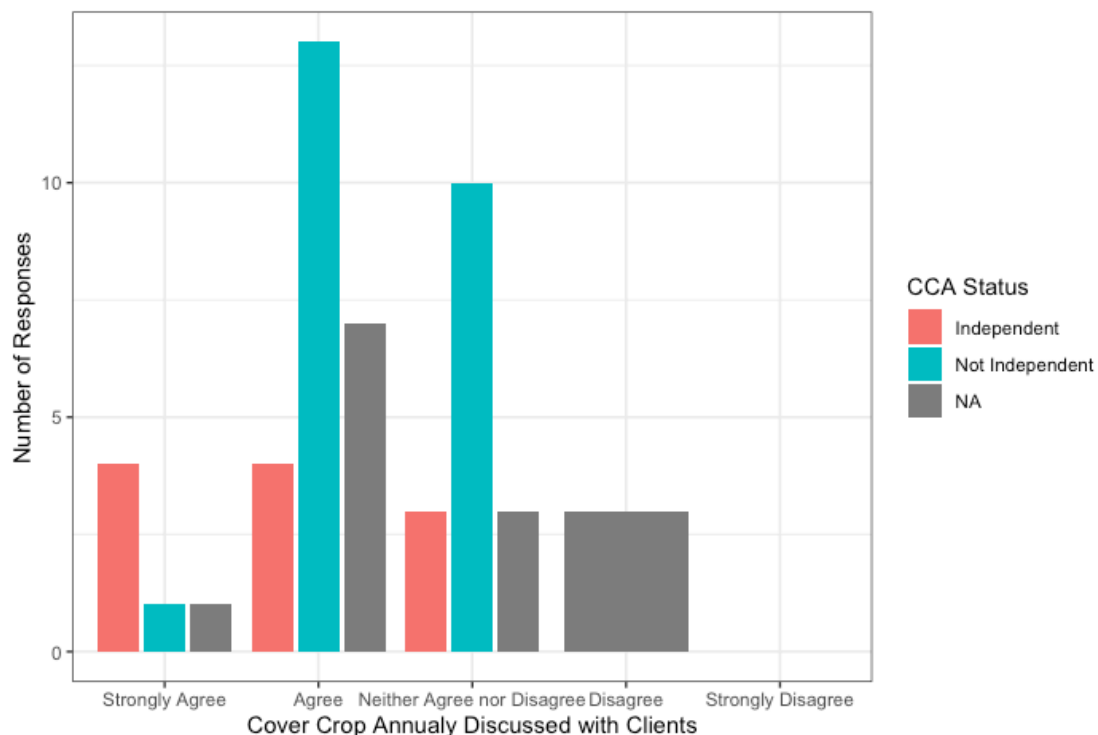


Figure 19 Discussion about cover crops with clients

"My clients expect cover crops are part of the crop plan. Still a few hold outs but most have accepted this practice as "normal""

"Depends on the grower, some want advice/planning help, others do their own and we don't talk about it."

We asked CCAs how likely clients who planted cover crops last year were to repeat the practice again this year. Responses indicate a strong correlation with farmers who are planting cover crops continuing to adopt the practice. Responses are particularly certain from the non-independent CCAs.

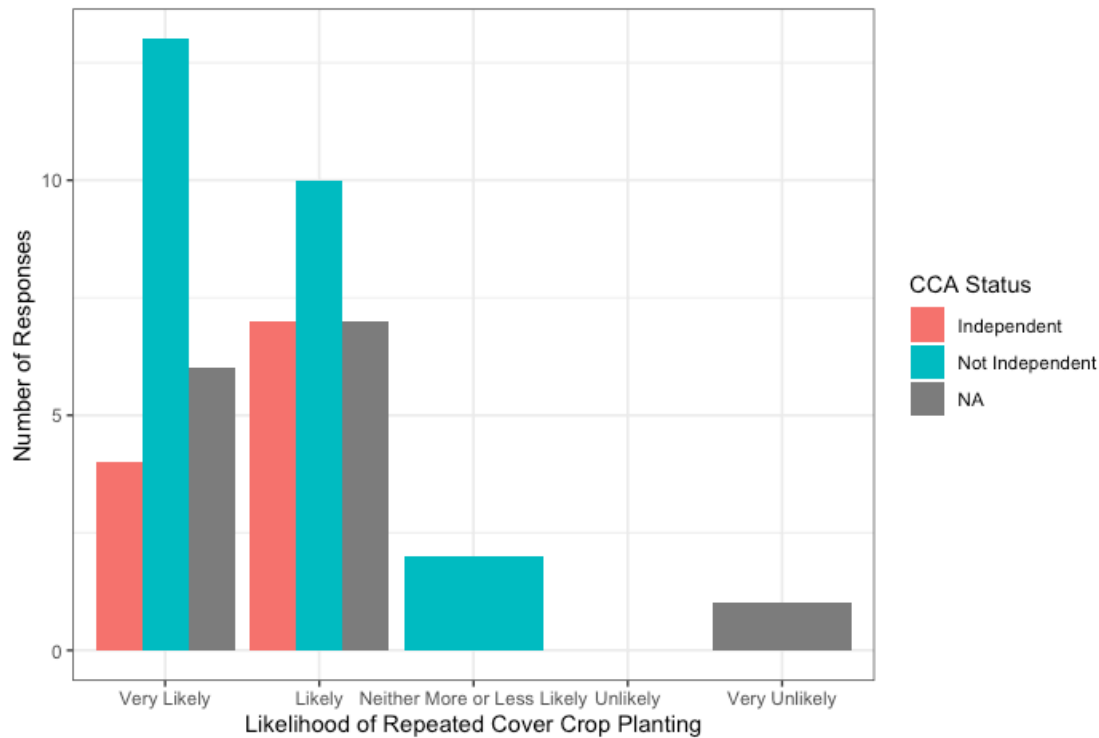


Figure 20 CCA reported likelihood of clients repeating use of cover crops

“Needs to have a fit in their system”

We asked CCAs how many times clients must use cover crops before they successfully adopt the practice long term. Responses indicate that three years is likely an ideal period of time to test the practice and commit to ongoing adoption. However, several comments provided by CCAs indicated that the number of years is irrelevant, and individual experience is a more accurate predictor of commitment to ongoing adoption, citing weather patterns, economic returns, challenges with establishment, late spring etc. as factors related to ongoing decision making.

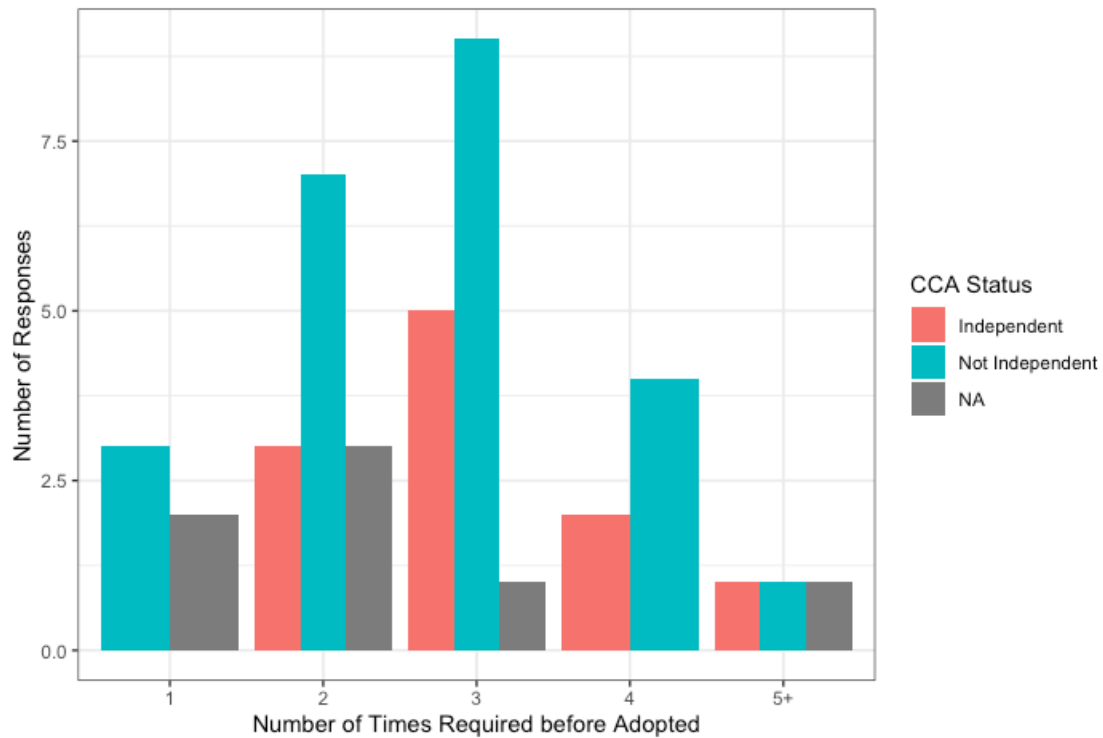


Figure 21 Reported number of times before practice is considered adopted

"They understand that this is a long term process to realize a return on investment and they are still evaluating BMPs for their own farm."

We asked whether CCAs perceived a trend in the use of cover cropping, where 0 = increasing, and 100 = decreasing. The mean trend estimate was 26.75 (red line on Figure 22). Overall, over 88.68% of respondents indicated that cover crops adoption is increasing.

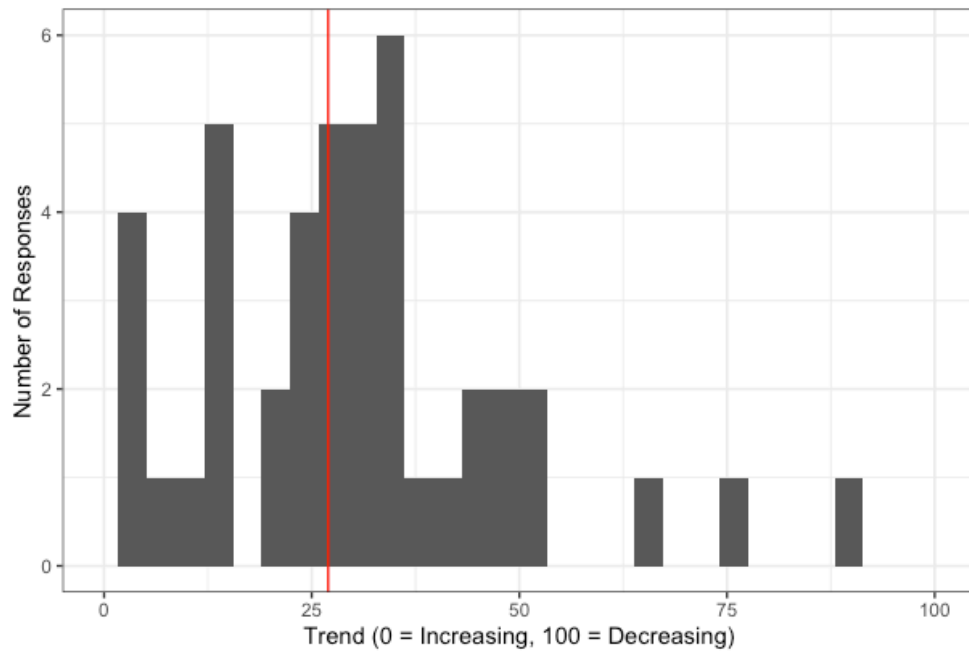


Figure 22 Reported trend in the use of cover crops, rated from 0 [Increasing] to 100 [decreasing]

Soil Testing

When asked to estimate the total acreage of customers who regularly soil test, the average was 22,764.52 acres (red line on Figure 23). Several CCAs were resistant to this question, however, it was skipped by the large majority, suggesting it was too challenging to estimate.

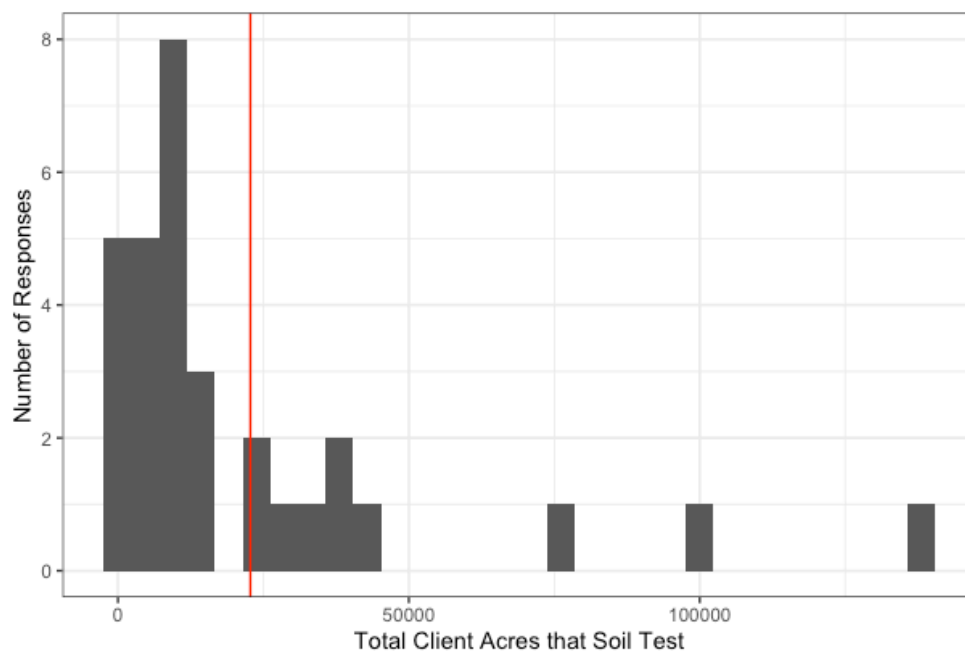


Figure 23 Estimated total acreage of client farms that regularly soil test

We asked whether CCAs perceived a trend in the adoption of regular soil testing, where 0 = increasing, and 100 = decreasing. The mean trend estimate was 32.2 (red line Figure 24). Overall, over 68% of respondents indicated that soil testing is increasing somewhat.

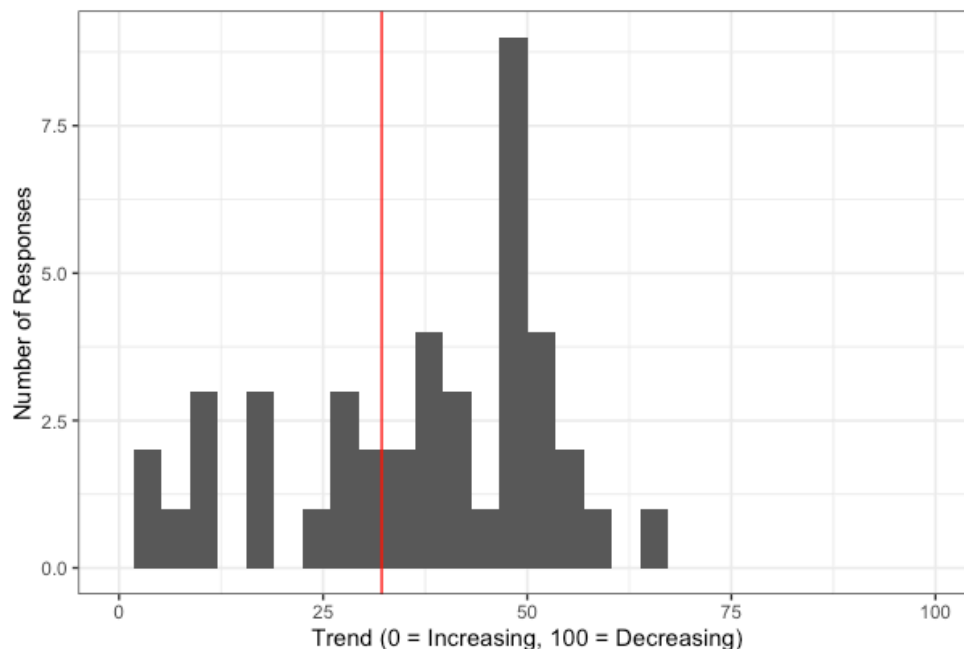


Figure 24 Reported trend in the use of soil testing, rated from 0 [Increasing] to 100 [decreasing]

Soil Labs

Four labs responded to our requests for interview. We ultimately determined that the University of Guelph Laboratory Services was not a good fit for this research based on their client base. Out of the three remaining labs, characteristics, applicable geography and clientele ranged dramatically. A & L Canada Laboratories Inc. conduct approximately 80% (self-declared) of the soil tests for farm businesses and because of this, the responses staff provided offer a broad provincial picture of practice uptake. Staff from Stratford Agri-Analysis commented that their customers are generally located wherever sales staff exist, but are concentrated mostly in southwestern and central Ontario. Honeyland Ag Services is focused in southwestern Ontario, particularly Huron and Middlesex. Key comments from discussions are as follows.

Questions	A & L Canada	Stratford Agri-Analysis	Honeyland Ag Services
What test do customers order most often?	Basic	Basic	Complete
What test should customers order more often?	Complete		Soil Texture
What is the percentage of your customers that soil test regularly? (at least once every three years)	100% (or close to)	75%	20%
How many acres do your clients farm?	Unsure, represent 80% of farmers who soil test, but commented that less than 20% of farmers are soil testing regularly	Approximately 400,000 acres	Unsure
What scale of sampling is most common for farm businesses?	Almost all zone sampled (direct them away from bulk sampling)	90% grid sampled	35% bulk sample, 40% grid sample, 25% zone
Is soil sampling increasing in Ontario?	Yes, but slowly	Not increasing, seen as standard procedure now	Yes, the younger generation is driving this increase with a demand for added information

Responses are split for almost every question, and the sample size is small so it is difficult to establish trends. However, the most common test ordered for two of the labs (including the largest in the province) is the basic test. This was noted by the labs as being an area where education or cost support may help to push producers to order complete soil tests, not just the lowest cost and most basic version. Two of the labs (including the largest in the province) indicate that when producers soil test with them, they commit to the practice and continue to test regularly at a very high rate. Two of the labs commented that customers are strongly encouraged to zone or grid sample. Two of the three labs also indicated that soil testing was increasing, but not at a quick pace. The third lab did not feel that soil testing was increasing.

One additional question that resulted in a wide range of answers is as follows: In your opinion, do clients have a clear understanding of the results of soil tests? All of the labs agreed that at times it is challenging for farmers to interpret results. The representative from Stratford felt that generally speaking producers now understand results, but that the clients who do not understand results are the most vulnerable to discontinuing regular sampling. The representative from Honeyland mentioned that most clients rely on their ag retail representative to interpret results and make recommendations, so this lab placed less focus on the producer understanding results. The representative from A & L spoke to the extensive work they do as a company to ensure producers understand soil test results. He felt that through education producer comfort was increasing. A & L Labs offers free day-long seminars for producers to understand results. It was noted that test results are simply numbers, and numbers are difficult for some to interpret. Producers may not know who to trust and if ag retailers or conservation extension staff have their best interest in mind. A & L labs has developed an application that depicts soil testing results visually across a field as either positive or negative through simple colours, “taking the conversation back to the basic good/bad,” Greg Patterson, Founder and CEO, A & L Labs, putting knowledge in the producer’s hands to speak with extension agronomic support staff about how to address challenging areas.

Seed Dealers

Comments were secured from four seed dealers across the province who represent businesses that sell cover crop seed. They range dramatically in scale and the geography in which their customers are located. The table below outlines key findings based on input provided.

Questions Asked	DFL Pickseed Canada	Hensall District Co-op	General Seed Company	Quality Seeds Ltd.
What percentage of clients use cover crops annually?	35%	50 to 60%	30-40%	5%
Of those using cover crops, what percentage of fields are cover cropped annually?	20 to 30%	25% - just with wheat	Too difficult to say because of variability	Unanswered
How many acres would you estimate your clients cover?	Based on our portfolio of products, we estimate we have at least one product on 30% of farms	Unsure	Unsure	Unsure
Based on trends you have seen, cover crop use in Ontario is:	Strongly increasing	Strongly increasing	Neither increasing nor decreasing	Strongly increasing
Are customers that planted cover crops the year prior likely to order again?	Yes	Yes	Yes	Yes
When customers place their	Yes	Yes	Yes	Yes

annual orders without including cover crops do you encourage them to try the practice?				
Do you offer soil testing for clients as part of a package? If so, what is the uptake from clients?	Under certain situations, yes but not broadly. Soil tests are geared more toward companies that sell fertilizer. We strictly sell seed.	soil testing paid for - limited uptake - trying to promote more heavily		

None of the individuals we spoke with were comfortable estimating the total acreage for their clients, when asked to identify the percentage of clients that use cover crops regularly responses ranged from 5 to 60%, suggesting that the clientele of these businesses may range dramatically, or that perhaps the primary geography they work in is varied has supports different rates of cover crop use. One individual we spoke with stated that some customers are very committed to cover crops and use them wherever possible, while several others are not open to trying the practice at all. This individual had a difficult time estimating an average use for the BMP. However, the average from responses as a whole suggest that companies selling cover crop seed directly to farm business are seeing an average of 33% of their clients purchase cover crop seeds annually. In addition, staff estimated that of the farm businesses planting cover crops, fields were likely covered 25% of the time on average, with the practice primarily being used in association with winter wheat. In terms of variety, oats were mentioned as a key popular cover crop species by 75% businesses, clover identified by 50% of the respondents and oil seed radish by 100%. Comments suggested that clients were generally moving away from complex mixes with costly seed included, and taking a more streamlined approach. Three out of four of the businesses felt cover crop use was increasing in Ontario. All respondents indicated that customers who ordered cover crops previously would do so again, and that if clients did not order cover crops the sales staff would encourage them to do so.

Conclusion

The analysis has revealed a complex picture when it comes to the adoption of soil testing and cover crops in Ontario. Firstly, there was much less information available about soil testing as compared to cover crops. Interviews with Soil Labs were instrumental in gaining an understanding of who is soil testing and at what frequency. Despite relatively widespread awareness nationally, results suggest that few producers in the province are soil testing regularly. That said, those who are soil testing appear to be very committed to the practice. CCAs felt that the trend in soil testing was increasing, but not as much as that of cover crops. CA staff also suggested limited uptake of soil testing as a practice within local stewardship programs. Clearly the knowledge required to understand and act on soil test results remains a barrier and impediment to expanding the practice. Over 85% of CCAs reported an increasing trend in the use of cover crops. While difficult quantities to estimate, this indicates that at least as perceived by CCAs, clients are more regularly considering adopting cover crops than soil testing.

Geographically, adoption of cover crops appeared higher in the Southwest focal region, followed by Central and then East focal regions. These results were backed up by the broader regional trends in farmland crop acreage, which tend to be larger in southwest vs northeast parts of the study area, as well as the findings in the literature linking environmental BMP adoption with farm size. Since no all-encompassing dataset exists documenting overall trends and acreages adopting these practices, it is necessary to piece together several sources of information to understand what is happening on the ground. Our analysis brought together several quantitative and qualitative techniques to identify key trends at the watershed and regional scales. Additional research with a larger sample size of farm businesses would be of value to enhance this preliminary analysis.

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Appendix 1 – Counties reporting cover crops in 2016 Agricultural Census in Focal Regions

Name	Number of Farms using Cover Crops	Total Number of Farms	Percentage of Farms using Cover Crops
Ottawa	92	1045	8.80
North Dundas	31	331	9.37
North Glengarry	13	275	4.73
The Nation	18	270	6.67
South Glengarry	20	268	7.46
South Frontenac	13	227	5.73
North Stormont	21	224	9.38
South Dundas	21	201	10.45
Elizabethtown-Kitley	12	189	6.35
Rideau Lakes	18	177	10.17
South Stormont	8	165	4.85
Drummond/North Elmsley	13	155	8.39
Alfred and Plantagenet	8	151	5.30
North Grenville	5	144	3.47
Champlain	14	132	10.61
Clarence-Rockland	7	130	5.38
Russell	6	116	5.17
Edwardsburgh/Cardinal	7	112	6.25
Tay Valley	8	108	7.41
East Hawkesbury	18	108	16.67
Augusta	4	90	4.44
Montague	3	81	3.70
Central Frontenac	6	81	7.41
Beckwith	4	64	6.25
Merrickville-Wolford	8	63	12.70
Athens	2	39	5.13

Table 1 Reporting Farms using Cover Crops, 2016, East focal region

Name	Number of Farms using Cover Crops	Total Number of Farms	Percentage of Farms using Cover Crops
Kawartha Lakes	211	1265	16.68
Grey Highlands	72	474	15.19
Clarington	60	357	16.81
Caledon	78	345	22.61
Scugog	53	303	17.49
Oro-Medonte	42	273	15.38
Uxbridge	48	271	17.71
Clearview	75	263	28.52
Springwater	73	253	28.85
King	37	242	15.29
Brock	56	239	23.43
Selwyn	32	189	16.93
Adjala-Tosorontio	37	166	22.29
Cavan Monaghan	38	164	23.17
Innisfil	49	157	31.21
New Tecumseth	54	156	34.62
Amaranth	22	149	14.77
Severn	11	149	7.38
Ramara	14	140	10.00
Essa	33	128	25.78
Melancthon	26	124	20.97
Mulmur	27	122	22.13
East Gwillimbury	19	121	15.70
Mono	18	119	15.13
The Blue Mountains	18	119	15.13
Bradford West Gwillimbury	31	117	26.50
Whitchurch-Stouffville	18	116	15.52
Tiny	13	105	12.38
Georgina	16	103	15.53
Tay	7	67	10.45
Oshawa	8	43	18.60
Trent Lakes	1	43	2.33
Newmarket	4	21	19.05

Table 2 Reporting Farms using Cover Crops, 2016, Central focal region

Name	Number of Farms using Cover Crops	Total Number of Farms	Percentage of Farms using Cover Crops
Chatham-Kent	877	2211	39.67
Middlesex Centre	178	500	35.60
Lakeshore	178	479	37.16
St. Clair	198	462	42.86
Kingsville	87	335	25.97
Southwest Middlesex	69	303	22.77
Leamington	81	302	26.82
Plympton-Wyoming	120	283	42.40
Enniskillen	117	274	42.70
Dawn-Euphemia	91	261	34.87
Warwick	91	241	37.76
Brooke-Alvinston	92	240	38.33
Adelaide-Metcalf	97	236	41.10
Strathroy-Caradoc	55	235	23.40
Essex	81	235	34.47
Lambton Shores	91	229	39.74
West Elgin	52	223	23.32
Central Elgin	78	201	38.81
Southwold	66	199	33.17
Dutton/Dunwich	41	176	23.30
Amherstburg	55	148	37.16
London	36	136	26.47
Sarnia	37	101	36.63
Tecumseh	21	71	29.58
LaSalle	8	38	21.05
Windsor	8	22	36.36

Table 3 Reporting Farms using Cover Crops, 2016, Southwest focal region