10. Field Scouting

Field Scouting

Field scouting is an important part of cropping system and farm management. Ongoing monitoring of fields and crops throughout the growing season and beyond, allows a producer to identify issues and apply remediation in a timely manner to minimize negative economic impact, while improving field operation efficiencies. Some problems cannot be addressed when observed, but the information can still be recorded for future use.

Traditionally, field scouting has been considered a part of integrated pest management (IPM) and thus solely associated with monitoring and managing pests. Field scouting also has many other benefits, including:

- pre-planting field walks to identify drainage issues
- post-planting field walks to look at equipment performance (e.g., planters delivering desired population, depth, placement across the entire unit)
- nutrient management (identifying specific areas with nutrient deficiency symptoms)
- crop variety selection (evaluating in-field comparisons of variety performance)
- observing field conditions (e.g., erosion, drainage) outside the cropping window when performing tasks such as soil sampling

Field scouting involves recording information attained from all field observations. This is important so that necessary action can be taken, immediately or incorporated into future planning. Scouting records are an important part of an overall farm record-keeping system.

Traditional Field Scouting

Field scouting involves walking through a field, and stopping at a number of either random or specific locations to make and record observations. Regular field examinations help to accurately identify yield-limiting problems during the growing season, at a time when they can often be corrected to preserve maximum economic yield potential. When scouting events occur beyond the point at which corrective action can be taken, records of the observations help plan for the next season to avoid the same problem(s). Begin every cropping season by reviewing previous scouting records and recording current year vital field information (soil fertility and crop inputs) on a field record form (either paper or electronic). Refer to Appendix N for a paper version of a field record form. This information, combined with regular field visits, accurate identification and diagnosis of problems, and a record of those observations, builds a successful crop monitoring program. In addition to dealing with immediate issues, scouting records are essential for planning purposes. For example, a pest such as soybean cyst nematode (SCN) will impact both crop rotation and variety selection in future years.

> A standardized farm and field naming and numbering system is the first step in organizing farm information to obtain the most from scouting records.

Timing of Field Scouting Operations

Early recognition and action on identified problems will minimize their economic impact on a crop. Under each commodity Chapter within this publication, crop scouting calendars illustrate the timing associated with the common crop pests found in Ontario. Monitor fields regularly, since conditions can change rapidly throughout the season. As optimum plant populations are critical for achieving maximum economic yields, perform crop stand evaluations within 1–2 weeks of plant emergence, and continue on a weekly basis. When approaching a control threshold, such as the application of a post-emergent herbicide or an insecticide, fields may require daily scouting to correctly time the intervention. Later in the season, bi-weekly scouting is normally sufficient. Some insects and diseases occur later in the season and may approach control thresholds in a matter of days. Examples of such pests include armyworm and soybean aphids. If field and weather conditions favour these later-season pests, scout weekly. Pre-harvest notes are often useful to estimate yield and to start the planning process for the next cropping year. Where weed escapes have obviously survived herbicide treatment, and where application and product issues have been ruled out, collect weed seed samples for herbicide-resistance testing before harvest. Samples can be submitted to the Weeds Lab, Crop Science Building, University of Guelph, 50 Stone Rd. E., Guelph, ON N1G 2W1.

Scouting Tools and Techniques

Tools used to monitor crop development and pests vary with the crop and the pest. Basic field scouting equipment includes:

- a clipboard with field scouting forms or field pocket guide to record observations (paper or electronic format)
- field maps
- a shovel
- a pocketknife
- plastic and paper bags for collecting specimens
- a 10X hand lens and a sampling frame (e.g., hula hoop)
- a ruler

Professional scouts often carry other tools that could include:

- aerial field images
- a camera (smart phone)
- labels for identification
- reference guides
- a sweep net
- drop cloth
- vials and isopropyl alcohol
- sticky cards or traps to detect insect pests
- a global positioning systems (GPS) unit and/or flagging material to mark specific locations, etc.

When scouting, proper clothing is important for protection from the sun and from other unknown risks such as poisonous plants, ticks and mosquitoes. Be aware of recent pesticide treatments applied to the field and comply with re-entry intervals indicated on product labels.

New Tools for Field Scouting

New tools are available to increase the value of scouting and to assist in record keeping. With the adoption of smartphones and tablets, a large number of apps are available to assist with scouting. Chosen apps should address all the information parameters of interest and integrate with other software/hardware systems on the farm. An app that isolates data on a phone or tablet offers little value. Many of the crop and whole farm management systems have developed field apps that integrate with their main programs. Many of these also take advantage of GPS capabilities, to better identify the location where problems/issues are discovered.

Another advantage of electronic devices is that, as part of the platform, they have the capability of quick access to resource materials such as field guides, measurement tools etc. This eliminates the inconvenience of carrying paper copies of field guides. Some of these tools also offer the opportunity to share observations with others. For example, insect observations can be shared so others can benefit from the mapping of occurrences, densities and spread pattern of infestations across the province. These collaborations can act as early warning systems and help target scouting activities throughout the season.

A new Ontario specific smartphone app has been developed to assist in field scouting of common pests. Pest Manager is available at the following website for all common platforms. (www.pestmanager.ca)

The function of the scouting software and/or application is to do more site-specific record keeping, as well as quantifying the extent of the issues identified in the field. In some cases, scouting software or applications may help diagnose an issue and allow someone to take management actions remotely from the field. Most electronic devices have GPS locational services that can provide the capacity to navigate back to trouble spots in the field (e.g., geotag photos).

The following is a short list of the basic functions that are found in typical field scouting software or mobile mapping apps:

- base maps and satellite imagery provided in the software or on the application for finding field locations (e.g., roads, waterways)
- map and/or mark a point, line or polygon to identify the trouble area
- calculate distance (i.e., length or width) or calculate the area affected (e.g., by weed or pest)
- geotagging photographs of trouble areas
- connect to lists and databases for crop diagnostics (e.g., weeds, disease, nutrient deficiency symptoms and photo libraries)

- order other agronomic services to diagnose or remedy the scouted issue (i.e., order soil sampling to a specific locations, place a work order for other custom application services)
- import and view (online or offline) other data, in-field device information (e.g., plant sensors) and maps (e.g., yield, previous scouting events and reports)
- semi- or fully-automated export and upload of all crop scouting data and records from the field via an internet connection (or as soon as the scout returns back to the office)
- several administrative levels for the same application, where certain tools or editing options can be turned on or off, offering large organizations the flexibility to customize services for different users (i.e., crop scout vs. manager)

Scouting for Insects

When scouting for insects that move too quickly in the canopy to be spotted or counted, or insects which are difficult to detect, it may be beneficial to use a drop cloth, insect traps or a sweep net to collect and count them.

Using a Drop Cloth

Spread a white drop cloth on the ground between two rows of crop. Pull the crop over the cloth and shake vigorously so that any insects on the plant are dislodged and dropped onto the cloth. The insects can then be identified and counted.

Using an Insect Trap

Insect traps can be useful for specific pests, such as swede midge and western bean cutworm. Many types of traps are available, often specific to the pest of interest. Insect pheromone traps are useful to monitor these pests over time. The use of pheromone traps allows for the collection, identification and counting of insects, in addition to comparing the population to known thresholds at specific crop development stages. Trapping networks provide useful information to help determine the particular pest populations in an area. Western bean cutworm in corn is an example of regional pests monitored by trapping networks.

Insect traps are available from a number of sources. Refer to Appendix A, *Insect-Monitoring Equipment Supply Companies*. For some pests, insect infestation thresholds that trigger application of control measures are calibrated to observations from the traps.

Using Sweep Nets

A sweep net is the preferred scouting method when evaluating insects in a solid stand crop such as cereals, alfalfa, canola or solid seeded soybeans. Standard 37 cm (15 in.) diameter sweep nets are available commercially through the various companies listed in Appendix A. While walking through the canopy, swing the net from side to side in a pendulum-like motion, across the top of the canopy so the top of the net is sweeping the top 37 cm (15 in.) of the canopy. Avoid collecting soil in the net during the sweeping procedure.

Pest management thresholds are established using one of two methods:

1. **Single sweep — two 180° arcs:** Some researchers set thresholds based on the definition that one sweep consists of two 180° arcs, bringing the net across from one side of the body to the other, and back to home, while walking slowly forward

2. **Single sweep — one 180° arc:** Other researchers set thresholds based on the definition that one sweep consists of only one 180° arc bringing the sweep net from one side of the body to the other only once

In order to avoid over- or underestimating the average number of insects per sweep, first determine which definition of a sweep was used to establish the specific threshold. In this publication, the definition of a sweep (i.e., either one 180° arc or two 180° arcs) is listed for each insect pest threshold, if it is known.

After completing the indicated number of sweeps, quickly close the top of the net by grasping it just below the ring. Slowly open the net, remove any plant debris collected, identify and count the insects captured. Though sweep nets will not give an absolute number, they will provide a relative estimate of insect pressures, allowing for a quick assessment of the presence of a particular insect.

Number of Sampling Locations

The number of sampling locations in a field depends on factors, including field size, crop, pest type and stage of development, level of infestation, timing, topography, and soil type changes across the field. The general number of sampling locations for a range of field sizes and pests (insects, diseases and weeds) is suggested in Table 10–1, *Number of suggested sampling locations based on field size and pest.* For pest scouting purposes, split fields into units of 16 ha (40 acres) or less. General field scouting for crop development, stand counts or impact from previous management should follow a similar sampling or recording patterns. Where side-by-side field trial comparisons have been established, or where contrasting crop performance is observed, sampling procedure should consider the variability of the area and how many samples over the given area will accurately reflect the observations. In this situation, treat each variable area of the field or treatment comparison as separate sampling sites. This allows for comparisons to be made across treatments or account for extreme variability in pest or disease incidence.

Table 10–1. Number of suggested sampling locations based on field size and pest

	Number of Sampling Locations	
Field Size	**Insects/ Diseases**	**Weeds**
Up to 8 ha (Up to 20 acres)	5	10
8–12 ha (20–30 acres)	8	15
12–16 ha (30–40 acres)	10	15

Scouting Pattern

The scouting pattern should cover all parts of a field and observation locations should vary each time the field is scouted. However, when hot spots or differences in growth are identified, recheck them to monitor the development of the observed condition or pest. Field flags or GPS can be used to mark locations.

Consider the following when determining what field scouting pattern to carry out:

- Use a scouting pattern that includes changes in variety/hybrid, soil type, past cropping history, fertilizer/manure application and any other factors that can affect plant growth. Refer to Figure 10–1, *Scouting patterns,* to identify scouting pattern best suited for specific pests.
- For general field scouting, select sampling locations on the basis of a random pattern, as opposed to factors such as crop appearance. When scouting for a specific pest, sampling locations may be influenced by factors such as crop appearance, location in the field (e.g., grassy areas) etc. In these areas, random sampling should occur within the specific areas that the pest or problem may be found.
- Start scouting at least 20 m (65 ft) into a field. Avoid outside rows and headlands in the scouting pattern unless there are specific reasons for sampling these areas (e.g., armyworm moving from cereal into corn fields).

For Pests Uniformly Distributed Across the Field

- Randomly select sampling locations evenly across the field as shown above. This pattern is also appropriate for soil sampling.
- Pests that fit this scouting pattern include corn rootworm, European corn borer and stalk rots.

For Pests Expected in Headlands or Outside Rows

- Randomly select sampling locations evenly around the edges of the field, as shown.
- Pests and problems that fit this scouting pattern include armyworm, spider mites, encroachment of weeds from field borders and soil compaction.

For Pests Developing in Specific Areas of the Field

- Concentrate sampling locations in areas where the problem or pests are most likely to be found, as shown above, but also monitor other areas of affected fields.
- Pests and problems that fit this scouting pattern include phytophthora root rot in damp clay soils, wireworms and grubs in sandy knolls and black cutworms in weedy patches.

Figure 10–1. Scouting patterns.

Plant Population and Pest Infestation Levels

Plant population and some pest infestation levels are determined by making counts in areas of a given size and then multiplying that number by a factor to obtain the population per hectare or acre.

For row crops with easily defined rows, plant population can be calculated by counting the number of plants in a row that represents 1/1,000 of a hectare (or acre), then multiplying the count by 1,000 to obtain the number of plants/ha (plants/acre). See Table 10–2, *Row length for a partial acre.* A standardized length rope or chain based on Table 10–2 is useful when doing population counts. Late emerging plants need to be noted and excluded from the count. Check non-emerged seeds to determine the cause.

Table 10–2. Row length for a partial acre

Row Width	Row Length for 1⁄1,000 acre[1,2]
18 cm (7 in.)	22.8 m (74 ft 8 in.)
38 cm (15 in.)	10.6 m (34 ft 10 in.)
51 cm (20 in.)	8.0 m (26 ft 2 in.)
56 cm (22 in.)	7.2 m (23 ft 9 in.)
71 cm (28 in.)	5.7 m (18 ft 8 in.)
76 cm (30 in.)	5.3 m (17 ft 5 in.)
91 cm (36 in.)	4.4 m (14 ft 6 in.)

[1] To obtain the number of plants per one-thousandth hectare, multiply the number of plants in the length of row for the specific row width by a factor of 2.47.
[2] Multiply the number of plants counted in the length of row above by 1,000 to determine the number of plants/acre.

To determine plant population in narrow-row crops or weed/insect infestation levels, a sampling frame with a known area can be used. Place sampling frames carefully into the canopy so as not to be destructive to the crop or dislodge the pests to be counted. Count all plants, pests or weeds within the area of the frame. This can be accomplished using a square frame (e.g., 1 m x 1 m = 1 m^2 = 1/10,000 hectare (25 in. x 25 in. = 4.36 ft^2 = 1/10,000 acre)) or a circular frame (e.g., a hula hoop). The square frame and hula-hoop methods are presented in Table 10–3, *Hula-hoop method for determining plant and pest populations.*

Many insect action thresholds are expressed as the average number of insects per plant, per sweep, per unit of area or per length of row. Some may also be based on a percentage of defoliation or damage. Regardless of the method used, take sufficient random counts in each field to determine average populations. Refer to Table 10-1, *Number of suggested sampling locations based on field size and pest,* for the recommended number of sampling locations based on field size and pest. Record each count. Take the average of all counts as the estimate of the field pest population. Within a field, spots with higher pest pressure may be identified. These “hot” spots may be isolated for targeted treatment, while leaving the remainder of the field untreated. To stay on top of the pest, monitor the entire field in subsequent scouting events.

Table 10–3. Hula hoop method for determining plant and pest populations

Count the number of plants found within the hoop or square and multiply that number by the pre-determined factor listed to determine plant population per hectare or acre.

Inside Dimensions	Area	Factor by Which to Multiply the Number of Plants Within the Hoop to Equal: Plants per Hectare	Plants per Acre
Inside diameter of hoop			
91 cm (36 in.)	0.66 m^2 (7.1 ft^2)	15,228	6,162
84 cm (33 in.)	0.55 m^2 (5.9 ft^2)	18,122	7,334
76 cm (30 in.)	0.46 m^2 (4.9 ft^2)	21,928	8,874
71.8 cm (28.25 in.)	0.37 m^2 (4.36 ft^2)	24,711	10,000
61 cm (24 in.)	0.29 m^2 (3.1 ft^2)	34,263	13,866
Inside dimensions of square frame			
63.6 x 63.6 cm (25 x 25 in.)	0.405 m^2 (4.36 ft^2)	24,712	10,000
100 x 100 cm (40 x 40 in.)	1.00 m^2 (11.1 ft^2)	10,000	3,920

Recording Field Observations

Field scouting records are an essential tool for making current and future management decisions. Using a field scouting form or smartphone/tablet application will help standardize the recording of field observations. Once recorded, add the scouting data to the field record files (paper, electronic or both). Computer software is also available to record and manipulate data from field observations.

Recorded information during scouting events includes:

Whole Field Standard Data

- field name/code, physical location, GPS coordinates and scouting date
- hybrid/variety planted, including traits (e.g., Bt, RR)
- weather conditions

Site Specific Data Collected at Each Sampling Location Within the Field

- soil conditions
- flowering, tasselling, heading dates
- weeds, insects and diseases present (identify growth stages and populations of each weed/pest species separately)
- crop damage
- results of scouting procedures performed, along with actions required

Sample Handling and Submission

It can be difficult to identify a pest or field problem. Seek diagnosis and assistance from other resources, including smartphones/tablets linked to internet tools, experts and/or diagnostic laboratories. The cameras on smartphones/tablets are important tools for the collection of data on unknown pests or conditions. Although cameras are a great tool, take pictures carefully and include additional information with any pictures sent for identification. Always take pictures (or samples) of both the affected and normal condition. Most smartphone/tablet platforms have apps available to enhance picture-taking and associated data recording. When taking samples from the field, following proper sample handling procedures is critical to ensuring accurate diagnosis and/or analysis. In general, samples should be collected and submitted quickly. Samples should be taken using proper equipment (e.g., clean plastic buckets for soil samples or paper bags for plant tissue samples) and should be kept cool to ensure accurate results. For more information on how to take proper samples, where to obtain sample submission forms and diagnostic service fees, see Appendix O, *Diagnostic Services.*

Using Growing Degree Days and Crop Heat Units

Growing Degree Days

Growing degree days (GDD), an estimate of accumulated heat, are used to predict the growth and development of plants, insects and diseases during the growing season. Insect, disease and plant development are very dependent on temperature and the daily accumulation of heat. The amount of heat required to advance a plant or pest to the next development stage remains constant from year to year, however, the actual amount of time (days) can vary considerably because of weather conditions.

Each crop, insect and disease species has a minimum base temperature or threshold below which development does not occur. These base temperatures have been determined experimentally and are different for each organism. GDD information can be very useful for predicting plant, insect and disease development. Some Ontario crops still use the GDD system while others have moved to the Ontario Crop Heat Unit (CHU) system described in the next section. Field crops that use the GDD system are cereals which have a Base: 0 (plant development occurs at 0°C or higher), and alfalfa and canola which have a Base: 5 (plant development occurs at 5°C or higher). To calculate GDD, first determine the mean temperature for the day. This is usually done by taking the maximum and minimum temperatures for the day, adding them together and dividing by two. The base temperature is then subtracted from the mean temperature to give a daily GDD. If the daily GDD calculates to a negative number it is recorded as zero. Each daily GDD is then added up (accumulated) over the growing season.

GDD are sometimes referred to as "degree days" or the "degree days averaging method." Some jurisdictions also use the term "heat units" interchangeably with "degree days." In Ontario, the terms "growing degree days" (GDD) and "crop heat units" (CHU) are used independently since they represent two very different, temperature-dependent, development models.

Growing Degree Day Equation:

The GDD equation used by OMAFRA is calculated as follows:
Daily GDD = ((T max + T min) ÷ 2) – T base
T max = the daily maximum air temperature
T min = the daily minimum air temperature
T base = the GDD base temperature for the organism being monitored

Example:
Maximum Temperature: 28°C
Minimum Temperature: 15°C
Pest: European corn borer (ECB)
Base Temperature for ECB: 10°C

Calculation:
Daily GDD = ((28 + 15) ÷ 2) - 10 = 11.5
Therefore: 11.5 GDDs were accumulated for that day for the European corn borer GDD model.

There are four factors to consider when comparing GDD accumulations from various sources or regions.

1. **Are the base temperatures used in the equations the same?**

   Different organisms have different base temperatures used to calculate GDD: 150 GDD at Base 10 does not equal 150 GDD at Base 0.

2. **Are the start dates for the accumulations the same?**

   Generally, GDD accumulations start on April 1 each year, but some insect GDD models start at the emergence of a specific life stage. This is referred to as a biofix.

3. **Are the equations used to calculate the daily GDD the same?**

   Many modifications to the simple GDD calculation have been developed over the years and may be referred to generally as degree days.

4. **Are the temperatures used in degrees Celsius or Fahrenheit?**

   GDD accumulations will vary significantly, depending on whether they are being tracked in Celsius or Fahrenheit. GDD models have been designed specifically for use in one or the other and cannot be interchanged without making conversions. The ECB GDD model was based on measurements in Celsius.

Crop Heat Units (CHU)

Crop Heat Units (CHU) are based on a principle similar to GDD. CHU accumulations are calculated on a daily basis, using the maximum and minimum temperatures, however, the equation that is used is quite different. The CHU model uses separate calculations for maximum and minimum temperatures. The maximum or daytime relationship uses 10°C as the base temperature and 30°C as the ceiling, because warm-season crops do not develop at all when daytime temperatures fall below 10°C and develop fastest at about 30°C. The minimum or nighttime relationship uses 4.4°C as the base temperature and does not specify an optimum temperature, because nighttime minimum temperatures very seldom exceed 25°C in Ontario. The nighttime relationship is considered a linear relationship, while the daytime relationship is considered non-linear because crop development peaks at 30°C and begins to decline at higher temperatures. Daily CHU are calculated by using the average of the two daily values from the equations below or can be read from the matrix in Table 10–4, *Daily crop heat unit accumulations based on maximum and minimum temperatures.* Figure 1–1, *Crop heat units (CHU-M1) available for corn production,* in Chapter 1 gives a map view of typical season total CHU-M1 accumulations for Ontario.

Producers who record high and low temperatures can use Table 10–4, *Daily crop heat unit accumulations based on maximum and minimum temperatures,* to calculate CHU accumulations for their own farm. CHU accumulations are recorded from May 1st at all locations and end with the first occurrence of -2°C in the fall. Corn development is driven primarily by temperature, and this is especially true during the planting-to-silking period. Unlike soybeans, day length has little effect on the rate at which corn develops. The Ontario CHU system has been developed to calculate the impact of temperature on corn development.

CHU accumulation affects soybeans differently than corn. Soybeans, a warm-season crop, are more susceptible to cold temperatures, especially during flowering. It is believed that sustained cold temperatures (less than 10°C) during flowering affect proper formation of pollen in the flower. Sustained cold temperatures result in poorly developed pods called parthenocarpic pods (also called “monkey pods”). There is some variety difference in tolerance to cold temperatures.

Table 10–4. Daily crop heat unit accumulations based on maximum and minimum temperatures

LEGEND: – = not applicable

Daily Recorded Maximum Temperature	Daily Recorded Minimum Temperature																				
	<5°C	5°C	6°C	7°C	8°C	9°C	10°C	11°C	12°C	13°C	14°C	15°C	16°C	17°C	18°C	19°C	20°C	21°C	22°C	23°C	24°C
<10°C	0	1	1	2	3	4	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11°C	2	2	3	4	5	6	7	8	–	–	–	–	–	–	–	–	–	–	–	–	–
12°C	3	4	5	5	6	7	8	9	10	–	–	–	–	–	–	–	–	–	–	–	–
13°C	5	5	6	7	8	9	10	11	11	12	–	–	–	–	–	–	–	–	–	–	–
14°C	6	6	7	8	9	10	11	12	13	14	15	–	–	–	–	–	–	–	–	–	–
15°C	7	8	9	10	10	11	12	13	14	15	16	17	–	–	–	–	–	–	–	–	–
16°C	8	9	10	11	12	13	13	14	15	16	17	18	19	–	–	–	–	–	–	–	–
17°C	10	10	11	12	13	14	15	16	16	17	18	19	20	21	–	–	–	–	–	–	–
18°C	11	11	12	13	14	15	16	17	17	18	19	20	21	22	23	–	–	–	–	–	–
19°C	12	12	13	14	15	16	17	17	18	19	20	21	22	23	24	25	–	–	–	–	–
20°C	12	13	14	15	16	17	17	18	19	20	21	22	23	24	25	26	26	–	–	–	–
21°C	13	14	15	16	16	17	18	19	20	21	22	23	24	25	25	26	27	28	–	–	–
22°C	14	14	15	16	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	–	–
23°C	15	15	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	29	30	31	–
24°C	15	16	16	17	18	19	20	21	22	23	24	25	25	26	27	28	29	30	31	32	33
25°C	16	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33
26°C	16	16	17	18	19	20	21	22	23	24	24	25	26	27	28	29	30	31	32	33	33
27°C	16	17	18	18	19	20	21	22	23	24	25	26	27	27	28	29	30	31	32	33	34
28°C	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34
29°C	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34
30°C	17	17	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	31	32	33	34
31°C	16	17	18	19	20	21	21	22	23	24	25	26	27	28	29	30	30	31	32	33	34
32°C	16	17	18	19	20	20	21	22	23	24	25	26	27	28	29	29	30	31	32	33	34
33°C	16	17	17	18	19	20	21	22	23	24	25	26	26	27	28	29	30	31	32	33	34
34°C	16	16	17	18	19	20	21	22	23	23	24	25	26	27	28	29	30	31	32	32	33

Calculating Daily CHU

The following equation is used to calculate a daily CHU for a site:

Daily CHU = (Y max + Y min) ÷ 2 where:
Y max = (3.33 x (T max–10)) – (0.084 x (T max–10)^2)
(If values are negative, set to 0)
T max = Daily maximum air temperature (°C) (measured from midnight to midnight)
(Accuracy should be <0.25°C)
Y min = (1.8 x (T min – 4.4))
(If values are negative, set to 0)
T min = Daily minimum temperature (°C)

Mapping Tools

Farm and field maps can support and enhance observations made in the field. Field sketches that use aerial photographs as a base are often used in nutrient management planning. Site-specific soil textures, tile drainage, elevation and aerial imaginary data are all available in maps, and often the information can be layered onto one map. This type of mapping is accessible online. Ontario Ag Maps (ontario.ca/agmaps) includes mapping tools to build customized maps of individual farms and fields. Figure 10-2, *Example field map using Ontario Ag Maps,* illustrates a farm property with topography and measured acres. Tile drainage and water runs, and areas where ponding occurs are evident and can indicate where additional scouting should occur or act as a record-keeping tool to illustrate the impact of changes.

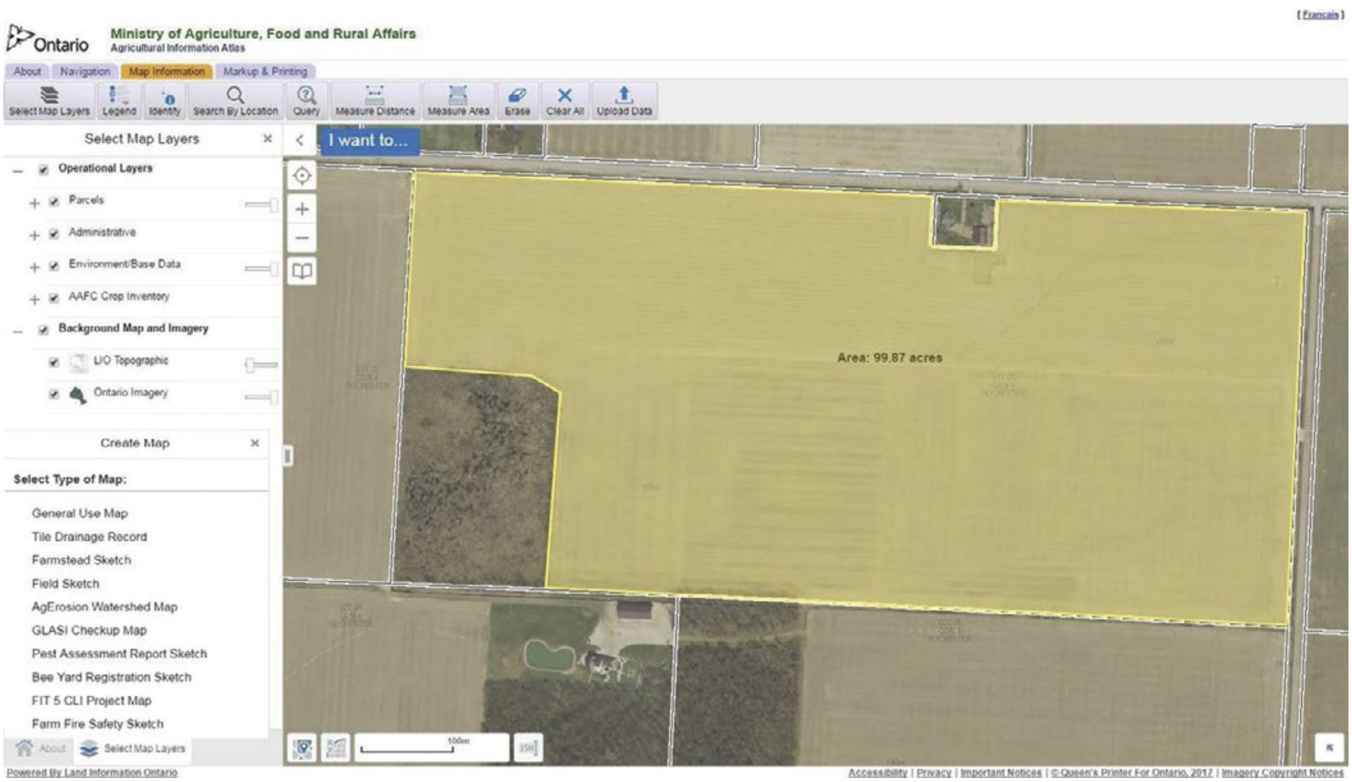

Figure 10–2. Example field map using Ontario Ag Maps (ontario.ca/agmaps).