



Prairie Crop Disease Monitoring Network (PCDMN) Blackleg of Canola Assessment Protocols Summer 2021

1. General

Blackleg is one of the key diseases faced by Prairie canola producers and has largely been kept in check with the use of resistant varieties and crop rotation. However, over the past 10-20 years there have been concerns regarding observed shifts in blackleg pathogen virulence in response to the major gene resistance used in a number of varieties. Changes in virulence patterns emphasize the critical need to stay on top of this disease; producers and crop scouts can play a critical role by scouting fields to monitor blackleg and detect any unexpected increases in disease levels on resistant varieties. For blackleg a critical time for scouting is later in the season to assess the prevalence, severity and impact of this disease issue. When assessing blackleg incidence and severity, **it is critical** to correctly identify symptoms of blackleg and differentiate these from normal or premature canola crop ripening due to a range of abiotic and biotic factors. Recent Prairie research has shown limited responses to in-crop fungicide when resistant varieties are grown, and especially where this resistance is still highly effective.

2. Timing

It is critical to assess end-of-season blackleg levels at the correct growth stage. Assessment of blackleg becomes increasingly difficult if plants have started to fully ripen. Table 1 outlines the recommended stage to assess end-of-season blackleg levels. For blackleg as well as sclerotinia stem rot the ideal stage to assess the final level of disease is just prior to swathing, i.e. GS 5.3 or just prior to when you have ~60% seed colour change (Harper and Berkenkanp 1976; CCC 2012). There is some flexibility for blackleg as assessments may be done for up to approximately 10 days following GS 5.3 or ~60% colour change. However, at or beyond this point grey stem starts to develop on the senescing canola crop making assessment of blackleg more challenging. If the canola canopy and stem tissues are starting to turn colour then assessment of blackleg becomes increasingly problematic as normal crop senescence and the development of saprophytic organisms can make it more difficult to differentiate blackleg symptoms from other issues.

Table 1. Growth stage information for assessment of blackleg of canola.

Growth stage for collection/assessment	Description of growth stage
<p>Harper and Berkenkamp (1975) – growth stage 5.3, or just prior to 60% seed colour change.</p> <p>Depending on the seeding date this stage will typically occur in early to mid-August and usually just prior to the crop being swathed.</p>	<p>GS 5.3 is typically when seeds in the lower pods are starting to turn colour, i.e. “5.3 Seeds in lower pods green-brown mottled”.</p> <p>More recent information indicates that swathing is recommended when you have an average of 60% seed colour change (CCC 2012). Thus, assessments should be done within 7 days prior to 60% seed colour change.</p>

3. Blackleg assessment sampling sites

When assessing late season blackleg levels, one should look at a representative sample of canola plants throughout the field. For example, **a minimum of 4-6 sites** should be looked at in a quarter section field, with a minimum of 25 plants assessed at each site. Half or full section fields will require more sites. If the field is quite variable then separate assessments in specific areas may be needed, e.g. lodged versus non-lodged. Assessments can also be made in sprayed versus unsprayed areas to determine the usefulness and benefit of in-crop fungicide applications. Leaving unsprayed checks, even small areas, can be quite useful to assess the impact and role of in-crop fungicide applications.

There are a variety of recommended patterns that one can follow for the assessment of blackleg. One of the most common ones to follow is a “w-shaped” pattern in a field starting from one side and moving towards the opposite side of the field (Figure 2a). Along this “w-shaped” pattern one can assess plants at several points along the path. Ideally you should avoid the headlands of the field as these areas may have somewhat different crop development due to double seeding and fertilization, compaction, or impacts due to tree lines along field edges. Individual sites along the “w-shaped path can be spaced according to the purposes of the assessments. If it is just to get a general idea of blackleg levels then the total length of the path should be at least 400-500 feet long with approximately 50-100 feet between sampling points (Figure 2a). In contrast, if one is interested in a more thorough assessment over the entire field, then more sampling points and time may be needed. Here the “w-shaped” pattern should cover most of the field going north to south and east to west (Figure 2b). If your field has an unusual shape due to water courses and/or bodies, etc., then modify your sampling pattern accordingly (Figure 2c). At each sampling point, randomly assess a minimum of 25-50 plants for blackleg.

An alternative pattern that can be used to get a general idea of blackleg levels is to follow a “diamond-shaped” path starting past the field headlands (Figure 3). The main reason for a “diamond-shaped” path is that it ensures that you exit the field at the same location where you



entered the field. This will help to shorten the time it takes to sample a field and avoid any unnecessary walking. Along the “diamond-shaped” path randomly assess a minimum of 25-50 plants at a minimum of 4-6 locations. Make sure the total sampling path is at least 400-500 feet in length. If you are interested in a more thorough assessment for the entire field, the size of the “diamond-shaped” pattern can be increased to cover a larger area.

4. Assessment of blackleg incidence and severity

Overall, the concern is in relation to the incidence and severity of lower stem infections. Typical symptoms of blackleg can be found via the Canola Council of Canada, the PCDMN disease info cards or other PCDMN information on differentiating blackleg from other issues in a canola crop (see links below). Although blackleg incidence can be readily assessed, the extent of disease development on canola stem bases is more important as it can be used to identify shifts in pathogen virulence as well as estimating potential yield losses.

Links to information to assist in the identification of blackleg symptoms and differentiating those from other plant symptoms due to various biotic and abiotic factors or healthy canola plants. Information related to rating blackleg and assessing potential yield loss is also available from one or more of the links.

1. Canola Council of Canada, Canola Encyclopedia: <https://www.canolacouncil.org/canola-encyclopedia/diseases/blackleg/>;
2. PCDMN blackleg disease info card: <https://drive.google.com/file/d/1hl9iPHjcjqeJp3ZXR-ovzHlmgMc4rcB0/view?usp=sharing>;
3. PCDMN blackleg info card tweet, August 2019: <https://twitter.com/pcdmn/status/1287895931782823938>;
4. PCDMN blackleg identification guide, August 2021: <https://drive.google.com/file/d/1B24FneDtKtUo8FI2NpaHk6kIXbFL9VIO/view?usp=sharing>;
5. Canadian Agronomist, blackleg article, August 2020: <https://canadianagronomist.ca/the-science-behind-blackleg-resistance-rotation/>;
6. Canola Digest article on yield-loss models for blackleg, November 2017: <https://canoladigest.ca/science-edition-2017/first-yield-loss-model-for-blackleg-on-the-prairies/?platform=hootsuite>;
7. Keep it Clean webpage on blackleg: <https://keepingitclean.ca/canola/blackleg>.

When evaluating blackleg levels it is important to ensure that plants are assessed at random. Unfortunately, there is a natural tendency to gravitate and focus on plants with symptoms. Try to avoid this by assessing plants non-selectively along the sampling path. One way to do this is





when you reach a sampling point you can pick a spot in the canopy at random. At this point one can move along a single row or along 2-3 rows assessing individual plants along the individual rows. If the field lacks distinct rows due to the type of seeding system and openers used, then one can follow a 12-18 inch wide path and assess the plants along this path at each sampling site.

For blackleg the recommended rating scale focuses on the extent of internal stem base infections. To help facilitate this one can pull individual plants and then cut the base of the stem at the soil surface. Note when pulling plants the farmer must be willing to permit destructive sampling in their field(s). Small hand-held pruning shears or clippers can be used to easily cut the canola stem bases. These small shears or clippers are available from a number of retail locations either in their stores or online (e.g. <https://www.leevalley.com/en-ca/shop/garden/garden-care/pruners/45669-felco-classic-pruner?item=AG701>; <https://www.rona.ca/en/outdoor/gardening-tools/small-gardening-tools>; <https://www.homedepot.ca/en/home/categories/outdoors/lawn-and-garden-centre/lawn-and-garden-tools/shears-and-pruning-tools/hand-pruners.html>; <https://www.canadiantire.ca/en/pdp/fiskars-professional-bypass-pruner-0596115p.html#srp>; <https://www.princessauto.com/en/detail/2-pc-bypass-anvil-pruner-set/A-p8788937e>). **Note mention of a particular retailer does not imply an endorsement of the retailer.**

The cross-section of the stem base of each individual plant is then examined and the extent of blackish discolouration is noted (Table 2 and see links above). The rating scale is used to assess variety resistance as well as for trials investigating pathogen virulence and disease management practices (Kutcher et al. 2011) and was previously reported by Guo and Fernando (2005) and is also reported on the Canola Council of Canada website (<https://www.canolacouncil.org/canola-encyclopedia/diseases/blackleg/genetic-resistance/> and <https://www.canolacouncil.org/canola-encyclopedia/diseases/blackleg/identifying-blackleg/>). Severity ratings are then recorded for each plant. Sometimes it helps to have two people doing the ratings; one individual cuts, examines and rates the plants, while the other person records the ratings and keeps track of the number of plants assessed. One option if rating alone is to put individual plants into piles for each rating category. Once all plants are rated for a site then you can count the number of plants in each rating category pile and record these values.

Assessments can be done in the field and data recorded using a small notepad and pencil or alternatively recorded onto a smart phone using a note app or a mini spreadsheet app. Make sure to label the assessments according to date, growth stage, field, and sampling point. Moreover, it may be a good idea to draw a small map to show the approximate areas where the sampling was performed. One can also use a GPS mapping app to identify the sampling point and this GPS value can be noted and recorded.

Once all plants have been examined and assigned a rating, one can calculate an average incidence value by taking the number of plants with any symptoms, dividing this value by the total number of plants assessed, and multiplying the resulting value by 100 to get the incidence





of blackleg infected plants. Average severity values can be calculated by using severity ratings for individual plants and averaging them over all plants assessed. Calculations for incidence and severity can be done for each individual site or the area of the field sampled, or for sprayed versus non-sprayed areas.

Recent research has resulted in some rules of thumb to estimate potential yield loss from blackleg (Wang et al. 2020). An article in the Canadian Agronomist provides some practical information regarding yield losses due to blackleg and is based on the work by Wang et al. (2020) (<https://canadianagronomist.ca/the-science-behind-blackleg-resistance-rotation/>). To estimate potential yield loss from blackleg, focus on the blackleg severity rating scale outlined above and as mentioned in the Canadian Agronomist article, which indicates per plant yield loss increases by about 20% with every unit increase in blackleg severity. However, yield losses are minimal if you have average severity ratings that range from >0 to 1 on the 0-5 rating scale. Therefore, the focus should be on ratings >1 where the potential yield loss increases by approximately 20% with every one unit increase on the 1-5 scale. For example, when your average field severity rating is 2 then the potential yield loss is 20%, while for an average rating of 3 the potential loss would be 40%, etc. If the average rating is a 2.5 then the potential yield loss would be 30%. Here the one unit change from a rating of 1 to 2 would represent a potential 20% loss and a half unit change from 2 to 2.5 would represent an additional 10% loss.

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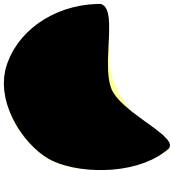
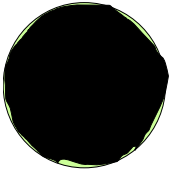
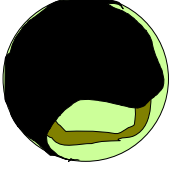
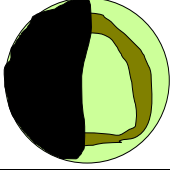
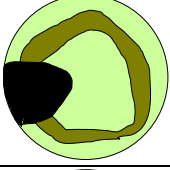
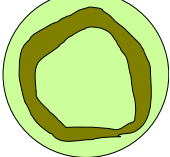
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Table 2. Rating scale for blackleg of canola severity assessments*.

Individual plant disease rating	Visual example	Symptoms
5		Diseased tissue occupies 100% of cross section with significant constriction of affected tissues; tissue dry and brittle, plant dead
4		Diseased tissue occupies >75% of cross section with little or no constriction of affected tissues
3		Diseased tissue occupies 51-75% of cross section
2		Diseased tissue occupies 26-50% of cross section
1		Diseased tissue occupies 25% or less of cross section
0		No diseased tissue visible in the cross section

Rating scale for assessing the severity of blackleg of canola for each individual plant. Taken from: Guo, X. W., and Fernando, W. G. D. 2005. Seasonal and diurnal patterns of spore dispersal by *Leptosphaeria maculans* from canola stubble in relation to environmental conditions. Plant Dis. 89:97-104; <https://www.canolacouncil.org/canola-encyclopedia/diseases/blackleg/genetic-resistance/> and <https://www.canolacouncil.org/canola-encyclopedia/diseases/blackleg/identifying-blackleg/>. Graphics courtesy of H.R. Kutcher and G. Peng, AAFC Saskatoon, and Carter Peru, Sask. Ag., Regina.

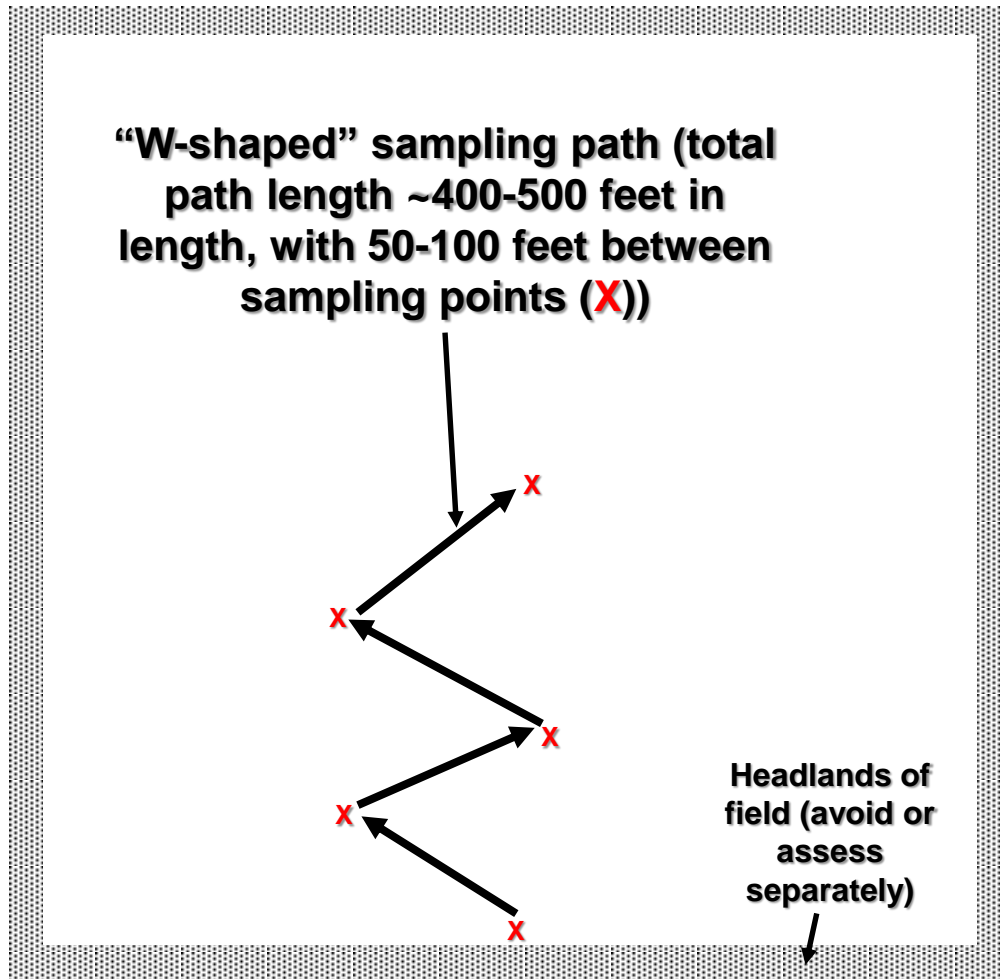


Figure 2a. Suggested “W-shaped” sampling pattern for a quick general assessment of canola plants.

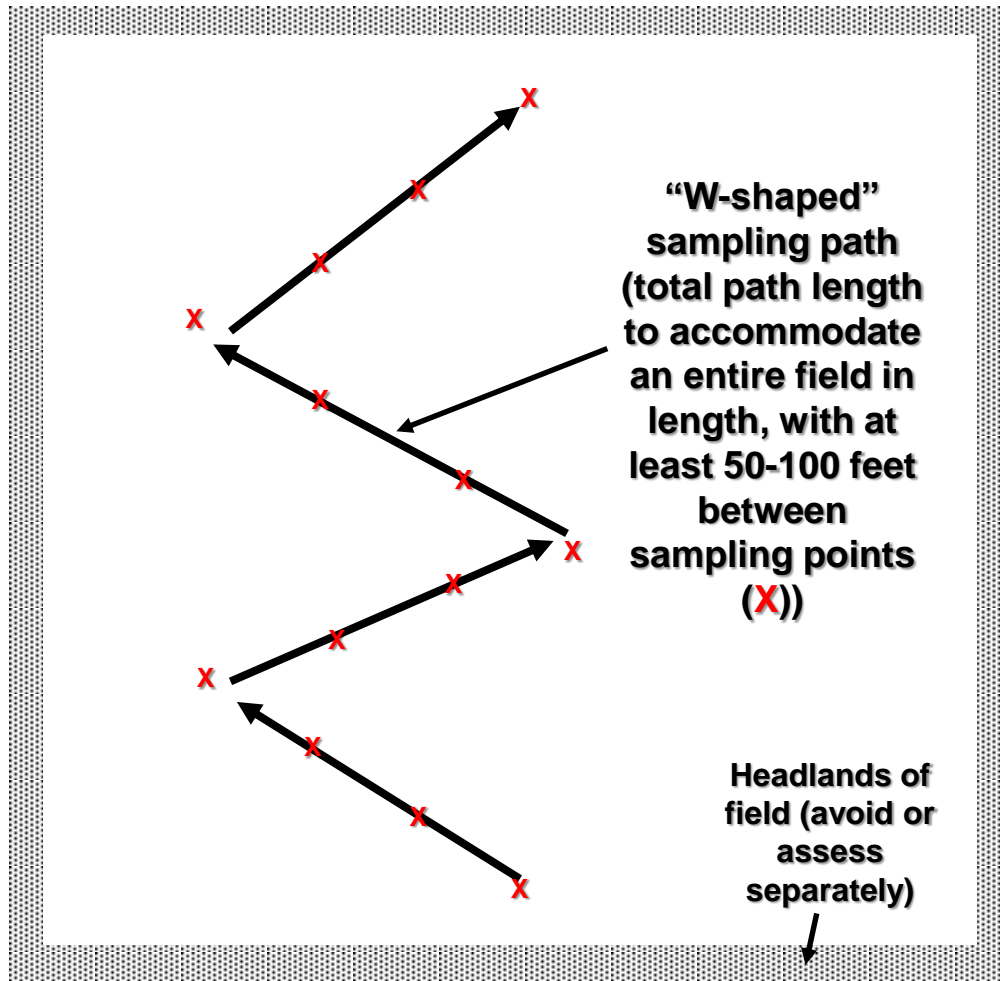


Figure 2b. Suggested “W-shaped” sampling pattern for more thorough entire field assessment of canola plants.

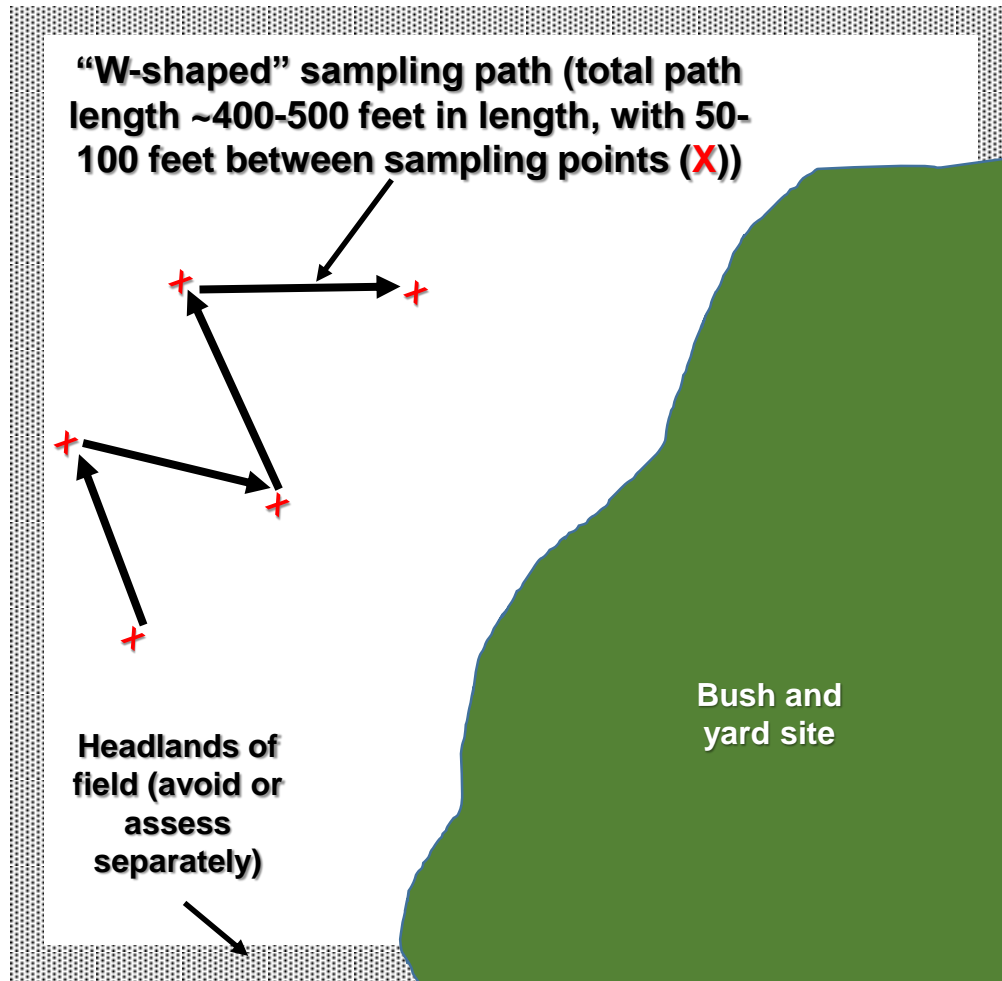


Figure 2c. Suggested “W-shaped” sampling pattern for a quick general assessment of canola plants. Pattern modified to accommodate an irregularly shaped field.

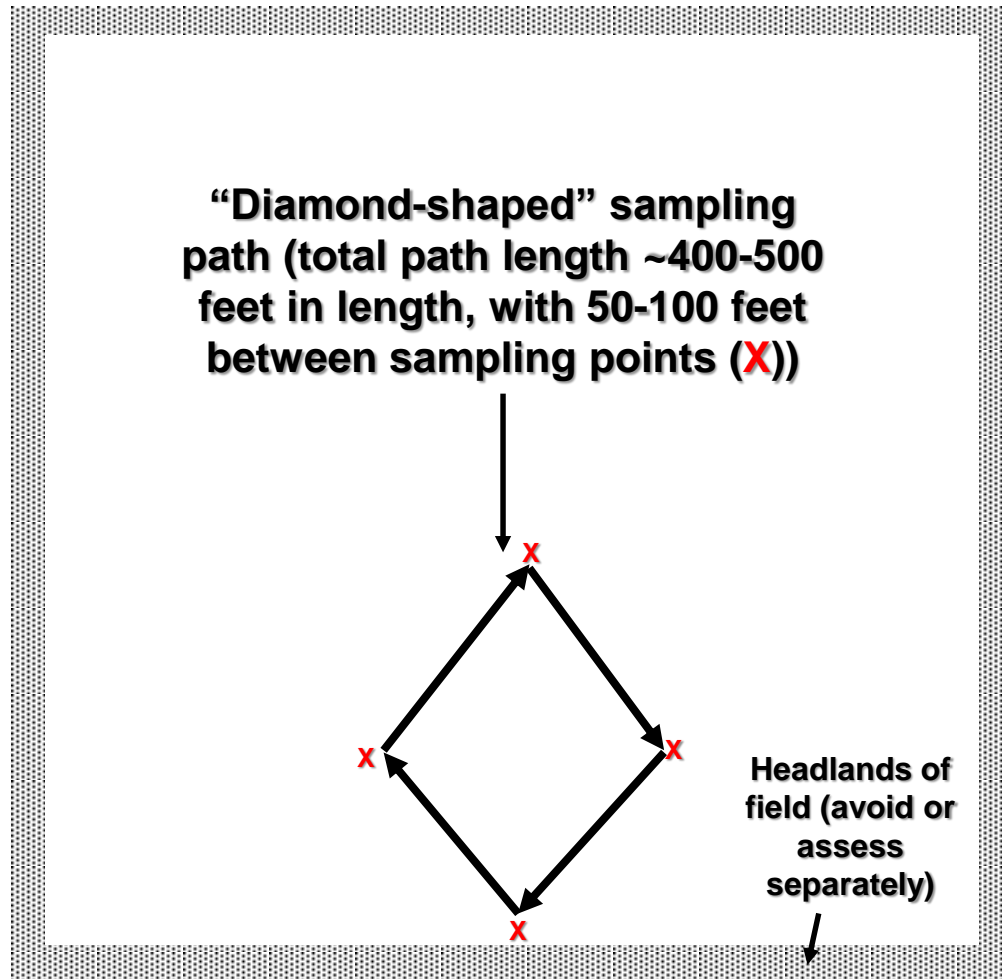


Figure 3. Suggested “diamond-shaped” sampling pattern for quick general assessment of canola plants.