

Canadian Corn Pest Coalition Mitigation Recommendations for European Corn Borer Resistance to Bt Corn (Cry1F) in the Maritimes

In 2018, field corn planted in Nova Scotia resulted in Unexpected damage (UXD) reports indicating the presence of populations of European corn borer (ECB) resistant to a single Bt product containing Cry1F (Herculex I). Importantly, while Cry1F is also present in other hybrids containing multiple Bt traits that each target ECB, there have been no reports of UXD by ECB to any of these hybrids. ECB showing tolerance to Cry1F were collected from two separate locations in the major corn growing areas of the province. Monitoring efforts are underway to determine if resistant ECB populations exist outside of Nova Scotia. Regions perceived to be at increased risk of resistance may share some common characteristics: a) shorter growing season; b) few low CHU hybrids; c) single Bt products targeting lepidopteran pests, and d) inadequate implementation of required refuge (i.e. 20% non-Bt blocks or strips – 400 m from the Bt planting).

Some hybrids contain more than one Bt trait to control the same pest ECB (referred to as a pyramided hybrid). The combination of multiple Bt traits in a single plant provides both improved efficacy over single Bt products and an effective approach for insect resistance management as it is significantly less likely that insects will develop resistance to two Bt traits at the same time. If insects have developed resistance to one of the Bt traits in a pyramided hybrid, resistance can develop more rapidly to the second trait. To prevent the spread of ECB resistant to Cry1F, we encourage growers to take steps to control the current resistant population and alert your seed company agronomist or sales representative, or provincial extension specialist of any field with unexpected damage by ECB in 2019.

Steps to Mitigate European Corn Borer Resistance

There are several measures that all growers should take to delay the development and spread of resistance in the European corn borer population:

1. Scout for ECB activity. It is important to monitor for ECB damage in Bt and non-Bt fields. ECB damage found in Bt fields (pictured below), should immediately be reported to the seed company agronomist or sales representative, or provincial extension specialists (shown below).

Companies can also be contacted through the below central numbers:

Syngenta Customer Interaction Centre: 1-87SYNGENTA (1-877-964-3682)

Corteva: 1-800-667-3852

Monsanto Technical Support Line: 1-800-667-4944

Provincial Specialists to Contact if ECB Damage is Found in Bt corn:

Province	Contact	Phone	Email
Nova Scotia	Angela Gourd	(902) 956-0981	angela.gourd@novascotia.ca
New Brunswick	Chris Maund	(506) 453-3477	chris.maund@gnb.ca
PEI	Sebastian Ibarra	(902) 314-0388	sibarra@gov.pe.ca
Quebec	Julian Saguez	(450) 464-2715 ext. 249	julien.saguez@cerom.qc.ca
Ontario	Tracey Baute	(519) 360-7817	tracey.baute@ontario.ca
Manitoba	John Gavloski	(204) 745-5668	john.gavloski@gov.mb.ca

2. Growers should know which Bt traits they are purchasing. A table of registered Bt corn products in Canada and refuge requirements, is available at:
<https://www.cornpest.ca/bt-corn/bt-corn-products-traits-available-in-canada-as-of-may-2019/>. Growers are strongly encouraged to plant a two-mode of action Bt trait above ground product.
3. All corn growers must follow the refuge requirements of the hybrids they are planting. For more details on proper refuge configuration, please go to:
<https://www.cornpest.ca/resistance-management/refuge-requirements/planting-configurations/>
4. When possible, growers should plant a corn hybrid that expresses multiple Bt traits targeting ECB. Using a hybrid with multiple Bt traits that each target ECB is much more effective at delaying resistance and mitigating the current resistant population. Growers should refer the trait table under point #2 above to identify multiple mode of action hybrids for ECB and contact their seed provider for additional information.
5. Growers who find damage in their Bt corn should take additional measures to control ECB to reduce the risk of resistance continuing in future ECB generations by reducing overwintering survivorship. One of the most effective mechanical measures to control overwintering ECB populations includes mowing corn stalks to as close to the soil surface as possible after harvest, followed by burying the mowed stalks in the fall. Shredding and burial of corn stubble can also reduce the population. Tilling corn stubble under without mowing or shredding them first is not as effective.

Signs of ECB Activity and Damage to Scout for in Bt Corn Fields

ECB lay eggs on the underside of the corn leaves, close to the mid-rib (Fig. 1). Fresh ECB egg masses (Fig. 1-top) are white but turn dark closer to hatching (Fig. 1-bottom) and are layered on top of each other like fish scales. Return to fields with egg masses later in the season to look for signs of feeding. ECB larvae are pale tan to pinkish-grey in colour with a dark head and small round brown dots along their body.



Figure 1. ECB egg masses. J. Gavloski, Manitoba Agriculture



Figure 2. ECB larva found in corn stalk. A. Tenuta, OMAFRA

NOTE: The presence of ECB egg masses is not an indication of resistance but fields with eggs should be scouted again in a few weeks to look for signs of feeding damage. If feeding damage is present in Bt corn as shown in the images below, contact your seed provider and provincial extension specialist.

Signs of ECB Feeding – Report if found on Bt Plants

ECB feeding found on Bt plants is a potential sign of resistance. Young larvae feed on the leaf surface and mine through the whorl of the younger plants. Early season signs of feeding may include window-paning, pinholes and shotholes (Figs. 3-5). These early signs of feeding are not unexpected damage as young larvae need to feed on the plant tissue to be exposed to the Bt protein and die. Older larvae are able to mine into the mid-rib of the leaf, tassel or stalk of the plant and ear shank. Frass present at the leaf axils, bent leaves at the midribs, broken tassels, lodged plants and dropped ears are signs of ECB feeding (Figs 6-9). If damage continues to progress beyond pinholes and window-paning, this would be considered unexpected damage.

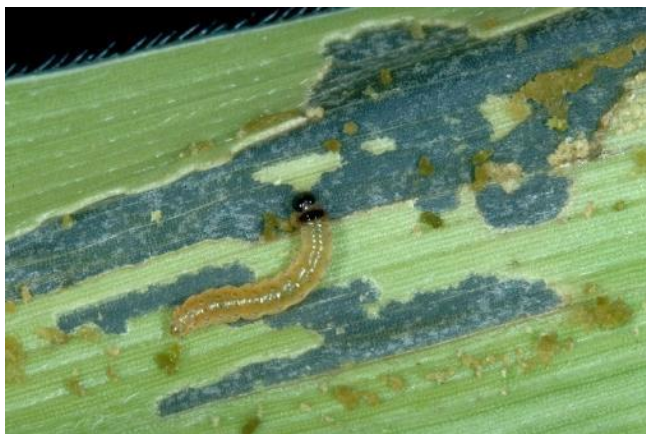


Figure 3. Young ECB larva and window-paning on leaf. M.E. Rice



Figure 4. Feeding on the whorl by ECB larvae. T. Baute, OMAFRA

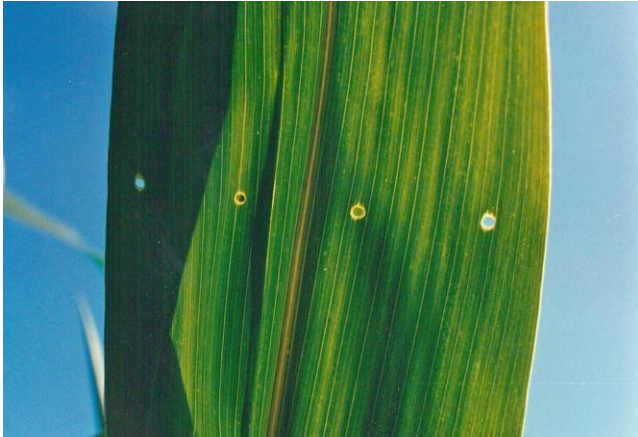


Figure 5. Pin-hole or shot-hole feeding pattern as the leaf unrolls from the whorl. T. Baute, OMAFRA



Figure 6. Bent or broken tassels are signs of ECB feeding. David Handley, U of Maine



Figure 7. ECB larvae may tunnel from the midrib of the leaf down to the stalk. T. Baute, OMAFRA



Figure 8. Entry hole and frass at leaf axil as ECB enters the stalk. J. Obermeyer, Purdue



Figure 9. Bent or broken corn stalks due to ECB tunneling. Damage to ear shank due to ECB tunneling. E. Bohnenblust, Penn State University