Managing Resistance to European Corn Borer (ECB)

Bt Corn

Transgenic corn varieties have been around for many years (3). Varieties of corn have had the addition of a genetic code to produce proteins naturally generated by a soil bacteria *Bacillus thuringiensis* (Bt) that are toxic to Lepidoptera larvae including larvae of the European Corn Borer (ECB) (2). When the ECB larvae feed on the plant tissue encoded with this protein, it causes the cells, found in the lining of the insects gut, to burst (2). This has been a great development for protecting corn crops from yield losses due to this pest; however, in recent years, certain species of ECB have developed resistance to these proteins and have been found surviving in corn with the Bt genes planted in the Atlantic provinces (1).

There are only 4 Bt proteins available to use against ECB and no new proteins will be available in the near future (1). Therefore, we must protect the integrity of the current proteins we have available.

Female ECB moth (5).

Frass from larvae tunnelling into stalk (5).

Mature larvae feeding into stalk (5).

What damage does ECB do?

The adult moths lay eggs on the underside of corn leaves (3). When larvae hatch they begin to feed on leaves and work their way to eat into the stalk. Feeding in the stalk causes structural damage increasing the incidence of lodging and reduces the capability of nutrients and water to be carried up and down the plant (3). The larvae have been known to feed on the ear and kernels of corn as well. On top of destroying the corn plant's structural integrity, these damages can make the plant more susceptible to harmful pathogens and bacterial fungi (3).

ECB Lifecycle

- 4 stages: egg, larvae, pupa, moth (3)
- 5th instar larvae overwinter in crop residue and pupate in spring (3)
- In May moths hatch and will mate (3)
- Female moths lay 15-20 eggs on the underside of corn leaves (3)
- Eggs can hatch within 3-7 days (3)
- Larvae feed on corn leaves and make their way to feed on stalk (3)

*there can be one or two full generations of ECB in New Brunswick the single generation is called univoltine and the two generation type is called bivoltine (3)

Strategies to Minimize Resistance

The first step is to select a corn variety that has more than one type of Bt protein (1). By having two or more strains, it is more difficult for the ECB to build up a resistance (1). When selecting the seed, be sure that the Bt traits present are ones that are highly effective against ECB specifically (3). Not all Bt seed has the genes to target ECB, as Bt strains also exist for corn rootworm and western bean cutworm (3).

Plant non-Bt refuge plants with the Bt corn to allow susceptible ECB insects to breed and dilute the resistant population (3). Some seed companies include the host seed mixed with the Bt seed, so be aware of what you are purchasing. It is recommended that 20% of the seed planted should be a non-Bt host crop when only one Bt protein is present in the seed's genetic code (3).

Utilize crop rotation between host-crops and non-host crops to remove ECB habitat so they do not remain in the field (3).

Keep the grasses and shrubs surrounding your field cut to reduce the area available for the moths to hide during the day and mate.

Later planting of corn has shown to reduce ECB presence especially in the areas where only a single generation completes the life cycle (4). This is because the plants will be smaller and less desirable at the time when moths are searching for a place to lay their eggs in late spring or early summer (4).

Perform regular crop scouting to identify presence of ECB. Pheromone traps can be set up outside the field to trap and count moths (4). The plants can be observed after the V6 stage for holes in leaves and stalks. Sawdust-like frass is a key indicator of ECB feeding (3).

When sampling for ECB look at the whorl leaves of 20 plants for shot hole feeding in several locations of the field (5). Pull out at least one damaged leaf out of the whorl per sample area to look for live larvae to gather an estimate of the number present in the field (5).

Flail mowing requires an extra pass but may be critical in reducing yield damaging levels of ECB in your fields for future corn crops.

Flail mowing corn stocks after harvest or leaving shorter stubble length will reduce the habitat for ECB larvae to overwinter (6). Plowing can also be done to reduce overwintering populations; however it is not as effective as destroying the residue (6). Burying the corn residue and disturbing the soil will make for poorer overwintering conditions.

As a last resort, apply insecticides at the appropriate time between larvae emergence and plant entering to kill them before they can reproduce (3). Note that pesticides used should be rotated and not the only mode of action used as this can build resistance as well.

The basis of Integrated Pest Management is to prevent the ECB from entering the corn crop first then manage for the larvae if found at yield damaging levels. It is important to try to incorporate multiple of these strategies in your fight again ECB as it will provide more effective decreases in ECB populations if one strategy falls short.

Crop scouting is going to become very important to monitor for future resistance to Bt proteins in ECB populations.

This factsheet was prepared by Andrea Koch (Central NBSCIA Coordinator) and reviewed and approved by Ray Carmichael (M.Sc Agr) November, 2023.

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