Newfoundland Labrador

Integrated Pest Management Projects
Final Report

Diamond Back Moth in Cole Crops
&
Corn Earworm and European Corn Borer in Sweet Corn


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Introduction

Across the Province of Newfoundland and Labrador monitoring sites and data collection provide valuable information that can help producers understand the pest problems they are having, and assist in implementing an integrated pest management (IPM) program that is right for their farm. An IPM program is important to have established so that pests/environmental conditions that can be economically severe are monitored, prevented and controlled. An action threshold is set for each pest (the point at which the pest population or environmental conditions indicates that action must be taken) (US.EPA, 2009). The species of interest in these projects were: Corn Earworm (*Helicoverpa zea)* and European corn borer (*Ostrinia nubilalis*) on Sweet Corn and the Diamondback Moth (*Plutella xylostella*) on Cole Crops.

These three species of interest are of great importance to the sweet corn and cole crop industry in Newfoundland and Labrador due to the fact that they can be some of the most economically severe pests found on cole crops and sweet corn. Through the use of an IPM program these economic losses can be avoided.

The corn earworm (*Helicoverpa zea*) is a major pest of most types of corn found in Newfoundland and Labrador. It is responsible for a large percentage of grade-out corn in this province. Earworms feed almost exclusively on the tips of the ears, which leaves no visible damage to the husk or the leaves of the plant. The earworm has a wide host range and feeds on many cultivated crops and weeds (OMAFRA1, 1998).

The corn earworm is one of several pests in Newfoundland and Labrador that does not overwinter here. Due to low winter temperatures, the entire population is killed off. Each spring, the moths must re-establish themselves, from overwintering populations in southern United States and Mexico. High-level wind currents carry the moths north. Since their migration is weather-dependent, the moths arrive at different times each summer in Newfoundland and Labrador.

The European corn borer (*Ostrinia nubilalis*) was found to be of economic importance in Newfoundland and Labrador. There are five larval instarts, and depending on temperature, larvae feed for 20-30 days before pupating. This long feeding stage can make this pest a large problem if not monitored. This pest overwinters as larvae in corn stalks and debris/residue left on the surface from the previous growing season (OMAFRA3, 1998).

The diamondback moth (*Plutella xylostella*) is one of the most economically hindering pests on cole crops in Newfoundland and Labrador. This moth is a world-wide concern due to the ability of this pest to develop pesticide resistance. A distinguishing feature of the diamondback moth is its reaction to being touched - it will wriggle frantically and rapidly attach a silken thread to the leaf and dangle over the edge (OMAFRA2, 1998) (Harcourt, 1957).

The diamondback moth does not overwinter in Newfoundland and Labrador, therefore the majority of adult moths migrate into the province on high-level wind currents during

the spring. Since their migration is weather-dependent, the diamondback moths arrive at different times each summer in Newfoundland and Labrador.

Methods and Materials

From 2005 to 2007, nine locations (45 acres) were established across the province for the Cole Crops IPM project. They were established to monitor the Diamondback Moth (*Plutella xylostella*) on commercial farms growing cole crops. Also from 2005-2007 the Sweet Corn IPM project was setup at eight locations province-wide to monitor the Corn Earworm (*Helicoverpa zea*), with a total of 45 acres of sweet corn. During the first year of monitoring, it was discovered the European Corn Borer *(Ostrinia nubilalis)* was also an economical pest of the sweet corn industry, so it was thereafter monitored as well.

The adult corn earworm, European corn borer and diamondback moth were monitored using pheromone traps for each species. Pheromone traps are useful in identifying the period of activity of the adults. These traps were placed upwind in the field so that the attractant would be carried across the fields. These traps were examined and changed on seven to 10 day intervals. The caterpillar stages of these pests were monitored by counting the number of caterpillars on five plants, per five sampling sites (in a V pattern) on an acre. When examining the five plants per sampling site, the upper and lower surfaces of each leaf were examined.

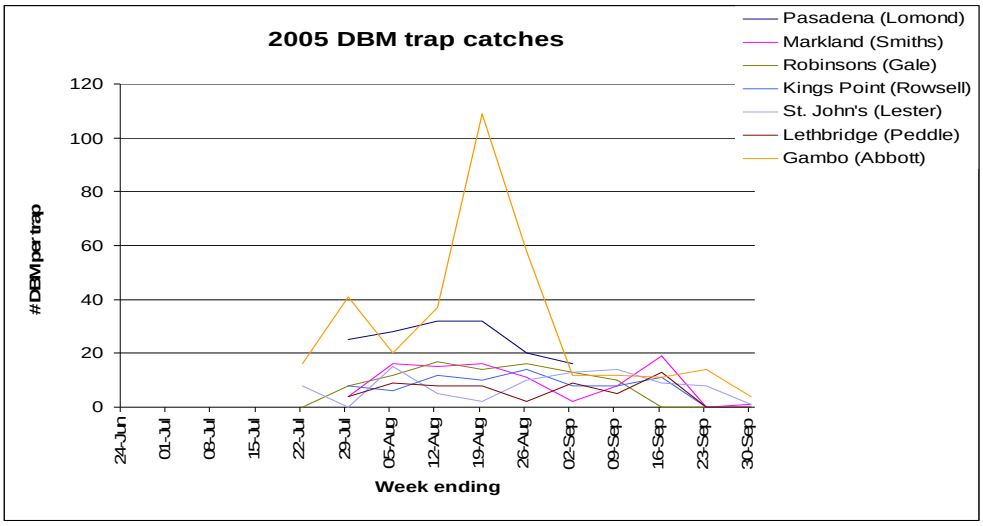
Results

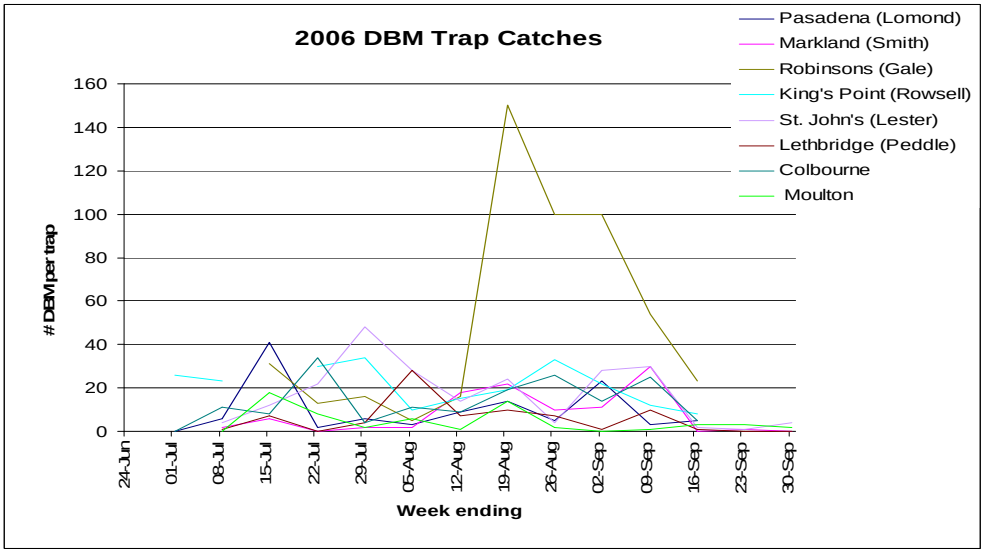
The monitoring sites for diamondback moth were setup from mid-June to the beginning of July. For each site, pheromone traps were placed out to detect the presence and relative abundance of the diamondback moth. Populations were detected the week they were first set out and caterpillars and/or adults of the diamondback moth were found at the first date monitored. Due to these circumstances, the sites were not established early enough during the three years of this study to determine the arrival dates for the diamondback moth (OMAFRA2, 1998).

In 2005, the sampling site in Gambo had very high trap catches compared with the other seven sites. Despite high trap catches there were low larval counts on the plant inspections. This indicates there is not a strong relationship between trap catches and potential crop damage. There was continuous moth activity throughout the sampling period (Figure 1).

In 2006, the diamondback moth appears to be present by the first week in July for most farms, however only farms in Roberts Arm/Colbourne, Pasadena and Burin/Moulton can possibly estimate an arrival time as they were the only ones to have zero moths in traps before the week ending on July 8th. The diamondback moth appeared in the first week of July at Roberts Arm/Colbournes (July 7th) and Pasadena (July 5th) and the second week of July at (Burin/Moultons (July 13th).

In 2007, the diamondback moth was present in traps by the first week in July at most farms. There was found to be continuous moth activity over the entire season at all locations, again with very high numbers in Gambo (as in 2005).





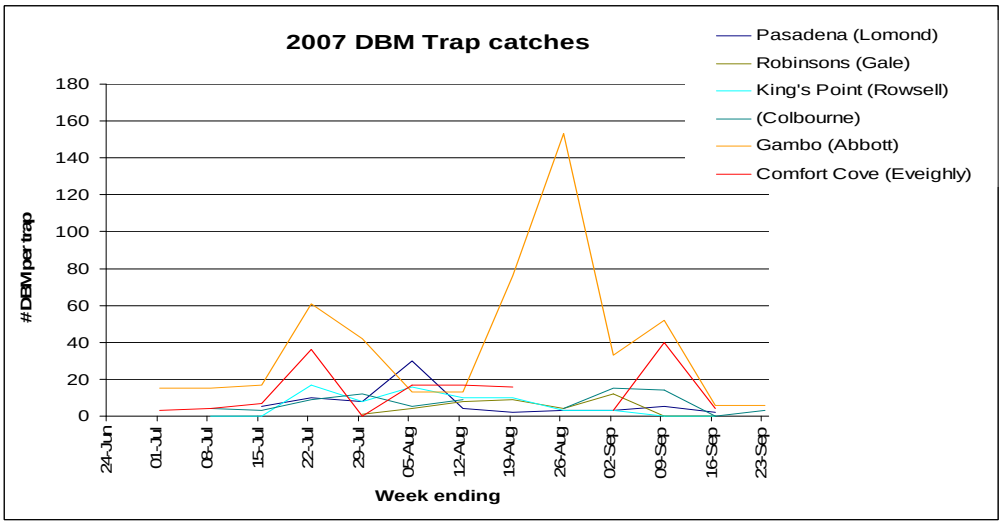


Figure 1: Diamondback moth trap catches by location 2005 - 2007.

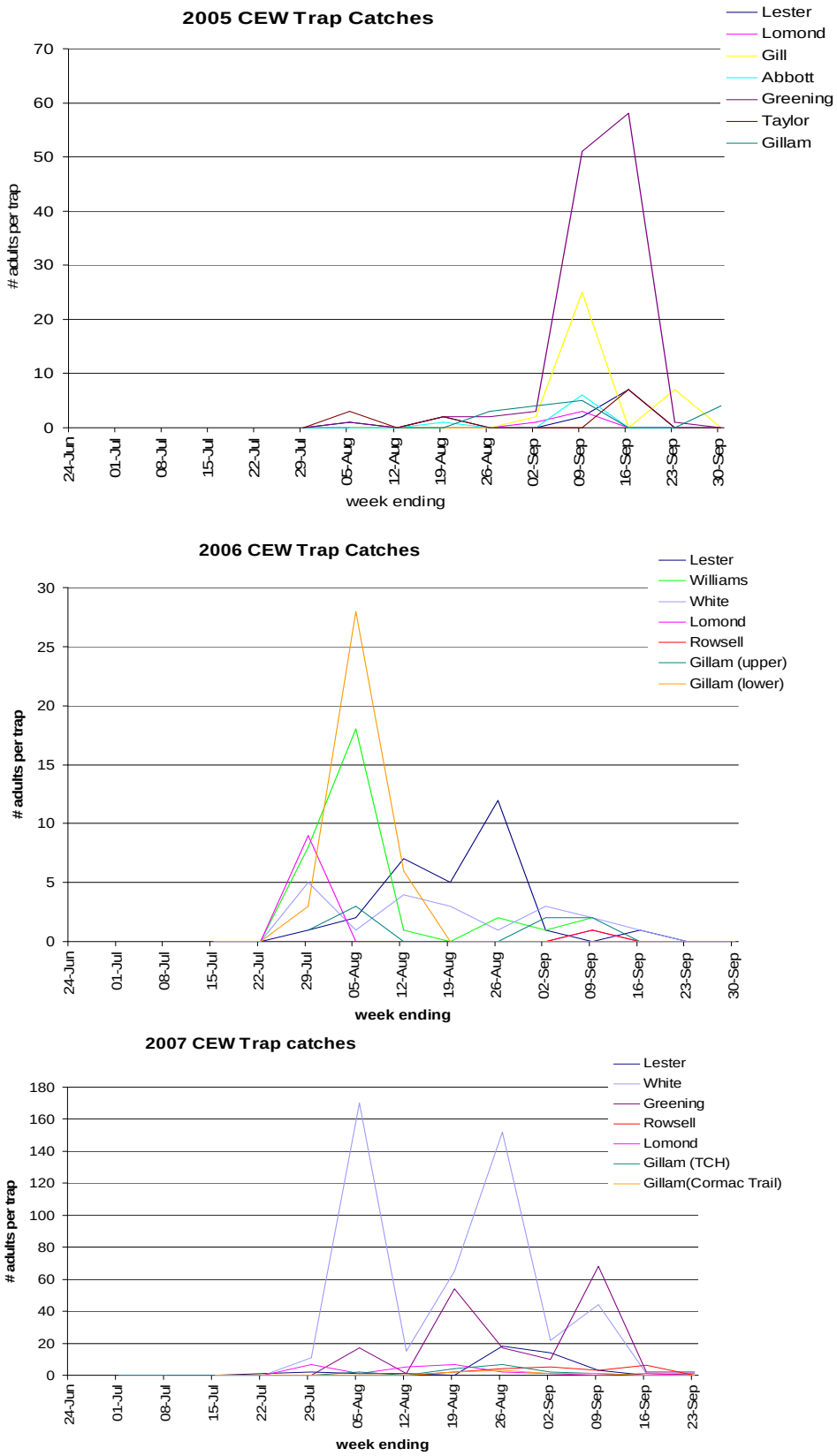


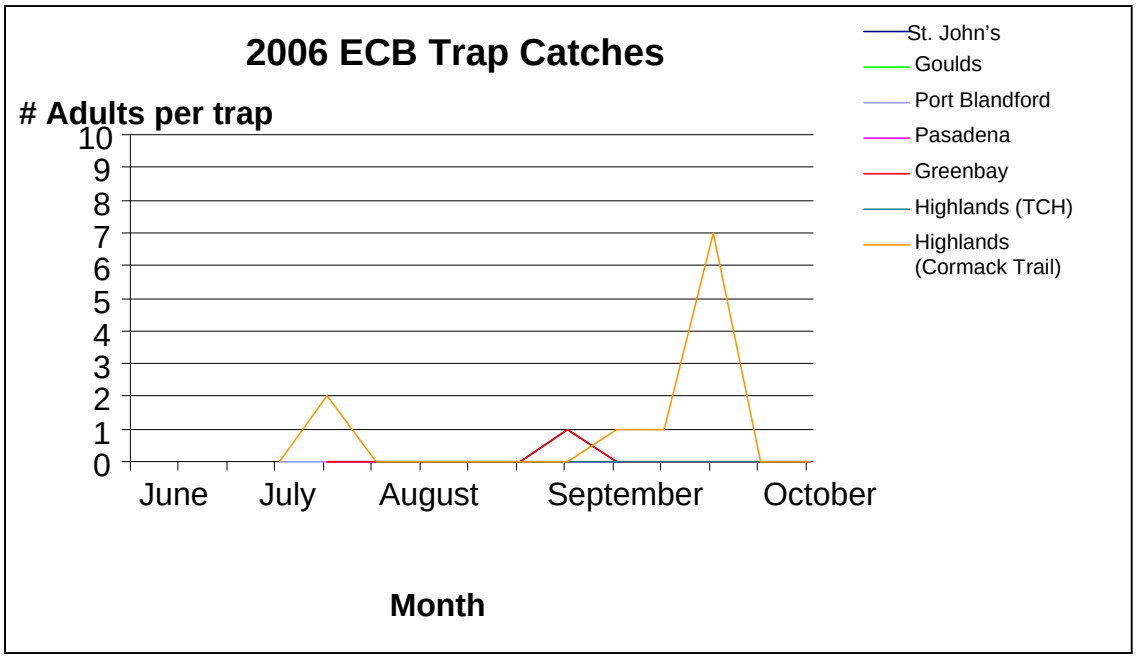
Figure 2: Corn earworm adult trap catches by farm, 2005-2007.

The monitoring sites for Sweet Corn were set-up mid-June to the beginning of July, and the pheromone traps were placed out. Corn earworm populations were detected during the end of July/mid-August. Arrival dates vary from the last week in July to the middle of August. The populations of this pest were significantly higher in 2007 than 2005 or 2006 (Figure 2). It was also observed that the adult flight period lasted into September for the duration of this project, with lower numbers of adults at the end of the flight period.

In 2005, small numbers of corn earworm arrived at most locations by the first week in August. Peak activity recorded for most farms was during the week ending early-September. Only Musgravetown and Wooddale recorded trap counts over 10 adults per trap (Figure 2).

In 2006, there were low trap catches at most locations across the province. There were trap catches over the entire trapping period at Port Blandford. The site Gillam (Cormack Trail) had the most activity with over 25 adults per trap during the week ending in early-August.

In 2007, there were high numbers of adult corn earworm caught in the traps at Port Blandford and Musgravetown. The corn earworms were present by the end of July/early August with peak activity occurring in the end of August/early September.



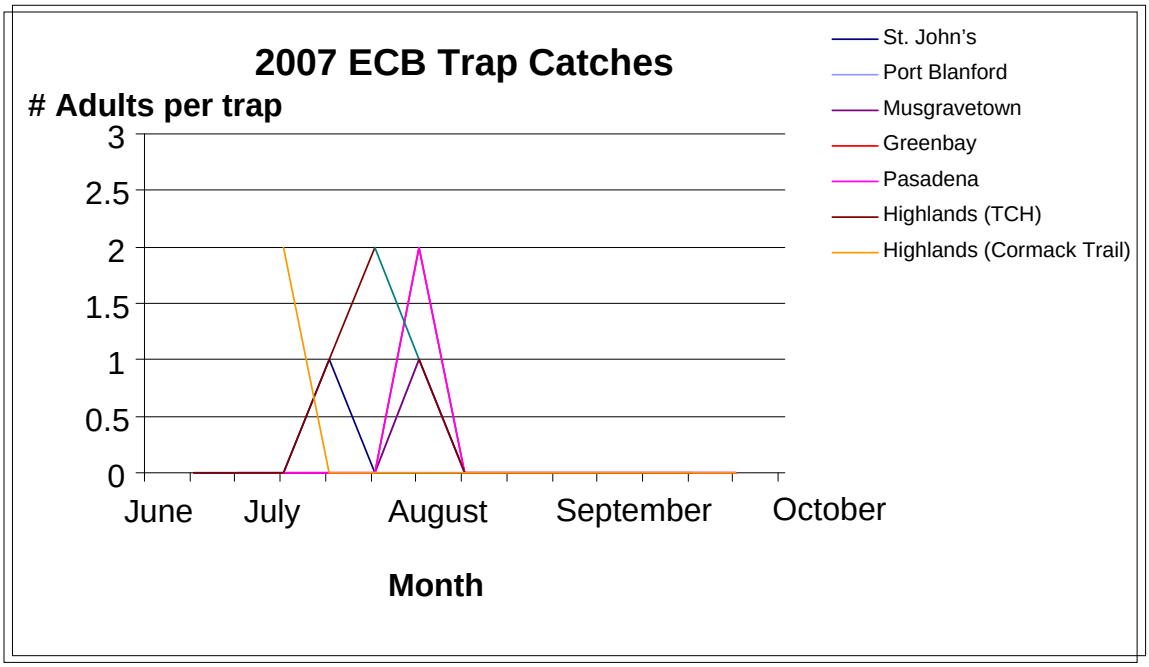


Figure 3: European Corn Borer adult trap catches by farm, 2006-2007.

Another common economical pest of sweet corn, the European corn borer was observed at all locations, with higher numbers (through caterpillar counts) on the west coast of Newfoundland and Labrador. Due to these finding, pheromones for the European corn borer were added to the monitoring program in 2006 and 2007. The pattern of higher population counts on the west coast was observed in 2006 as well as in 2007.

There were low catches of European cornborer over both years. The site Highlands (lower), during 2006 was the only farm to have multiple catches over multiple dates, although not in economical populations. The other sites observed during 2006 and 2007 had sporadic population counts. Arrival times were undeterminable, due to the low trap catches. In 2006, there were catches at the site Highlands (Cormack Trail) from July to the first few weeks of September (Figure 3). In 2007, the most activity for the European cornborer was found to occur between mid-July and early August.

Discussion

Control methods for the Diamondback Moth:

Though arrival dates were not determined, it was observed that the activity of the adult moths was weather dependent. Cold and wet weather decreases the flying movement which can affect the mating pattern of the diamondback moth. Thus, egg laying could be delayed and/or decreased. This type of weather would also lengthen the time it takes to complete this pest's lifecycle; therefore there may be a decrease in the generations that appear in one season. In Ontario, it was found that there can be up to four generations per season, again dependant on weather. The final generation is of less economical importance, because it does less damage, due to growth stage of the crop (OMAFRA2, 1998).

Caterpillars feeding directly on the heads or growing points are a more serious threat than those feeding on the outer leaves. When plants are small, damage has a more profound effect on yield and head size. Therefore, caterpillar control is more critical just before harvest because of feeding damage and the presence of grass.

Several beneficial predators and parasites occur naturally in the field. These parasitic wasps and flies may keep the pest populations low, but economic control cannot be achieved from these insects. Research in Ontario has shown that fields where IPM is practiced can have more than 50% parasite rates (OMAFRA, 1996).

Two different methods for accessing the action threshold for the diamondback moth are the Cabbage Looper Equivalent (CLE) or % infestation (OMAFRA, 1996). Newfoundland and Labrador has not established its own thresholds. These recommendations are available from the Ontario Ministry of Agriculture Food & Rural Affairs.

<u>Cabbage Looper Equivalent (CLE):</u>
On 25 plants from the 5x5 scouting:

- Record the number of *cabbage loopers, imported cabbageworms and diamondback moths*
- Multiply: a = *cabbage loopers* x 1.0, b = *imported cabbage worms* x 0.5, c = *diamondback moths* x 0.2
- Add together: a+b+c
- Divide by 25
- Thresholds: cabbage = 0.3, cauliflower/broccoli = 0.2-0.3

<u>% Infestation:</u>
On 25 plants from the 5x5 scouting:

- Add: the # of plants that have 1 or more caterpillars
- Multiply: by 4
- Thresholds:
    - Cabbage – 20-30% before head fill, 10-15% after head fill
    - Cauliflower/Broccoli – 20-30% before heading, 5-10% after heading

Insecticides are more effective against small larvae than larger ones. Application of insecticides should be started when young larvae are found and continue on a five-to-10 day schedule, or as necessary for adequate protection of the crop. Scouting is an excellent way to assess the population of brassica-crop caterpillars (OMAFRA2, 1998). These thresholds were developed for Ontario and may vary for Newfoundland and Labrador.

Control methods for the Corn Earworm:

Corn growers applied mineral oil to the silk of each ear to prevent invasion by corn earworms. This is an effective control for the pest, but is time consuming and the oil left at the ear tip may be distasteful to consumers (OMAFRA1, 1998).

Several predators and parasites, including ladybird beetles, lacewings, predatory bugs, and parasitic flies and wasps, attack earworm eggs and larvae. These beneficial insects are naturally present in the field and may keep the pest population in check. They are not, however, adequate for economic control. To date, no commercially available biological control agents will effectively control the earworm.

Those who want to avoid earworm damage without the use of insecticides must plant early. Sweet corn harvested before the middle of August is usually free of earworms. After that time, insecticides may be necessary to protect the crop. The late growth stage and variety choice of corn (tight wrapped cobs) may deter the caterpillar from entering the cob later in the season.

The corn earworm does not overwinter in Newfoundland and Labrador. Once the adult is captured in the traps, the thresholds that are representative of this pest are measured by the amount of moths that are captured in a trap per week and the temperature/weather. When pesticides are used these counts will determine the spray interval for this pest, as seen below in Table 1 (OMAFRA1, 1998). These thresholds were developed for Ontario and may vary for Newfoundland and Labrador.

Table 1: Spray Interval Thresholds for the Corn Earworm.

Moths per trap per week	**Daily Maximum Temperature**	
	< 27°C (81°F)	**27°C (81°F)**
1- 6	5- 7 days	>5- 7 days
7- 90	5 days	4 days
More than 90	4 days	3 days

Control methods for the European Corn Borer:

Shredding sweet corn residue/debris after harvest is an effective way to destroy borers overwintering in stalks and stubble. The European corn borer has the potential to overwinter in Newfoundland and Labrador. It is possible that as acreages of sweet and silage corn increase, pest populations will increase, respectively.

The presence of eggs or 5% feeding injury on the corn plants warrant insecticide control. Table 2 can be used to determine if insect control is necessary. Timing is the key to the successful use of pesticides against this pest. The first application should coincide with the first signs of feeding damage done by this pest. Applications at five to seven day intervals give satisfactory control (OMAFRA3, 1998). These thresholds were developed for Ontario and may vary for Newfoundland and Labrador.

Table 2: Threshold levels for The European Corn Borer

Plants Examined	Spray if > than # are damaged
>5- 25	3
30- 50	4
55- 105	5>

The primary weed pests that were noted during this project were Lady's Thumb (*Polygonum persicaria*), Chick weed (*Stellaria media*) and Lamb's quarters (*Chenopodium album*). These three weed species were present at most sites over the three-year project. Other weed species that appeared to be more site specific include wild mustard (*Sinapis arvensis*), hemp nettle, corn spurry (*Spergula arvensis*), dandelion (*Taraxacum officinale*), goldenrod and Kentucky blue grass (*Poa pratensis*).

Conclusions

This project has monitored and recorded diamondback moth and corn earworm populations throughout various locations in Newfoundland and Labrador from 2005/2006 to 2007/2008. The European Corn Borer, after being established as a primary insect species on sweet corn, was monitored from 2006/2007 to 2007/2008.

Arrival dates for the diamondback moth were not determined, but it had been observed that the activity of the adult moths is weather dependent. It was found there can be up to four generations per season, which again is dependant on the weather. It was also found that the final generation is of less economical importance because it does less damage due to growth stage of the crop.

Arrival dates of the corn earworm varied from the last week in July to the middle of August. It was also observed that the adult flight period lasted into September, with lower numbers of adults at the end of the flight period. The variety choice of corn (with tight wrapped cobs) may deter the caterpillar from entering the cob later in the season.

The European corn borer has the potential to overwinter in Newfoundland and Labrador. Shredding corn residue/debris after harvest is an effective way to destroy borers overwintering in stalks and stubble. It is possible that as acreages of sweet and silage corn increase, pest populations will increase, respectively.

Possible future research endeavors and recommendations include early monitoring for arrival dates of species that do not overwinter in Newfoundland and Labrador. The Department of Natural Resources will assist producers in establishing IPM programs on their farms as well as monitor new potentially economic pests to the vegetable industry in Newfoundland and Labrador.

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