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2020
Gypsy Moth Aerial Spray Program
Town of Pelham

Prepared For:

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Introduction

In May 2020, the Town of Pelham implemented an aerial spray program to treat various parts of the Town for gypsy moth. The goal of the program was to have less than 50% defoliation in sprayed blocks. Lallemand Inc./BioForest (“BioForest”) was contracted by the Town to provide spray timing and assessment services. This report presents an overview of the spray program and the methods for and the results of the timing and assessment of the program.

Program Overview

Figure 1 presents an overview of the gypsy moth spraying that took place in the Town of Pelham in 2020. In Ontario, spray programs also took place in the City of Sarnia and in five Grand River Conservation Authority properties (Brant, Byng, Dickson, Dryden and Pinehurst).

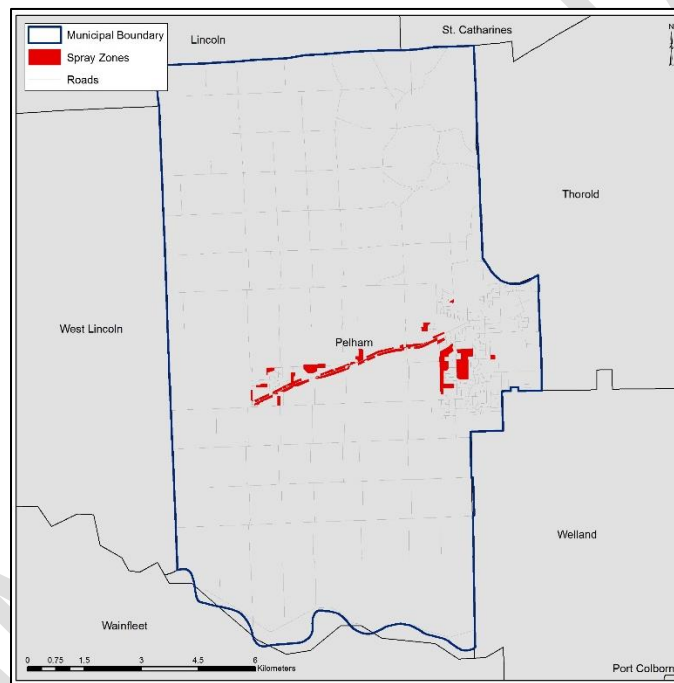


Figure 1. 2020 Pelham, Ontario aerial spray program overview.

In the Town of Pelham, a total of 130.5 hectares in the urban areas of Fenwick and Fonthill, as well as a corridor along Canboro Road, were treated with two applications of Foray 48B (*Bacillus thuringiensis* var. *kurstaki* [Btk]), supplied by Valent BioSciences Corporation and applied at a rate of 50 BIU/4.0L/ha. The first application of Btk took place on May 27, and the second application took place on June 4.

Methods

Spray Timing

The benefits of using Btk to control gypsy moth are maximized when first applications target host leaves that are providing an optimum deposit surface. For white oak and red oak, the target level of leaf development is 30-40% and 50-60%, respectively. These stages of leaf development typically coincide with first and second instar gypsy moth larvae.

BioForest monitored gypsy moth development using BioSIM, a software tool for predicting larval development. Host leaf development and egg mass hatch was monitored from field measurements.

BioSIM Forecasts

BioForest used the latest version of the BioSIM phenology model developed by the Canadian Forest Service to provide advance indication of probable program start dates based on 90% gypsy moth egg hatch. BioSIM was also used to assist with the timing of field activities.

Host Development

To monitor host development, the following development plots were established in or near the following spray blocks: Hillside Cemetery, Cherry Ridge Park, Memorial Drive, Haist Street, Hillcrest Park, Kunda Park, Timmsdale Crescent (Figure 2).

Sampling in development plots took place on May 6, May 13, May 19, May 22 and May 25. To track host leaf expansion in each development plot on each sample date, one 40cm branch was clipped from each of 10 trees, and 10 leaves were measured and compared to mature leaf size to determine percent development. When possible, the 10 trees sampled were five red oak and five white oak. When a representative branch could not be collected due to tree height, visual ground surveys were conducted using binoculars.

Egg hatch observations were made by marking 50 egg masses at each development plot and monitoring those same 50 egg masses for the duration of the assessment period. Field crews were careful to include egg masses at various heights and at different exposures, to account for these factors that influence egg hatch timing.

Weather

On spray days, for both applications, BioForest field crews monitored weather conditions in or near the spray blocks being sprayed. Temperature, relative humidity, wind speed and direction were recorded every five minutes. Any significant deviations from specified weather parameters were reported to command central.

Spray Assessment

Spray Deposit

For both applications, spray deposit was assessed using the ADAM (Accurate Deposit Assessment Method) Field Kit supplied by Valent BioSciences Corporation. Following each application, foliage samples from between two and five trees were collected from a sub-sample of the spray blocks within 6 hours. Foliage samples were stored at 4°C until they could be processed in the lab. The amount of deposit was determined for each sample, and a deposit index was calculated for each spray block sampled. The deposit index calculations were based on the following ADAM Kit deposit categories:

- 1 = nil (0 ng Btk/ml)
- 2 = low (< 20 ng Btk/ml)
- 3 = moderate (20 – 100 ng Btk/ml)
- 4 = high (> 100 ng Btk/ml)

Defoliation Surveys

Host defoliation rates were assessed upon completion of gypsy moth larval feeding. On June 30, BioForest field crews evaluated defoliation in 10 of the spray blocks, as well as seven sites not included in the spray program. Evaluated trees were a combination of red and white oak and were selected to provide a representative sample of each block. Three branches from each tree were assessed and assigned one of the following six defoliation classes: <5%, 6-25%, 26-50%, 51-75%, 76-95% and >95%. Each tree was also assigned an overall defoliation class.

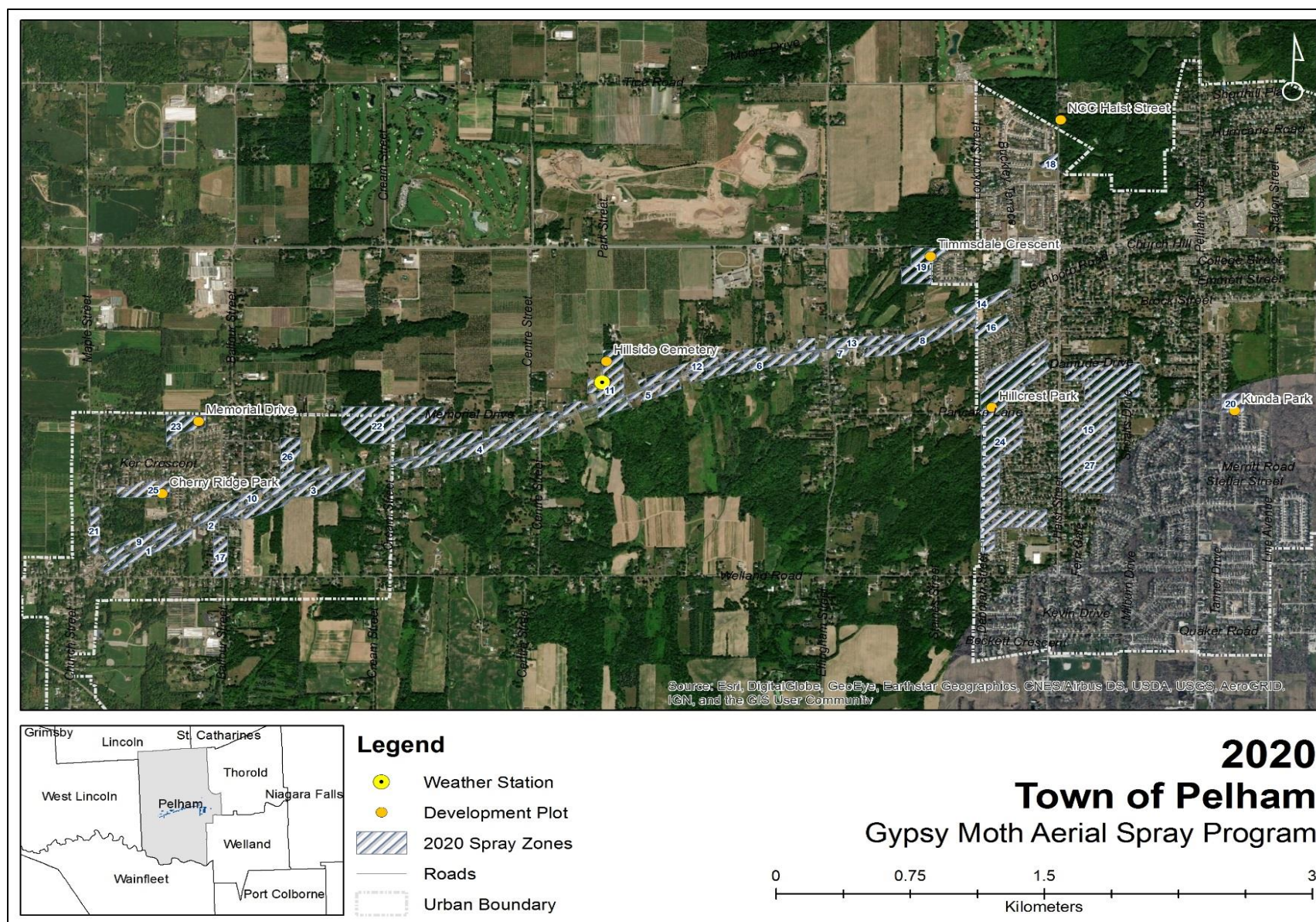


Figure 2. Development plots and weather stations for 2020 Town of Pelham aerial spray program.

Results

Spray Timing

BioSIM Forecasts

On April 27, BioSIM predicated that 90% egg hatch would occur in Pelham between May 20 and May 25.

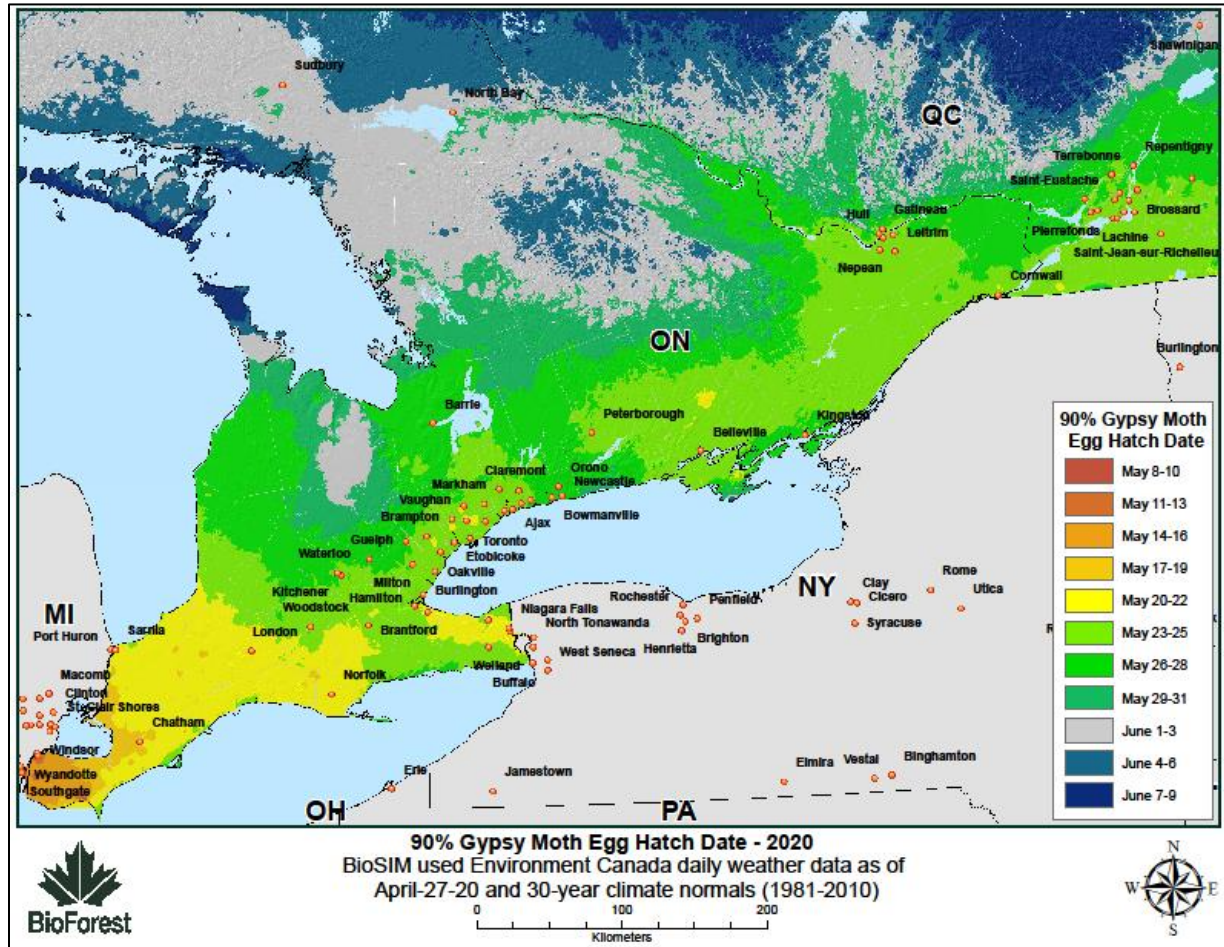


Figure 3. BioSIM prediction of 90% gypsy moth egg hatch in Ontario as of April 27, 2020.

To fine tune that prediction, field sampling to monitor host development and egg hatch began on May 6.

Host Development and Egg Hatch

Figure 4 presents red and white oak development from each of the development plots that were monitored. Figure 5 presents gypsy moth egg hatch from all of the development plots where egg masses were monitored.

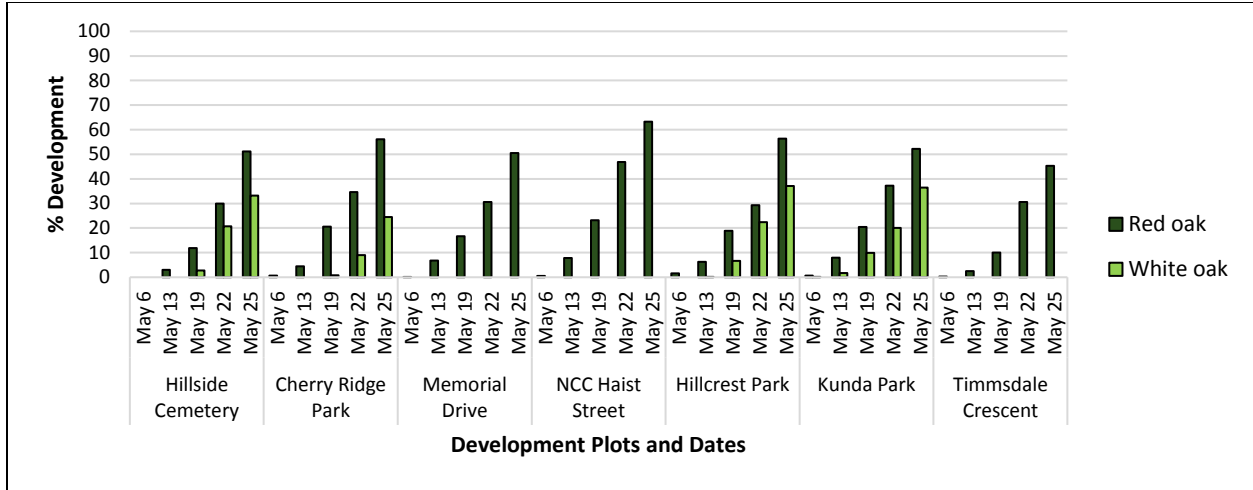


Figure 4. Percent development of red and white oak in Town of Pelham development plots, 2020.

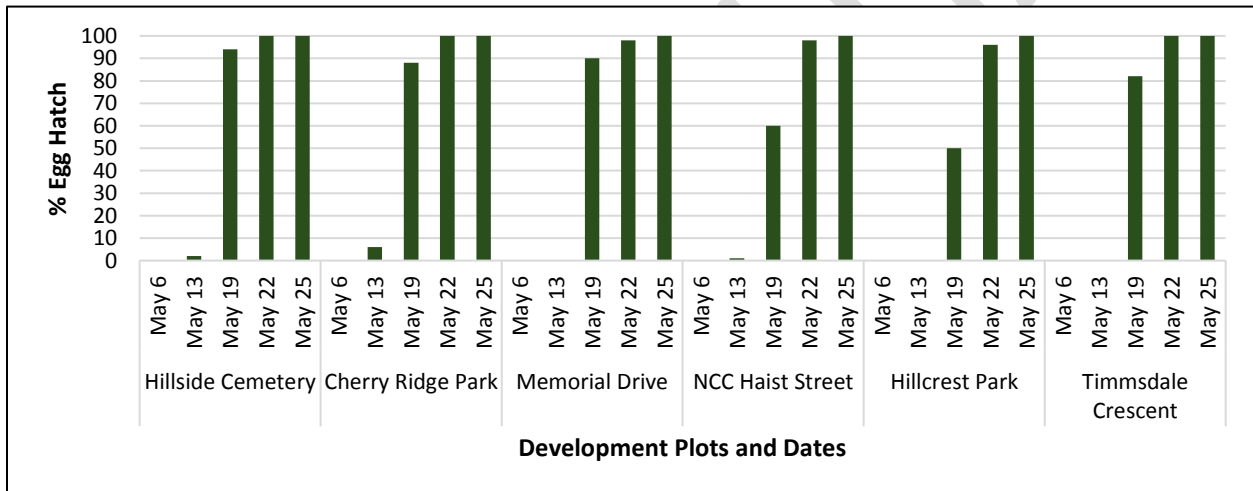


Figure 5. Percent gypsy moth egg hatch in Town of Pelham development plots, 2020.

The first application occurred on May 27, when white oak development ranged from approximately 24.5 to 37.1%, red oak development ranged from approximately 45.3 to 63.3% and egg hatch was observed to be 100% at all plots.

Weather

Spray weather parameters for the Town of Pelham aerial spray program were:

- Calm winds (less than 16 km/h)
- High humidity (>40%)
- Temperatures between 2 and 25°C
- No precipitation within 24 hours, minimum 6 hours

Detailed weather data collected on spray days is presented in Appendix A. Table 1 summarizes the weather data collected on each spray day.

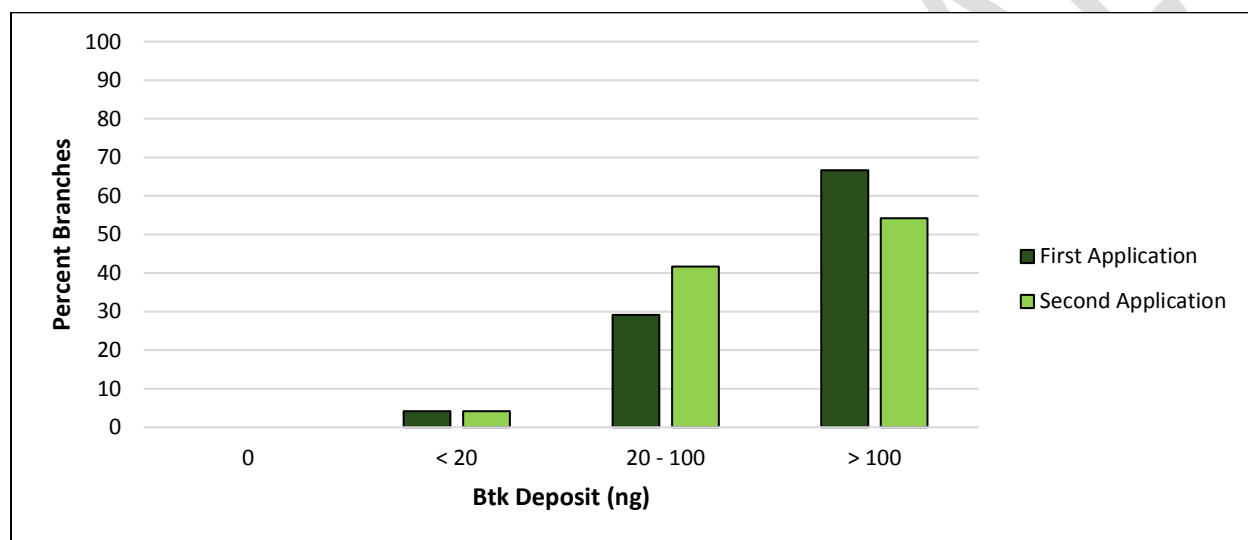
Table 1. Weather summaries for the 2020 Town of Pelham aerial spray dates.

Spray Date	Application	Blocks Sprayed	Weather Station	Average Wind Range (km/h)	Temperature Range (°C)	RH Range (%)
May 27	1	All	Hillside Cemetery	0 – 3.2	20.3 – 23.0	69 – 81
June 4	2	All	Hillside Cemetery	0 – 1.9	13.6 – 19.2	64 – 96

Spray Assessment

Spray Deposit

After the first application, all branches sampled had Btk present (Figure 6). The majority of branches sampled after each application had 20-100 ng Btk/ml (deposit index of 3), or >100 ng Btk/ml (deposit index of 4). Table 2 presents the deposit index after each application for each of the nine spray blocks sampled with the ADAM Kit.

**Figure 6. Amount of Btk on branches sampled from nine Town of Pelham spray blocks, 2020.****Table 2. Average deposit index (ADAM Kit) after each application in nine Town of Pelham spray blocks, 2020.**

Spray Block	Description	Location	Average Deposit Index – First Application	Average Deposit Index – Second Application
25	Cherry Ridge Park	Fenwick	4.0	3.3
21	Maple Street	Fenwick	4.0	3.5
17	Garner Avenue	Fenwick	4.0	3.5
26	Sunset Drive	Fenwick	4.0	3.5
22	Memorial Drive	Fenwick	3.7	3.7
11	Hillside Cemetery	Canboro Corridor	3.7	3.3
18	Haist Street	Fonthill	2.7	3.5
24	Hillcrest Park/ Berkwood Place/ Rolling Meadows	Fonthill	3.7	4.0
15	Oak Lane/ Pancake Lane/ Cross Hill Road	Fonthill	3.3	3.3

Defoliation Surveys

Of the 100 trees that were evaluated for defoliation within the spray blocks, the significant majority of branches (84.3%) and trees (94%) had less than 5% defoliation (Figure 7 and Figure 8). None of the trees had more than 25% defoliation, and only 1% of branches evaluated had more than 25% defoliation.

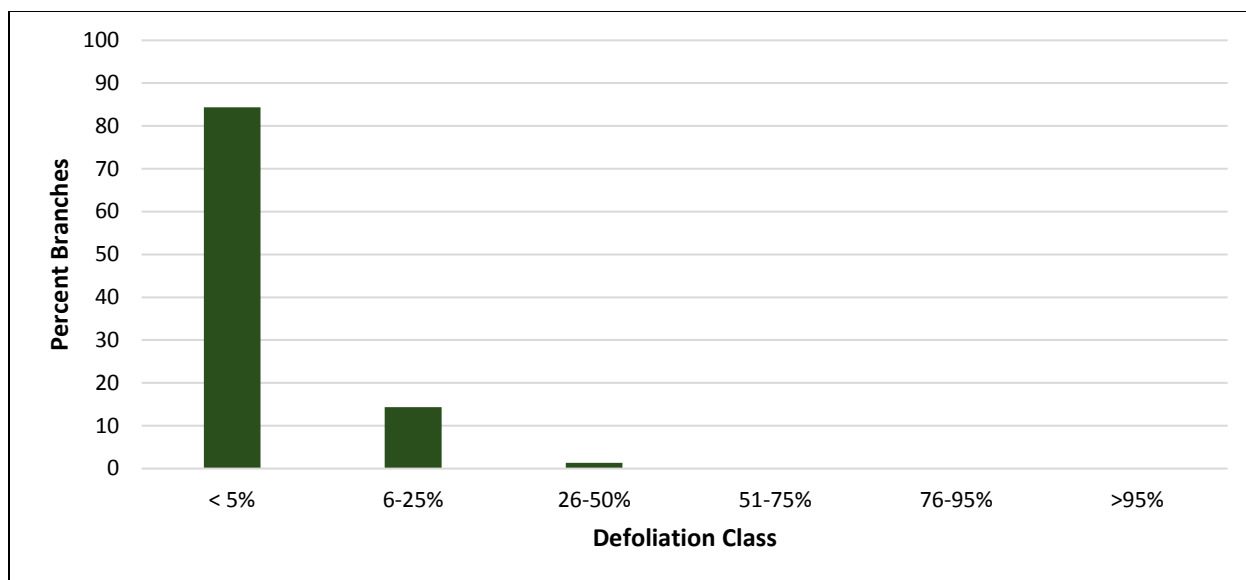


Figure 7. Percent branches in each defoliation class from 10 Pelham spray blocks, 2020.

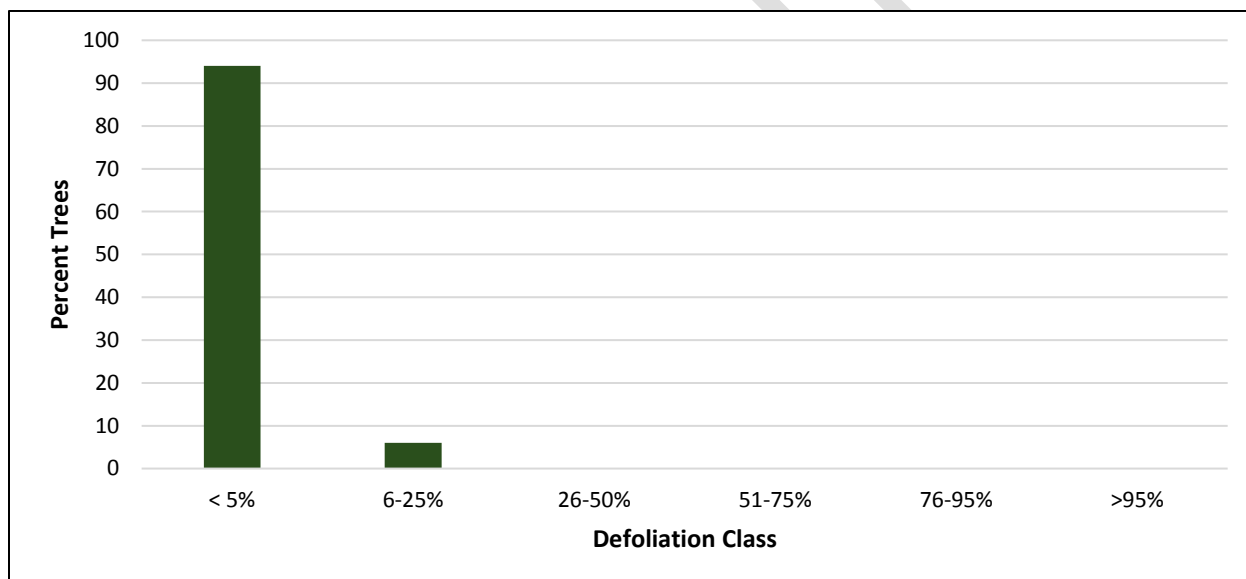


Figure 8. Percent trees in each defoliation class from 10 Pelham spray blocks, 2020.

For comparison purposes, seven sites that were not sprayed (but were forecasted to experience severe defoliation by the 2019 egg mass surveys) were also evaluated for defoliation. The majority of branches (57%) and trees (51.4) exceeded 50% defoliation (Figure 9 and Figure 10).

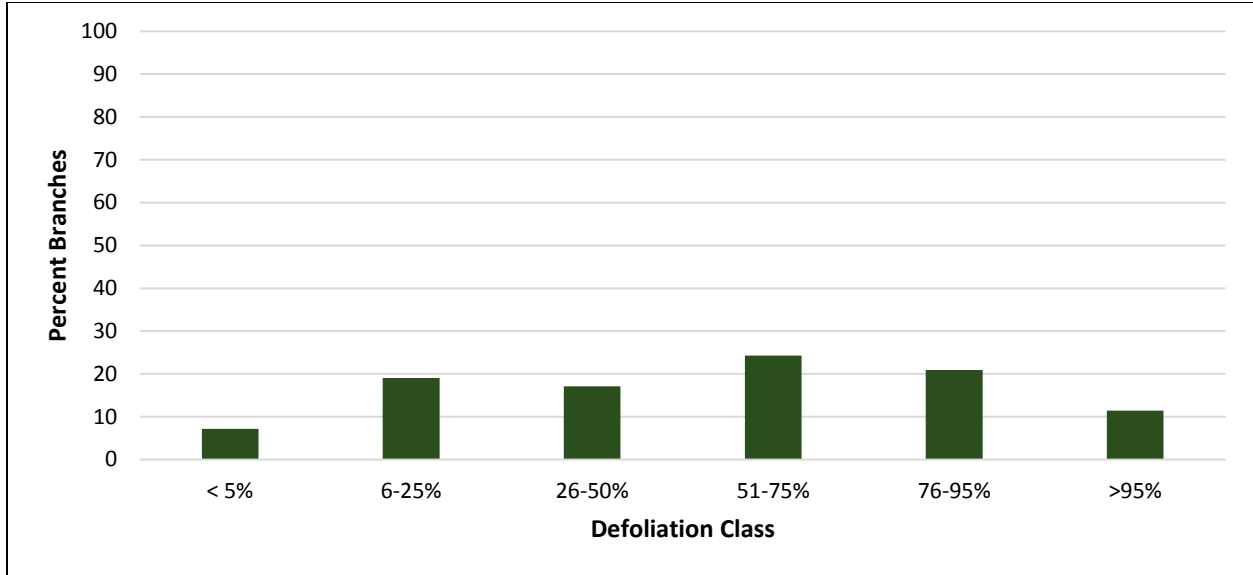


Figure 9. Percent branches in each defoliation class from sites with severe defoliation forecasts NOT included in Pelham spray area, 2020.

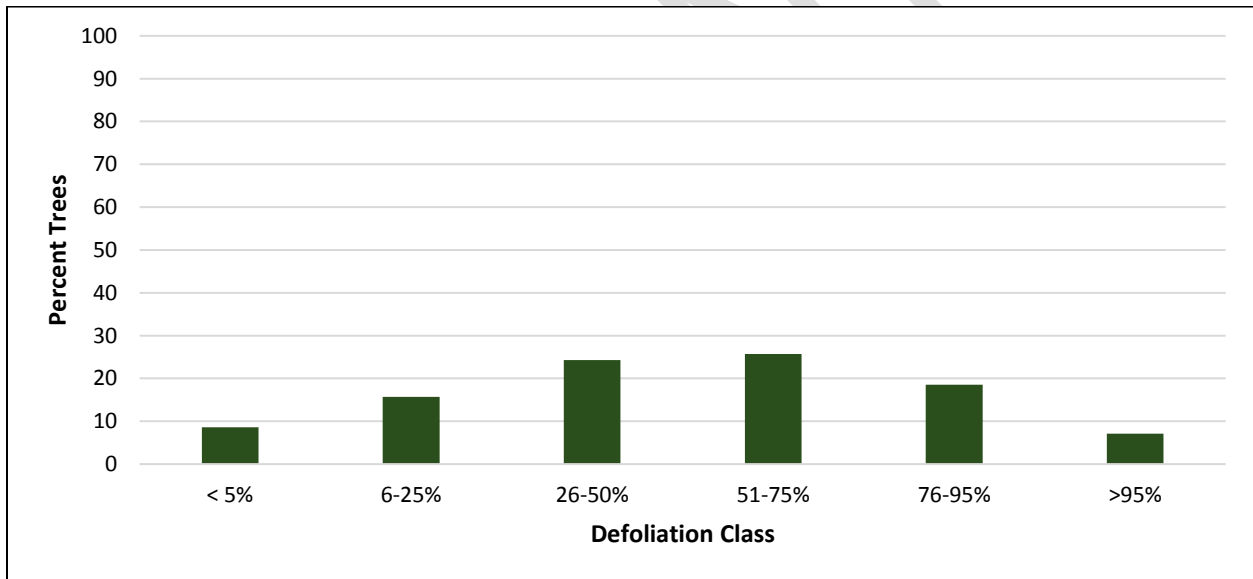


Figure 10. Percent trees in each defoliation class from sites with severe defoliation forecasts NOT included in Pelham spray area, 2020.

Conclusion

The Town of Pelham’s management objective, as per Policy No. S801-14, is to “...protect the tree canopy within its Municipal Boundary against tree mortality caused by defoliation by the gypsy moth...” Assessment of the 2020 aerial spray program indicates that the program was effective at achieving program goals. Host development and egg hatch at the time of spraying were within acceptable ranges. For each of the spray dates, the average wind, temperature, and relative humidity were within spray parameters. There was some rain on the day after the first application (15.5 mm), however the Btk had sufficient time to dry and adhere to the leaf surface (six hours post-application, rain-free).

Following the first application, all branches sampled had Btk present, and following the second application all branches sampled had Btk present. All blocks had Btk present following both applications. None of the trees surveyed within the spray area had greater than 25% defoliation and most had less than 5% defoliation, which confirms that the rain event following the first spray day did not have a negative impact on program results.

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Appendix A: Spray block wind, temperature and relative humidity records for Town of Pelham spray days

Spray Day Weather Record										
Location:		Hillside Cemetery					Date:		May 27 2020	
GPS Coordinates:		Zone	Easting		Northing					
		17T	636337		4766163					
Crew:		AC		Application:		1st	2nd			
Time	Wind					Temperature		RH		Comments
	Avg		Max			°C	↑ ↓ →	%	↑ ↓ →	
	kph	Direction	kph	Direction	Time					
5:30	0	-	0	-	-	22.5	→	69	→	
5:35	0	-	0	-	-	21.5	→	74	→	
5:40	0	-	0	-	-	21.0	→	76	→	
5:45	0	-	0	-	-	20.7	→	79	→	
5:50	0	-	0	-	-	20.6	→	79	→	helicopter up
5:55	0	-	0	-	-	20.4	→	80	→	
6:00	1.3	E	3.5	E	6:04	20.4	→	80	→	
6:05	1.9	E	4.5	E	6:06	20.3	→	81	→	
6:10	0	-	0	-	-	20.4	→	81	→	
6:15	0	-	0	-	-	20.4	→	81	→	
6:20	2.4	E	2.9	E	6:22	20.4	→	81	→	helicopter overhead
6:25	1.9	E	2.5	E	6:27	20.5	→	80	→	helicopter overhead
6:30	0.9	E	3.5	E	6:32	20.7	→	80	→	
6:35	0	-	0	-	-	20.9	↓	78	↑	
6:40	0	-	0	-	-	20.9	↓	75	↑	
6:45	0	-	0	-	-	20.9	↓	76	↑	
6:50	0	-	0	-	-	20.9	→	77	→	
6:55	0.8	E	1.9	E	6:56	20.9	→	77	→	
7:00	2.1	E	3.5	E	7:03	21.1	→	76	↓	
7:05	1.4	E	2.9	E	7:09	21.1	→	77	↓	
7:10	0	-	0	-	-	21.8	→	76	↓	
7:15	0.6	NE	1.7	NE	7:19	22.0	↑	74	↓	
7:20	3.2	NE	5.1	NE	7:21	22.2	↑	75	↓	
7:25	0	-	0	-	-	22.9	↑	75	↓	
7:30	2.7	NE	5.7	NE	7:34	23.0	↑	74	→	helicopter down

Spray Day Weather Record										
Location:		Hillside Cemetery					Date:		4-Jun-20	
GPS Coordinates:		Zone	Easting		Northing					
		17T	636337		4766163					
Crew:		AC		Application:		1st	2nd			
Time	Wind					Temperature		RH		Comments
	Avg		Max		Time	°C	↑ ↓ →	%	↑ ↓ →	
	kph	Direction	kph	Direction						
5:30	1.7	E	3.3	E	5:31	19.2	↓	64	→	
5:35	0.6	-	1.3	E	5:39	15.9	↓	78	→	
5:40	0	-	0	-	-	14.8	↓	85	→	
5:45	0	-	0	-	-	14.1	↓	90	↑	
5:50	0.5	E	1.1	E	5:54	13.8	↓	94	↑	
5:55	0	-	0	-	-	13.8	↓	95	↑	
6:00	0	-	0	-	-	13.7	↓	96	↑	helicopter overhead
6:05	1.2	E	6.4	E	6:07	13.6	↓	96	↑	helicopter overhead
6:10	0	-	0	-	-	13.7	↓	96	↑	
6:15	0	-	0	-	-	13.8	↓	96	↑	
6:20	0	-	0	-	-	14.0	↓	96	↑	
6:25	1.3	SE	1.9	SE	6:26	13.8	↓	96	↑	
6:30	1.5	S	3.7	S	6:34	13.9	↓	96	↑	
6:35	1.9	S	2.9	S	6:38	14.0	↓	95	↑	
6:40	1.3	S	5.1	S	6:40	14.0	↓	95	↑	
6:45	1.3	S	1.5	S	6:46	14.1	→	94	↑	
6:50	0.9	S	6.9	S	6:54	14.3	→	94	↑	
6:55	1.1	S	2.5	S	6:55	14.4	→	94	↑	
7:00	1.2	S	4.1	S	7:04	14.8	↑	93	↓	
7:05	0.9	S	3.3	S	7:05	14.9	↑	92	↓	helicopter down