



NOTE

Rhagoletis pomonella (Diptera: Tephritidae), a new record for the island of Newfoundland

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The apple maggot, *Rhagoletis pomonella* (Walsh) (Diptera: Tephritidae), is one of the most serious pests of apples in North America (CABI 2015) and is strictly regulated to prevent spread to important apple producing regions around the world. In Canada, it has been recorded from Prince Edward Island, New Brunswick, Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and portions of British Columbia (CFIA 2016). *Rhagoletis pomonella* is well-studied, especially regarding ecological speciation and host shifts (Feder 1998; Berlocher and Feder 2002). This native North American pest moved onto domesticated apples (*Malus pumila* P. Mill.) (Rosaceae), from its ancestral host, hawthorn (*Crataegus* spp.) (Rosaceae), in the mid-1800s. In addition to apples and hawthorn, *Rhagoletis pomonella* has been documented on 55 additional host plants (see Yee et al. 2014).

Berlocher and Dixon (2004) conducted an extensive survey of *Rhagoletis* spp. on the island of Newfoundland. The authors collected 45,055 fruits from several species of fruiting plants known to be hosts of *Rhagoletis* spp. elsewhere in North America, including 2960 *Crataegus* spp. fruits, collected in early September and mid-October, from three areas on the island. *Crataegus* spp. known from Newfoundland include the native *Crataegus chrysocarpa* and *Crataegus macrosperma*, as well as the ornamental *Crataegus monogyna* (Todd Boland, Memorial University Botanical Garden, St. John's, Newfoundland and Labrador, personal communication 2016). The collections did not include apples. The lack of detection of *Rhagoletis pomonella* was attributed to the rarity of Newfoundland *Crataegus*.

In August 2016, CP was contacted by a family member about “maggots” infesting their apples on a backyard tree in Port Blandford, NL (Site 1) (Figure 1). Photos were taken and a sample of 2–3 dozen apples collected and brought back to the Agriculture & Agri-Food Canada Entomology lab at the St. John's Research and Development Centre, St. John's, NL. Apples presented with classic apple maggot feeding tracks (Figure 2); approximately six, were subsequently cut open and larvae removed. These larvae were identified as Tephritidae by CP (key provided by BS) and a sub-sample was subsequently sent to BS at the Canadian National Collection of Insects (CNC) in Ottawa where they were confirmed as *Rhagoletis pomonella* through taxonomic keys (Foote et al. 1993; Jackson et al. 2011) and host association. Remaining apples were placed in single layers on mesh hanging above plastic tubs containing sand and housed in a growth chamber (20 °C; 75% RH; 16 h light:8 h dark photoperiod). Emerging larvae fell into the sand and pupated. Puparia were removed via flotation in water, counted and placed in cups with a 2:1 volume sand:peat moss mix. Apples were subsequently collected from 4 additional sites (Sites 2-5) in the area surrounding the original tree (Figure 1), approximately 3 weeks after the first collection, and puparia extracted in the same manner as above. Less than 12 apples per site were collected at Sites 2-5.

Larvae emerged and pupated from apples collected from all five sites (Table 1). A total of 146 puparia were recovered. Of these, 101 were put in a cool room (5 °C +/- 2 °C) to overwinter, 30 were sent to BS for overwintering (growth chamber gradually reduced from 18 °C to 4 °C), and 15 placed in a growth chamber (20 °C; 75% RH; 16 h light:8 h dark photoperiod) to determine whether any adults would eclose without a cold period. The overwintered pupae were kept in the cool room for variable lengths of time, and transferred to the growth chamber (20 °C; 75%

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Figure 1. Map of the island of Newfoundland indicating location of sites sampled for *Rhagoletis pomonella*.

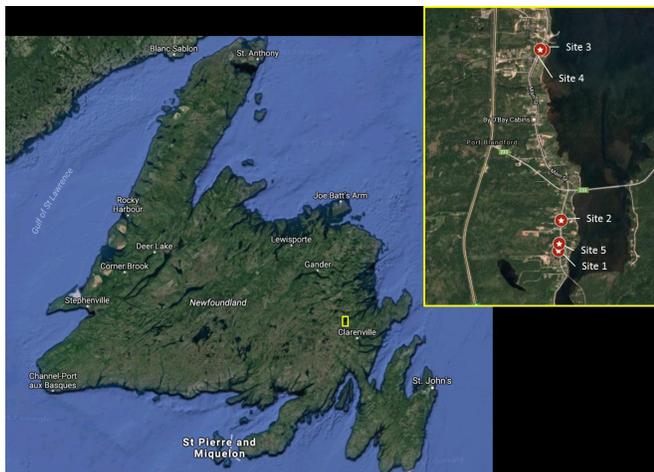


Figure 2. Apple collected at Port Blandford, NL showing typical apple maggot tunnelling damage.



RH; 16 h light:8 h dark photoperiod) for all subsequent rearings. Between 16 November – 18 December 2016, 11 adult flies (9 ♀, 2 ♂) eclosed from the 15 puparia housed in the 20 °C growth chamber; these were confirmed as *Rhagoletis pomonella* (Figure 3). It is well documented that *Rhagoletis pomonella* will forgo diapause if exposed to high temperatures for an extended period (Porter 1928; Prokopy 1968; Feder et al. 2010). Table 2 shows the eclosion totals of flies from the different sites under varying periods of cool treatment. No parasitoids emerged, and one fungus, suspected to be *Beauveria bassiana* (Hypocreales, Ascomycota), was isolated from one puparium. Voucher specimens were deposited in the CNC (database numbers: 1017996-1018013).

This is the first record of *Rhagoletis pomonella* in Newfoundland but it is not known how long this

Table 1. Sampling of apple trees for apple maggot, *Rhagoletis pomonella*, at five sites at Port Blandford, NL.

Site Number	Collection date	Lat/Long	No. of puparia
1	26 Sep / 15 Oct 2016	48.338036 -54.161113	117
2	15 Oct 2016	48.341602 -54.160623	22
3	15 Oct 2016	48.360839 -54.163564	1
4	15 Oct 2016	48.360881 -54.164127	5
5	15 Oct 2016	48.338952 -54.160910	1

Figure 3. Image of *Rhagoletis pomonella* collected and reared from infested apples at Port Blandford, NL.



population has been there. The owner of the tree at Site 1 observed similar damage for the past few years, but not beyond that. The lack of detection of *Rhagoletis pomonella* by Berlocher and Dixon (2004) may be the result of not collecting apples, not collecting in the area where the insect was discovered in 2016, the rarity of hawthorn (Berlocher and Dixon 2004), or possibly due to this population being a recent introduction via infested apples (Hood et al. 2013). The implications of finding this population on the island are unknown. Newfoundland does not produce apples for export and the reported production area according to Statistics Canada (2017) is only two acres. However, there has been an increase in the number of newly established orchards for both fresh market and cider production. The area of Newfoundland from which *Rhagoletis pomonella* was recovered is known for having an abundance of wild apple trees and this discovery could potentially impact future growth of the industry. In many apple producing areas, such as Nova Scotia, the threshold for application of insecticides is one

Table 2. Number of adult *Rhagoletis pomonella* eclosing from apples collected at Port Blandford, NL and subjected to different cold treatments.

Site Number	No. of puparia	No. of weeks in cold	No. of adult <i>Ragoletis pomonella</i> eclosed
1	15	0	11
1	72	20	41
*1	30	27	20
2	22	30	11
3	1	30	1
4	5	30	4
5	1	30	1

* these puparia were sent to and held under diapause conditions at the CNC, in Ottawa, Ontario.

fly per baited trap or 5 flies on unbaited traps (Braun and Craig 2018), and, regional management involves the culling of wild or unmanaged backyard apple trees. Further investigation into the distribution and population level of this pest and its potential impact on the imminent increase in apple production in the area is warranted.

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