

**CROP:** Onion (*Allium cepa* L.)  
**PEST:** Onion Maggot (*Delia antiqua* (L.))

**NAME AND AGENCY:**

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**TITLE: STERILE FLY RELEASE FOR ONION MAGGOT MANAGEMENT IN ONION SET AND COOKING ONION PRODUCTION IN ONTARIO**

**MATERIALS:** Sterilized/irradiated *Delia antiqua* pupae, onion maggot sticky traps.

**METHODS:** Four fields near Exeter, Thedford, and Scotland Ontario, were planted with onions in the spring of 2024. At the Exeter and Thedford field sites, two fields, approximately 28 km apart, with Granby sandy-loam (**Figure 1, A**) and Fox sandy-loam (**Figure 2, A**) soils, were seeded at a high density of ~20 million seeds/ha (~8 million seeds/ac) between 14 and 15 May to produce onion sets. The field near Exeter measured approximately 11.4 ha (28.3 ac) and the Thedford field was 12.4 ha (30.6 ac). In addition to these two fields, onions were also seeded ~2.0 km north of the Exeter field (**Figure 1, B–C**) but fly counts were not monitored. Both of the monitored fields had no insecticide treatments at planting or throughout the 2024 growing season (**Table 2**). The Exeter 2024 sterile insect release field was adjacent to fields where onions were grown and sterile flies were released in 2023, and approximately within 2.0 km from the 2018, 2019, 2020, 2021, 2022 onion fields with releases took place (**Figure 1, D–I**). Only the onion field near Thedford were there other major onion fields within 20 km of these sterile fly release fields.

Another two fields were transplanted with cooking onions near Scotland, Ontario, at an average density of ~345,000 plants/ha (140,000 plants/ac) with no insecticides used at planting or transplant, but other insecticides were applied to manage thrips later in the season (**Table 2**). The early transplanted field was comprised mainly of Scotland sandy-loam and directly adjacent to the later transplanted field which was comprised of Camilla sandy-loam. The early transplanted field is approximately 8.1 ha (20.0 ac) in size and was planted from 26 April to 8 May (**Figure 3, A**). The second field is approximately 4.6 ha (11.4 ac) in size and was planted from 8–15 May (**Figure 3, B**). Both fields had sterile flies released in 2024. There were no other major onion fields within a 20 km radius from either of these fields near Scotland. Sterile flies were released in nearby field that was cropped in onions in the last 5 years (**Figure 3, C–M**).

Onion flies were reared by Phytodata, then sterilized and released using Sterile Insect Technology (SIT) according to Phytodata protocol. The *Delia antiqua* pupae were irradiated by Phytodata using an x-ray irradiator (model RS 1800Q, Rad Source Technologies Inc., GA, USA), dyed pink, shipped to Thedford/Exeter and Scotland, ON, emerged as adult flies, and kept alive until release, following protocols developed by Phytodata Inc (**Figure 4, C**). Fly releases at the Exeter, Thedford and Scotland sites began the week of 7 May with both locations continued weekly releases until the week of 3 September. The Exeter and Thedford fields released an average of ~20,000 flies/ha/season while the Scotland site released at an average rate of ~100,000 flies/ha/season. Flies were released after harvest to target the onion maggot population that would overwinter. Flies were released at least 30 m from the closest sticky card trap at all fields. Four onion maggot sticky traps, consisting of three stakes with blue sticky cards clipped above the crop canopy, were placed on the middle of each side of every field (**Figure 4, B**). Cards were monitored weekly for natural onion maggot populations and sterile/pink fly

displacement throughout the growing season. In the fields producing onion sets in Exeter, damage plots (15 cm x 15 cm) capturing ~25 plants were set up a short distance away from the sticky traps at the flag leaf stage (**Figure 4, A**). At the Scotland fields, damage plots were created by counting out 25 plants on four rows for a total of 100 plants/plot. Damage plots were counted weekly until harvest at all field sites. The onions were harvested 16–29 August at the Exeter field, 10–15 August at the Thedford field, and from 12 August to 13 September at the first release field and from 13–20 September in the second release field near Scotland (**Tables 1, 3**).

**RESULTS:** As outlined in Tables 1–3 and in Figures 1–6.

**CONCLUSION:** Historically, onion maggot (*Delia antiqua*) management has relied heavily on group 1B organophosphates, specifically chlorpyrifos insecticides, which are now no longer a registered use pattern for onions in Canada. Sterile Insect Technology (SIT) in Québec has shown that the release rates of sterile flies could be decreased by up to 90% within 5 years of repeated use due to the reduction of wild populations, decreasing the cost of sterile fly programs over time. Likewise, based on previous monitoring and releases, this work demonstrates the decline of wild fly populations and offers an effective tool to manage onion maggot without chlorpyrifos.

In the Exeter and Thedford field sites, sticky card counts of wild flies indicated an average number of wild flies of 1.6 and 2.0 flies / trap / week throughout the season, which was similar to counts in 2023 (season average of 1.9 and 2.0 flies / trap / week) but both 2023 and 2024 was an increase compared to 2022 which saw an average of 1.1 and 1.2 flies / trap / week as a season average for the two fields monitored. The number of flies released per season per hectare started at 100,000 flies / ha / season and has been decreased to ~16,000 flies / ha / season. The Exeter field was within 2 km or less from the past seven years of onion set fields where sterile flies were released and the Thedford field was within 1 km of an onion set field in 2022 (**Figures 1–2**). Despite growing onions in fields adjacent to each other, and a decrease in the average rate of flies released per hectare, no plants were found during the duration of the season that showed onion maggot damage and the amount of flies captured per week remained relatively low. Peaks of 7.2 and 11.7 flies / trap / week were counted at the Exeter and Thedford field sites. (**Table 1; Figure 5**). This was the third year where all fields of onion sets were grown without the use of any insecticides. These results seem to indicate that wild onion maggot levels remained low as a result of sterile fly releases even with continuing cropping of onion sets in the same area for seven years, no clothianidin/imidacloprid seed treatment used, no chlorpyrifos drench at planting, and no foliar insecticides targeted at onion maggot applied throughout the growing season (**Table 2**).

At the Scotland field sites, season average fly counts have remained low for the past three years with 2021 being the last year seeing elevated number of wild flies (**Figure 6**). A peak of 4.7 and 3.6 wild flies / trap / week was observed 10 July (**Table 3; Figure 6**). Onion maggot larvae were found and identified at the Scotland location, however these wilted plants containing larvae were not in the damage plots (**Table 3**). Flies were originally released at an average rate of 100,000 flies/ha/season and were dropped to 75,000 flies/ha/season in 2024. The north field in Scotland was last planted with onions in 2019, and both fields were within 3 km of where onion were grown in 2023 (**Figure 3**).

Over the years, sticky cards are typically replaced on a Tuesday at the field sites near Exeter and Wednesday at the field sites near Scotland, while the sterile flies were released on Sunday/Monday. If the sticky cards were changed more frequently, a more accurate number of wild and sterile flies may have been recorded. Despite no chemical management towards wild onion maggot flies, this data demonstrates that onion maggot can be managed through sterile fly releases when there are no fields that can act as a refuge of wild flies in the general vicinity.

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**Table 1.** Sterile fly release dates, plant stage, weekly average trap counts and damage plot fly population levels at the Exeter and Thedford release field sites. Flies were released at a rate of approximately 16,000 flies pre hectare per season.

Date	Release Field – Exeter ~11.4 ha					Release Field – Thedford ~12.4 ha				
	Release Quantity ('000)	Plant Stage <sup>1</sup>	Wild Flies	Pink Flies	Damage Plots <sup>2</sup>	Release Quantity ('000)	Plant Stage <sup>1</sup>	Wild Flies	Pink Flies	Damage Plots <sup>2</sup>
24/05/07	6	--	--	--	--	6	--	--	--	--
24/05/14	6	pre	1.4	0.0	--	7	pre	11.7	0.0	--
24/05/21	8	pre	0.9	0.0	--	8	pre	1.7	0.0	--
24/05/28	10	loop	5.8	0.0	--	11	loop	2.2	0.0	--
24/06/04	14	2LS	2.1	0.0	--	15	2LS	0.2	0.0	--
24/06/11	16	3LS	2.8	0.0	40.3	18	3LS	0.8	0.0	43.3
24/06/18	16	3LS	2.5	0.0	40.3	18	3LS	0.3	0.0	42.5
24/06/25	14	3LS	1.1	0.0	38.3	15	3LS	0.6	0.0	40.8
24/07/02	13	4LS	0.4	0.0	38.0	14	4LS	0.3	0.0	40.3
24/07/09	9	5LS	1.0	0.0	37.0	10	5LS	0.3	0.0	35.0
24/07/16	6	6LS	7.2	0.0	37.0	6	6LS	2.8	0.0	34.5
24/07/24	9	6LS	0.0	0.0	32.5	10	6LS	0.0	0.0	34.5
24/07/29	12	6LS	0.3	0.0	32.5	13	6LS	0.0	0.0	34.5
24/08/06	11	wind	0.7	0.0	30.0	12	7LS	0.1	0.0	28.3
24/08/15	8	wind	1.9	0.0	30.0	8	wind	0.6	0.0	--
24/08/20	6	post	5.7	0.0	--	7	post	9.9	0.0	--
24/08/27	8	post	--	--	--	9	post	--	--	--
24/09/03	7	post	--	--	--	7	post	--	--	--

<sup>1</sup> Plant stage where pre = pre-emergence, loop = loop stage, flag = flag leaf stage, LS = leaf stage, post = after pulling/harvest, and -- = data points not taken

<sup>2</sup> Average number of plants in within a 15 cm x 15 cm square

**Table 2.** Insecticide applications from seeding to harvest at the Scotland field sites. No insecticides were applied at the Exeter or Thedford field sites during the 2024 season.

Date	Field(s)	Trade Name	Common Name	Rate / Hectare
24/05/30	All	Movento 240 SC	Spirotetramat	365 mL
24/06/10	All	Movento 240 SC	Spirotetramat	365 mL
24/06/24	All	Agri-Mek SC	Abamectin	270 mL
24/07/01	All	Agri-Mek SC	Abamectin	270 mL
24/07/06	All	Exirel	Cyantraniliprole	1500 mL
24/07/13	All	Exirel	Cyantraniliprole	1500 mL
24/07/20	All	Delegate WG	Spinetoram	336 g
24/07/26	All	Delegate WG	Spinetoram	336 g

**Table 3.** Sterile fly release dates, plant stage, trap counts and damage plot levels at the two release field sites near Scotland, ON. Flies were released at a rate of approximately 75,000 flies pre hectare per season.

Date	Release Field 1 – North ~8.1 ha					Release Field 2 – South 4.6 ha				
	Release Quantity ('000)	Plant Stage <sup>1</sup>	Wild Flies	Pink Flies	Damage Plots <sup>2</sup>	Release Quantity ('000)	Plant Stage <sup>1</sup>	Wild Flies	Pink Flies	Damage Plots <sup>2</sup>
24/05/02	--	2LS	0.3	0.0	--	--	flag	--	--	--
24/05/08	8	4LS	0.7	0.0	--	5	2LS	0.8	0.0	--
24/05/15	21	4LS	3.3	0.0	--	12	3LS	3.5	0.0	--
24/05/23	27	5LS	0.8	0.0	100.0	15	4LS	1.3	0.0	100.0
24/05/29	34	6LS	3.3	0.0	99.5	19	5LS	4.6	0.0	99.3
24/06/06	49	7LS	1.7	0.0	97.8	28	6LS	1.7	0.0	99.0
24/06/12	58	8LS	1.6	0.0	96.5	33	6LS	0.0	0.0	98.8
24/06/20	58	8LS	0.3	0.0	93.0	33	7LS	1.3	0.0	97.3
24/06/27	50	9LS	1.1	0.1	90.8	28	7LS	0.7	0.1	96.3
24/07/04	45	9LS	0.5	0.2	88.0	25	8LS	0.3	0.1	95.0
24/07/11	32	10LS	3.6	0.0	86.5	18	9LS	4.7	0.0	94.8
24/07/18	18	11LS	1.8	0.1	84.5	10	10LS	1.0	0.0	92.8
24/07/23	31	11LS	0.4	0.0	84.5	17	10LS	1.0	0.0	92.5
24/08/01	41	11LS	0.0	0.0	84.5	23	11LS	0.4	0.0	92.5
24/08/07	40	11LS	0.4	0.0	82.3	22	11LS	0.5	0.0	90.0
24/08/15	27	wind	0.1	0.0	73.5	15	11LS	0.6	0.2	82.8
24/08/22	22	post	--	--	--	13	11LS	--	--	--
24/08/29	28	post	--	--	--	16	post	--	--	--
24/09/06	24	post	--	--	--	13	post	--	--	--

<sup>1</sup> Plant stage where LS = leaf stage, wind = windrowed, and post = harvest, and -- = data points not taken

<sup>2</sup> Average number of plants in damage plots starting with 100 plants per plot on 23 May, 2024



**Figure 1.** The Exeter release field sites approximately 11.4 ha (28.3 ac) (A), 8.1 ha (20.0 ac) (B), and 7.0 ha (17.3 ac) (C) in size. Only fly counts were recorded in field (A) that were adjacent to fields where sterile flies were released in 2023 (E). Sterile flies have been released in this 2km area since 2018 and no control fields (with no sterile fly releases) have been conducted since 2020 (C, D).



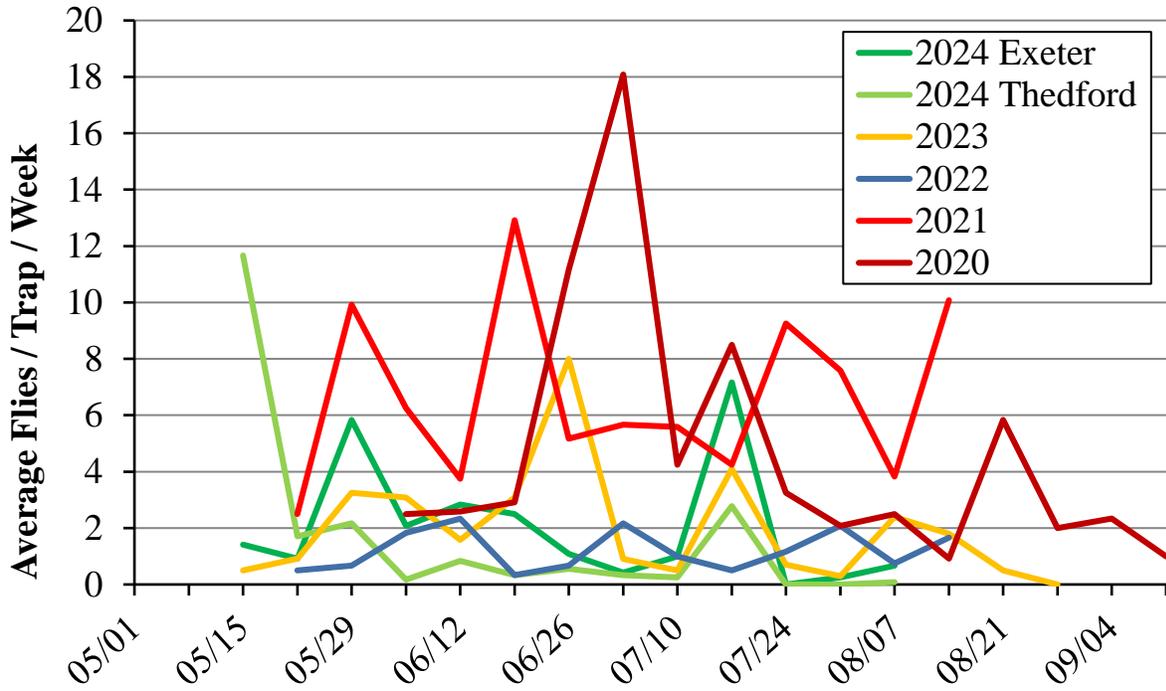
**Figure 2.** The Thedford release field approximately 12.4 ha (30.6 ac) (A) was seeded approximately 4.0 km to other transplant and direct seeded onion fields. This field produced onion sets in 2024 and was 500 m from a 2022 onion set field where sterile flies were also released.



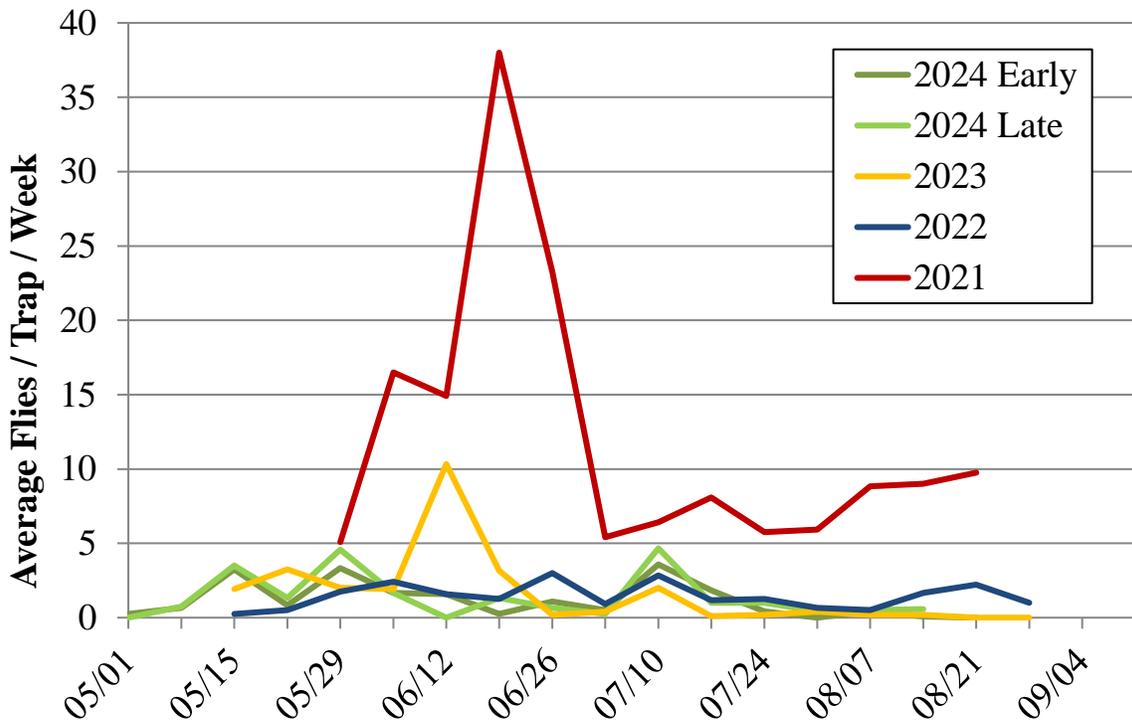
**Figure 3.** Sterile flies were released and monitored at two onion fields near Scotland. The release field that was transplanted first measured approximately 8.1 ha (20.0 ac) (A) was located adjacent to the later-transplanted release field measuring approximately 4.6 ha (11.4 ac) (B). Sterile flies were released in onion fields within 2 km in 2023 (C–D), 2022 (E–F), 2021 (G–H), 2020 (I–L) and 2019 (A) and in 2019, one field was left as a control where no flies were released that year (M).



**Figure 4.** Damage plots in onion set field in a 15 cm x 15 cm square (A), sticky cards (B) and sterilized, pink onion maggot flies prior to release (C).



**Figure 5.** Average wild flies per sticky trap per week at the release field sites near Exeter, and Thedford, ON. Except for the Thedford field site, all fields shown were within 2 km of each other. Wild/fertile fly counts showed peaks in late June/early July in 2020.



**Figure 6.** Average wild flies per sticky trap per week at the field sites near Scotland. Wild/fertile fly counts at the release fields in 2024 (dark and light green) peaked at 3.6 and 4.7 flies / trap / week.