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2020 PMR REPORT # 002 **SECTION H: PEST MANAGEMENT METHODS – BIOLOGICAL CONTROL**

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

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TITLE: **THIRD YEAR FIELD DEMONSTRATION OF THE STERILE FLY RELEASE TECHNOLOGY FOR ONION MAGGOT MANAGEMENT IN ONION SET AND COOKING ONION PRODUCTION IN ONTARIO**

MATERIALS: Sterilized/irradiated *Delia antiqua* pupae.

METHODS: Several fields near Exeter and Scotland, Ontario were sown with onions in the spring of 2020. At the Exeter field site, three fields comprised of Granby sandy-loam and Granby/Brady sandy-loam were seeded at a high density of ~20 million seeds / ha (~8 million seeds / ac) to produce onion sets with no soil application of chlorpyrifos. Onion seeds were sown in 13 May at these three fields. The field where sterile flies were released (**Figure 1, A**), measured approximately 10.8 ha (26.6 ac) and was seeded approximately 100 m from the field where sterile flies were release during the 2019 field season measuring approximately 3.2 ha (8.0 ac) (**Figure 1, B**). The control field where no sterile flies were released was situated between 2018, 2019 and 2020 release sites and was approximately 6.0 ha (14.9 ac) in size (**Figure 1, C**). An additional onion field approximately 9.7 ha (23.3 ac) in size was seeded in 2020 and no monitoring took place nor sterile flies were released at this field (**Figure 1, D**). At the second site near Scotland, Ontario, three fields were transplanted with onions at an average density of ~345,000 plants / ha (140,000 plants / ac) with no soil application of chlorpyrifos. At two of these three fields, approximately 3 km apart, sterile flies were released. The first field, comprised of Caledon sandy-loam was approximately 5.3 ha (13.0 ac) in size (**Figure 2, A)** and planted from 27 April to 18 May directly adjacent to the field where sterile flies were released in 2019 (**Figure 2, B**). Two other fields were planted with onions near this first field in 2020 but were not monitored (**Figure 2, C & D**). Sterile flies were released at these fields at the same concentrations of sterile flies / acre but were not monitored using sticky cards. The second field where sterile flies were released and monitored (**Figure 2, E**), was adjacent to the 2019 control field which had no sterile flies released in 2019 (**Figure 2, F**). This second field was comprised of Brady loamy-sand, was approximately 5.1 ha (12.6 ac) in size and was planted 25–30 May. In addition, a field near Princeton, Ontario was planted 6–8 May, approximately 17 km from the first two fields, and was comprised of Brady and Granby sandy-loam, measuring approximately 4.2 ha (10.3 ac) in size (**Figure 3**, **A**). No sterile flies were released at this third, control field and onions had been planted near this field every year for the previous five years. There were no other major onion fields within a 20 km radius from either the Exeter or Scotland field sites. Onion flies were reared by Phytodata, and then sterilized and released according to the protocol developed by Phytodata, using the Sterile Insect Technology (SIT). The *Delia antiqua* pupae were irradiated by Nordion, dyed pink, and then shipped to Exeter and Scotland, ON, emerged as adult flies and kept alive until release following protocols

developed by Phytodata Inc (**Figure 4, C**). 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 as well as for the displacement of sterile / pink flies throughout the growing season. Fly releases at the Exeter and Scotland sites began on 13 May and continued weekly until the week of 16 September. Flies were released after harvest to target the onion maggot population that would be overwintering. Flies were released at least 30 m from the closest sticky card trap at all fields. Damage plots measuring 15 cm x 15 cm capturing ~40 plants were set up a short distance away from the sticky traps at the flag leaf stage at each of the four sites around the onion set fields near Exeter (**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 the week of 24 August at the Exeter fields, and the Scotland fields were harvested starting from mid August to early October (**Tables 1, 3**).

RESULTS: As outlined in Tables 1-4 and in Figures 1-6.

CONCLUSION: Onion maggot (*Delia antiqua*) management has relied heavily on group 1B organophosphates, specifically chlorpyrifos insecticides which are currently in the process of phasing-out 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 while also decreasing the cost of the sterile fly program itself. At the Exeter field site, there was no control field monitored in 2019 and the control field in 2020 was adjacent to the release field. Sticky card counts of wild flies indicated that there is a year to year increase in the average number of wild flies during the population peaks (**Figure 5**). An average of 18.1 flies/trap/week were counted during the first peak 30 June and 5.8 flies/trap/week during the second distinct peak 18 August (**Table 1; Figure 5**). Sterile, pink flies were found on a single sticky card on the west side of the control field 30 June. At the Exeter field site, the level of onion maggot damage in these fields in 2018 and 2019 was low relative to other years and no onion maggot damage was observed in 2020 (Grower correspondence). Despite growing onions in fields adjacent to each other or only implementing a single year without onion, levels of wild flies did not increase to levels high enough to cause observable damage at the Exeter field site (**Figure 1, 5; Table 1**). At the Scotland field sites, an average of 159.9 wild flies/trap/week were observed 17 June at both release fields while a peak of 70.8 wild flies/trap/week were observed 17 June at the Princeton field. The peaks of an average of 159.9 flies/trap/week observed at both release fields 17 June was likely an under-estimation due to the cards being completely covered by flies and being unable to catch any additional flies. Sticky cards were typically replaced on Tuesday/Wednesday, while the sterile flies were released on Sunday/Monday. If the sticky cards would have had to have been changed more frequently, a more accurate number of wild and sterile flies may have been recorded. Fly counts remained low relative to these peaks after 4 July (**Tables 3,4; Figure 6**). At both Scotland release fields, pink flies were found at every trap but most were quantified throughout the season at the closest trap relative to where the sterile flies were released. No pink flies were found on any of the sticky cards at the control field at the Princeton location. Destructive sampling did not find any onion maggot larvae throughout the season however onion maggot damaged was observed in other plants (**Tables 1 & 3**). At the Scotland release fields, wild fly pressure was high to begin with due to the high levels observed in 2019 and previous years. The previous onion maggot population was most likely unequal between the two release sites and control. Both field sites in Scotland were closely planted to onion fields in 2020 or 2019 that had no sterilized flies released which may have acted as a refuge for wild flies. A continuation of this program is required to observe the long-term effects of a sterile fly release on the onion maggot population to determine the overall effectiveness, and, in turn, reduce the need of chemical control options.

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Table 1. Sterile fly release dates, plant stage, weekly average trap counts and damage plot levels at the Exeter release and control field sites.

		Release Field				Control Field			
Date	Release Quantity ('000)	Plant Stage[1]	Wild Flies	Pink Flies	Damage Plots	Plant Stage[1]	Wild Flies	Pink Flies	Damage Plots
20/05/12	27	--	--	--	--	--	--	--	--
20/05/19	27	--	--	--	--	--	--	--	--
20/05/26	67	--	--	--	--	--	--	--	--
20/06/02	85	loop	2.5	0.0	0.0	loop	1.8	0.0	0.0
20/06/09	107	flag	2.6	0.3	32.3	flag	1.6	0.0	37.0
20/06/16	154	1LS	2.9	0.0	33.0	1LS	2.0	0.0	41.3
20/06/24	181	3LS	11.2	0.0	27.3	3LS	15.0	0.0	34.3
20/06/30	181	4LS	18.1	0.0	28.3	4LS	12.8	0.1	40.0
20/07/07	154	5LS	4.3	0.0	26.8	5LS	3.7	0.0	39.8
20/07/14	168	6LS	8.5	5.5	32.0	6LS	4.7	0.0	35.3
20/07/21	101	7LS	3.3	1.1	27.3	6LS	4.4	0.0	40.0
20/07/28	56	7LS	2.1	0.3	24.0	7LS	1.5	0.0	38.0
20/08/04	46	8LS	2.5	0.0	23.0	8LS	2.5	0.0	35.8
20/08/11	62	8LS	0.9	0.8	18.0	8LS	1.8	0.0	24.5
20/08/18	80	8LS	5.8	6.3	26.0	8LS	1.1	0.0	40.5
20/08/26	40	--	--	--	--	--	--	--	--
20/09/02	0	--	--	--	--	--	--	--	--
20/09/09	55	post	1.0	2.8	--	post	0.5	0.6	--
20/09/16	57	--	--	--	--	--	--	--	--

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

Table 2. Insecticide applications from seeding to harvest at the Exeter field site.

Date	Field	Trade Name	Common Name	Rate / Hectare
20/06/19	All	Mako	Cypermethrin	175 mL

Figure 1. The release field site approximately 10.8 ha (26.6 ac) near Exeter (**A**) was seeded approximately 100 m from the field where sterile flies were release during the 2019 field season measuring approximately 3.2 ha (8.0 ac) (**B**). The monitored control field where no sterile flies were released (**C**), was situated between 2018, 2019 and 2020 release sites and was approximately 6.0 ha (14.9 ac) in size. An additional onion field approximately 9.7 ha (23.3 ac) in size was seeded in 2020 (**D**) and no monitoring took place and no sterile flies were released at this field.

Table 3. Sterile fly release dates, plant stage, trap counts and damage plot levels at the two release and one control field site near Scotland, ON.

	First Release Field					Second Release Field					Control Field			
Date	Release Quantity (‘000)	Plant Stage[1]	Wild Flies	Pink Flies	Damage Plots	Release Quantity (‘000)	Plant Stage[1]	Wild Flies	Pink Flies	Damage Plots	Plant Stage[1]	Wild Flies	Pink Flies	Damage Plots
20/05/12	9	--	--	--	--	7	--	--	--	--	--	--	--	--
20/05/19	9	--	--	--	--	7	--	--	--	--	--	--	--	--
20/05/28	22	2LS	5.1	0.0	99.3	17	2LS	10.8	9.1	--	2LS	4.8	0.0	99.5
20/06/04	28	3LS	4.0	0.0	97.5	22	3LS	--	--	--	3LS	3.1	0.0	99.0
20/06/11	36	4LS	12.0	1.0	97.3	27	4LS	32.1	0.1	99.8	4LS	9.4	0.0	99.0
20/06/17	51	5LS	159.9	0.0	97.3	40	5LS	159.9	0.1	99.8	5LS	70.8	0.0	98.0
20/06/25	60	7LS	23.8	2.0	99.0	46	5LS	24.3	3.5	99.8	7LS	19.5	0.0	98.0
20/07/01	60	8LS	9.6	0.7	98.0	46	6LS	7.8	1.6	99.5	8LS	8.4	0.0	98.0
20/07/08	51	9LS	2.8	0.0	98.0	40	6LS	1.3	0.0	99.5	9LS	1.3	0.0	98.0
20/07/15	56	10LS	1.8	0.3	98.0	43	7LS	2.7	0.3	99.3	10LS	2.4	0.0	96.3
20/07/23	33	11LS	2.6	0.0	98.0	26	8LS	2.3	0.3	98.5	11LS	3.7	0.0	96.3
20/07/30	19	12LS	1.4	0.0	98.0	14	9LS	1.2	0.4	98.5	12LS	6.8	0.0	94.5
20/08/05	15	12LS	0.8	0.1	97.8	12	9LS	0.8	0.0	98.5	12LS	6.3	0.0	92.5
20/08/12	21	13LS	3.2	0.5	87.7	16	9LS	1.3	0.6	98.5	13LS	5.8	0.0	88.8
20/08/19	20	13LS	10.8	9.1	27.7	15	9LS	--	--	--	13LS	10.3	0.0	88.5
20/08/26	13	--	--	--	--	10	--	--	--	--	--	--	--	--
20/09/02	0	--	--	--	--	0	--	--	--	--	--	--	--	--
20/09/09	19	--	--	--	--	12	--	--	--	--	--	--	--	--
20/09/16	18	--	--	--	--	6	--	--	--	--	--	--	--	--

[1] Plant stage where LS = leaf stage and -- = Data points not taken

Table 4. Insecticide applications from seeding to harvest at the Scotland field sites.

Date	Field	Trade Name	Common Name	Rate / Hectare
20/06/08	All	Movento 240 SC	Spirotetramat	356 mL
20/06/15	All	Movento 240 SC	Spirotetramat	356 mL
20/06/29	All	Agri-Mek SC	Abamectin	200 mL
20/07/13	All	Agri-Mek SC	Abamectin	200 mL
20/07/25	All	Delegate WG	Spinetoram	336 g
20/08/07	All	Delegate WG	Spinetoram	336 g
20/08/14	All	Dibrom	Naled	530 mL

Figure 2. The field sites near Scotland had four release fields in 2020 and two were monitored. Release I was approximately 5.3 ha (13.0 ac) in size (**A**) and was located adjacent to the 2019 release field (**B**). Two other onion fields saw sterile flies released but were not monitored in 2020 (**C & D**). Release field II (**E**), was located adjacent to the 2019 control field where no sterile flies were released in 2019 (**F**) and was approximately 5.1 ha (12.6 ac) in size.

Figure 3. The control field site (**A**) near Princeton, was situated ~17 km from the release sites and was approximately 4.2 ha (10.3 ac) in size. No sterile flies were released at this field site.

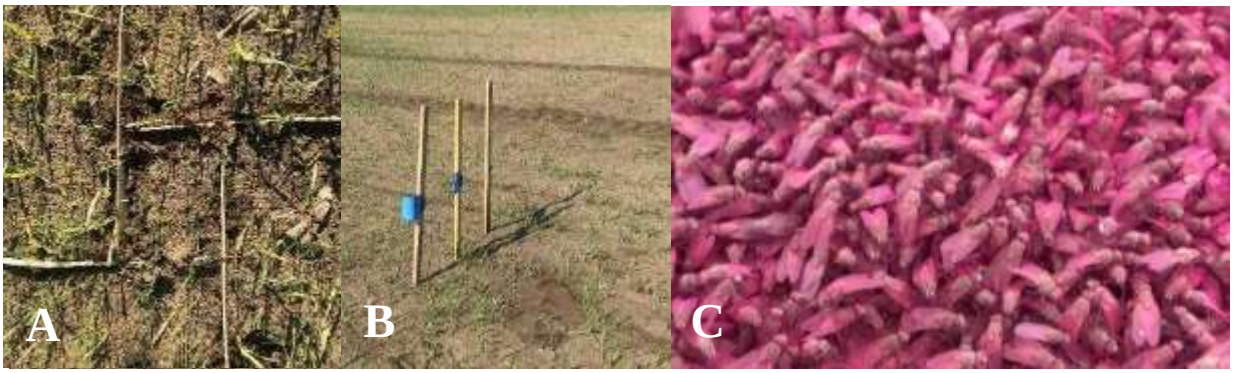

Figure 4. Damage plots (**A**), sticky cards (**B**) and sterilized, pink onion maggot flies prior to release (**C**).

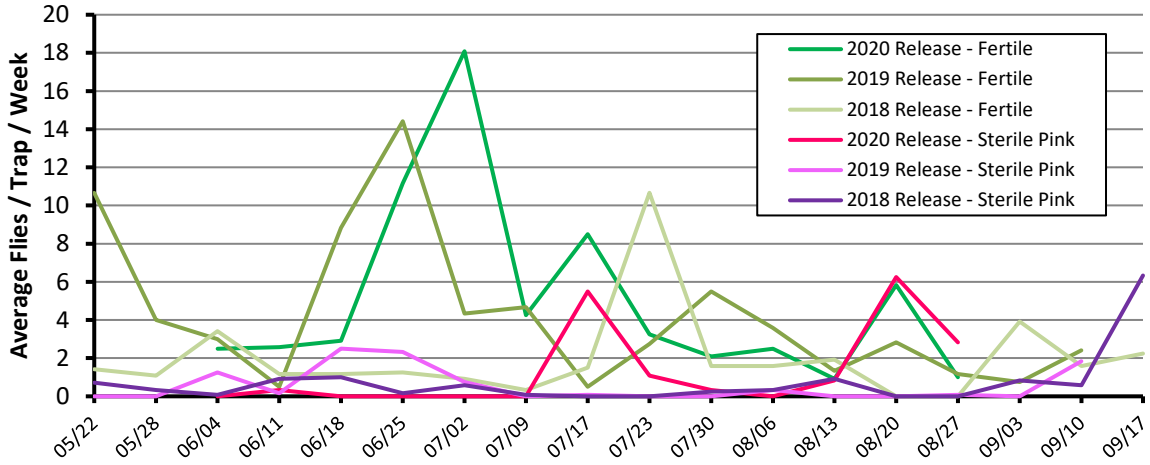

Figure 5. Average wild flies per sticky trap per week at the field site near Exeter from 2018 to 2020. Wild/fertile fly counts showed peaks in late June/early July in 2019 and 2020 while the first peak was identified in late July in 2018 (**greens**). Counts of sterile pink flies remained relatively low all three years (**pink/purple**).

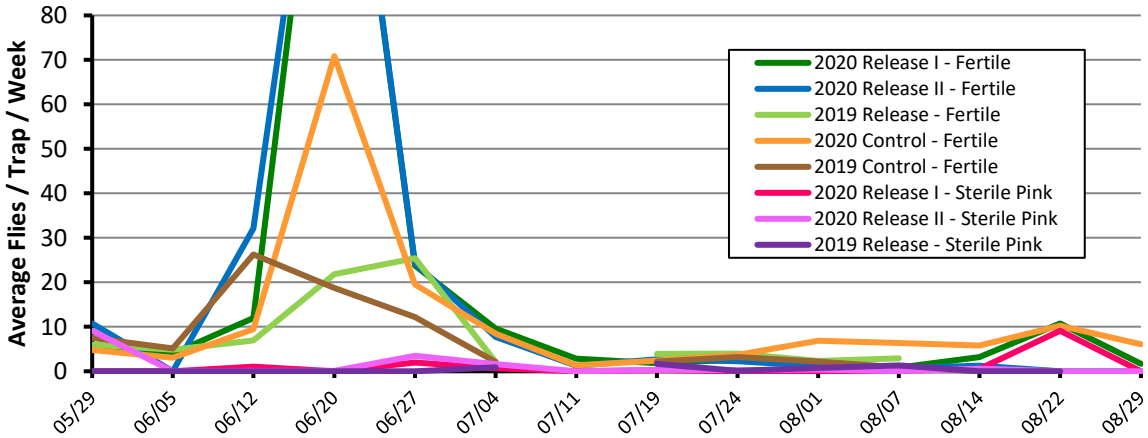

Figure 6. Average wild flies per sticky trap per week at the field sites near Scotland. Wild/fertile fly counts at the release fields in 2020 (**dark green and blue**) peaked the week of 20 June and filled the sticky cards at an average of 160 flies/card. Wild/fertile flies also reached a peak at the control field approximately 17 km away (**orange**) the same week. Both release fields were adjacent to fields planted with onions in 2019. Sterile pink flies were found in relatively low numbers at the release fields throughout the season (**red, pink**) and in 2019 (**purple**).