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TITLE: THE INTEGRATED PEST MANAGEMENT PROGRAM SUMMARY FOR MUCK VEGETABLE CROPS, 2016

An Integrated Pest Management (IPM) program is provided to growers in the Holland/Bradford Marsh, Ontario, by the Muck Crops Research Station (MCRS). This project was funded in part through *Growing Forward 2 (GF2)*, a federal-provincial-territorial initiative. The Agricultural Adaptation Council assists in the delivery of *GF2* in Ontario. Funding was also provided in part by the Bradford Cooperative Storage Ltd., agrochemical companies, and growers participating in the Muck Crops Research Station IPM program. The main objectives of the project are: to scout growers' fields for diseases, weeds, and insect pests, to provide growers with disease and insect forecasting information, to identify and diagnose diseases, insect pests and weeds, and to implement roto-rod spore traps to trap and analyze spores of various vegetable crop pathogens.

SCOUTING

In 2016, 76 commercial vegetable fields, totalling 828 acres (onion 399 A., carrot 371 A., celery 58 A.), were intensively scouted for 27 growers. Fields were scouted twice per week during the growing season and growers received scouting reports after each field survey.

DIAGNOSTICS, EXTENSION & DISSEMINATION OF INFORMATION

Any grower, whether in the IPM program or not, may bring in samples (plant and/or insect/weeds) for diagnosis. The on-site tools available for diagnosis are visual inspection and laboratory inspection using a microscope and culturing. Diagnoses are made by comparison to known symptoms, published descriptions of pathogens, insect pests and weeds, and personal experience. Following assessment, the extension advice given was based on Ontario Ministry of Agriculture and Food and Rural Affairs (OMAFRA) recommendations for pesticides.

From 5 February to 3 November, 2016, the diagnostic laboratory of the MCRS received 121 samples for diagnosis. Of these, 71% were infectious diseases (86 samples) and 29% physiological disorders (35 in total). These samples were associated with the following crops: onion (47.9%), carrot (31.4%), celery (5.8%), tomato (4.1%), and other crops (10.8%). Along with plant disease samples, a total of 5 samples of insects or insect damage were assessed and 3 weed samples identified. Nematode damage was reported for 2 samples. For extension services, data collected from growers' fields and the MCRS research plots were compiled twice per week, analyzed and summarized. The results were compiled in an 'IPM report' and updated twice per week and circulated to participating growers, academia, industry, OMAFRA staff, posted on the MCRS web site (www.uoguelph.ca/muckcrop), and a copy was displayed at the Bradford Co-op.

PEST PREDICTIVE MODELS

The IPM program provides disease and insect forecasting based on spore traps, disease forecasting models BOTCAST (for botrytis leaf blight of onion), DOWNCAST (for onion downy mildew), and BREMCAST (for lettuce downy mildew)), degree day models, and insect traps. These disease and insect forecasts alert growers by predicting the potential for disease and insect pest incidence.

CROP PEST SUMMARIES

At the end of the scouting program, 100 carrot samples were collected from each scouted field and assessed for damage from insects (Table 1) and diseases/physiological disorders (Table 2).

CARROT

Insects

In 2016, carrot fields were scouted for carrot weevil (*Listronotus oregonensis*), carrot rust fly (*Psila rosae*), aster leafhopper (*Macrosteles quadrilineatus*) and other insect pests. Degree day models were used to predict the occurrence of the various life stages of these insects.

Table 1. Average percent carrot rust fly and carrot weevil damage on carrots at harvest in scouted fields in and around the Holland Marsh, 2016.

Location	% Damaged Carrots	
	Weevil damage	Rust fly damage
West HM	6.0	2.0
South HM	2.7	0.0
Central HM	8.6	0.3
North HM	9.9	0.7
East HM	12.7	2.6
Bradford & surrounding area	1.8	0.4
Average	6.9	1.0

Carrot weevil adults were first found in wooden traps on 22 May in carrot fields. The threshold of 1.5 or more weevils/trap was reached by 26 May in south, central, east and north regions of the Holland Marsh.

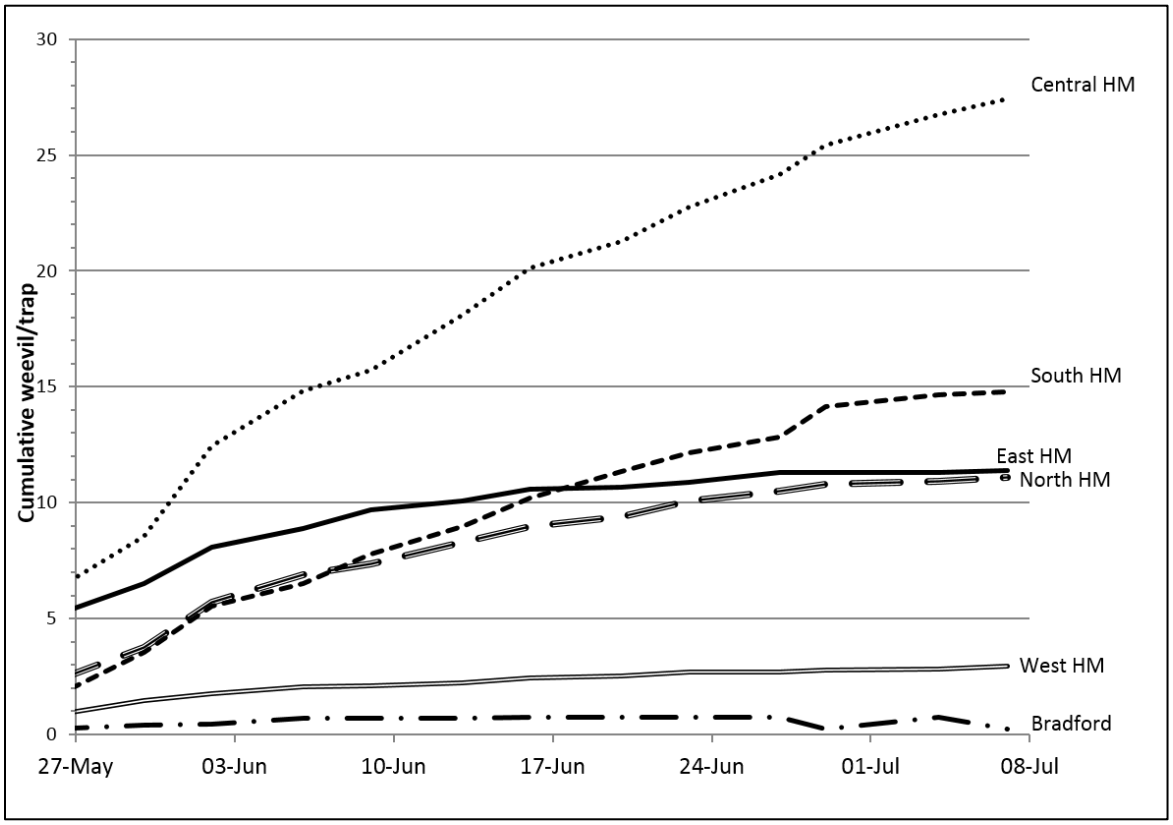

Figure 1. Average cumulative number of carrot weevils/ trap in various areas of the Holland Marsh, 2016.

Carrot weevil counts around the Holland Marsh have been increasing since 2010. The first and second spray thresholds are now being reached in most areas by the beginning of June. This increase in counts has been accompanied by an increase in carrot weevil damage seen in carrots from Holland Marsh (Figure 2).

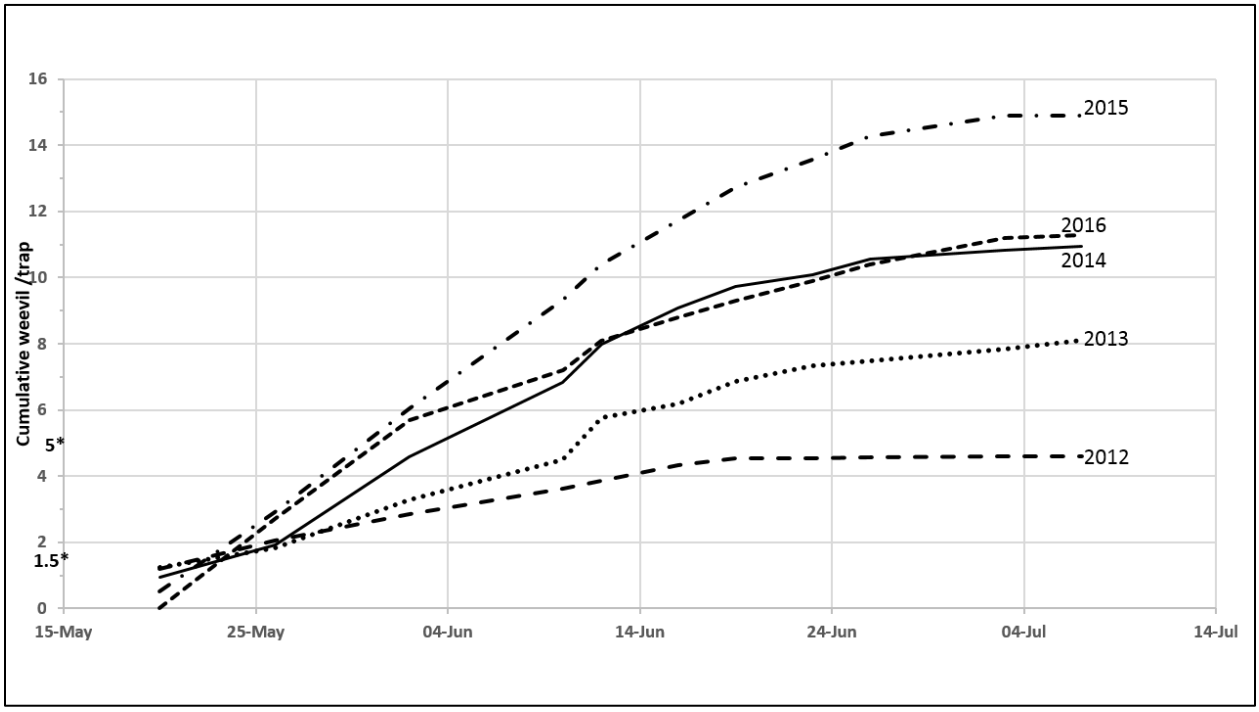

Figure 2. Average cumulative numbers of carrot weevils/trap over the past five years in the Holland Marsh, 2012-2016.

Orange sticky traps and degree day models were used to monitor and estimate carrot rust fly and aster leafhopper numbers. Carrot rust flies were first found on sticky traps on 30 May, which was 3 days after the degree day model predicted emergence. The spray threshold for fresh market carrots (0.1 flies/trap/day) was reached by the 2 June (Figure 3).

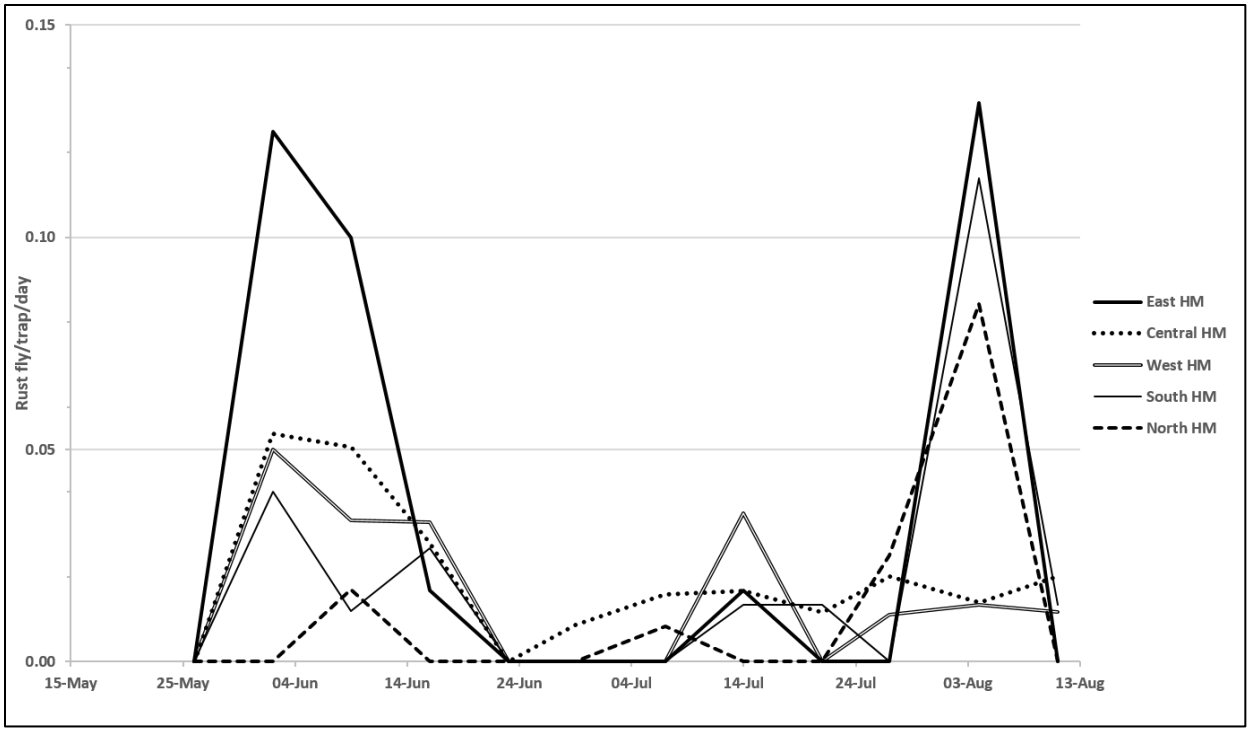

Figure 3. Average carrot rust fly counts/trap/day from fields in different areas of the Holland Marsh, 2016.

Aster leafhoppers are pests of carrots, celery, lettuce and leafy greens. Aster leafhopper adults were first found on orange sticky traps by the middle of June in carrots and celery. Aster yellows were first seen in mid-July. Aster leaf hopper counts remained low throughout the season.

Diseases

Carrot fields were scouted for the main carrot diseases found in the Holland Marsh. Leaf blight, which is caused by the fungi *Alternaria dauci* and *Cercospora carotae*, was first seen by 26, July but only two of 35 fields scouted reached spray threshold by mid-September.

Hundred carrot samples were taken from each of the 35 scouted fields and roots were assessed for diseases. All the surveyed fields had cavity spot (*Pythium* spp.) with incidence ranging from 1 to 33%. Crater rot (*Rhizoctonia carotae*) was found in 13 of 35 fields surveyed with incidence ranging from 0 to 25.4%.

Carrots in 9 of the 35 fields sampled had crown gall (*Agrobacterium tumefaciens*) with disease incidence ranging from 0 to 10%. Fusarium rot (*Fusarium* spp.) was found on carrots from four surveyed fields with an incidence of 1%. Three fields had carrots with aster yellows, with 0.9-1.5% carrots showing hairy root symptoms.

Of the 35 surveyed carrot fields, 14 fields showed splitting (growth cracks) from 0 to 7% incidence, and forking was observed in all fields with incidence ranging from 0 to 33%.

Table 2. Disease incidence on carrot samples collected from commercial fields in the Holland/Bradford Marsh, Ontario in 2016.

Disease	Pathogen	Mean incidence (%) (n = 35)	Fields affected (n = 35)
Cavity spot	*Pythium* spp.	13.3	35
Pythium root dieback	*Pythium* spp.	2.9	29
Crater rot	*Rhizoctonia carotae*	2.2	13
Crown gall	*Agrobacterium tumefaciens*	1.3	9
Fusarium rot	*Fusarium* spp.	1.0	4
Aster yellows	*Phytoplasma*	0.1	3
Splitting (Growth cracks)	--	0.9	14
Forking	--	8.2	35

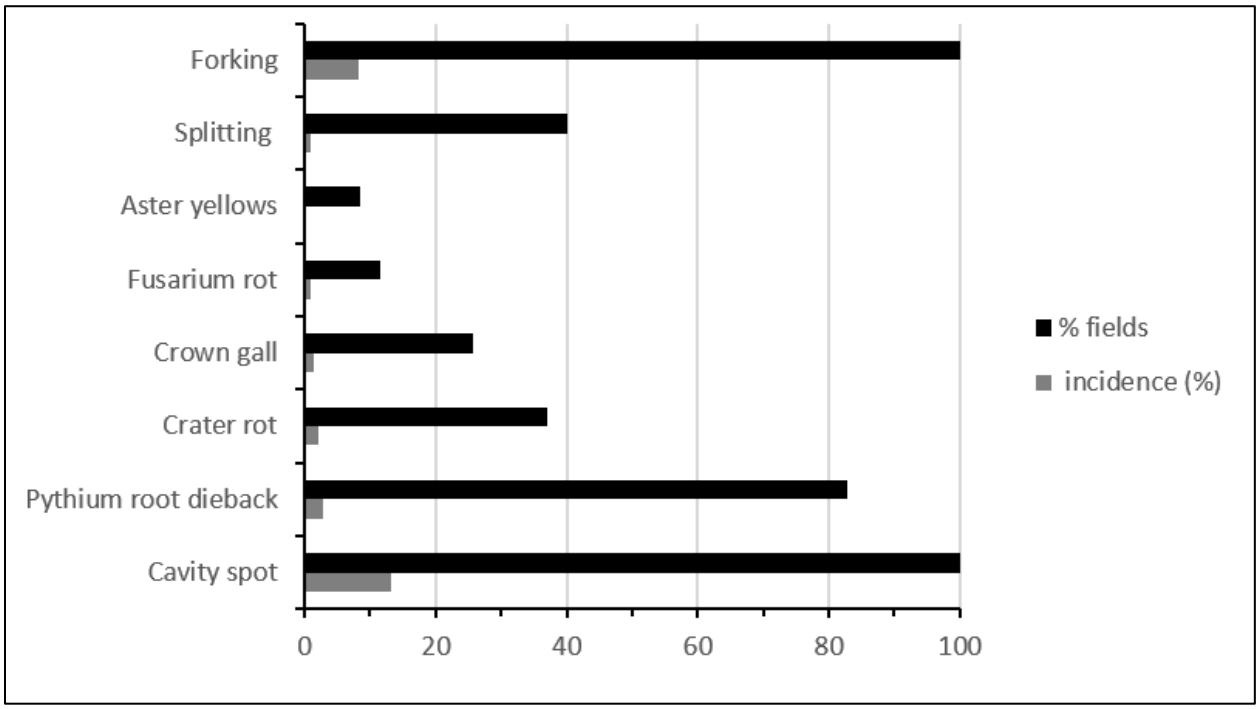

Figure 5. Disease incidence on carrot samples collected from commercial fields in the Holland/Bradford Marsh, 2016.

ONION

Insects

Onion fields were scouted for onion maggot (*Delia antiqua*), onion thrips (*Thrips tabaci*), cutworms and other insect pests. The degree day threshold for emergence of first generation onion flies was reached on May 21. The first onion flies were found on May 24 and we reached the first-generation peak by May 30 (Figure 5).

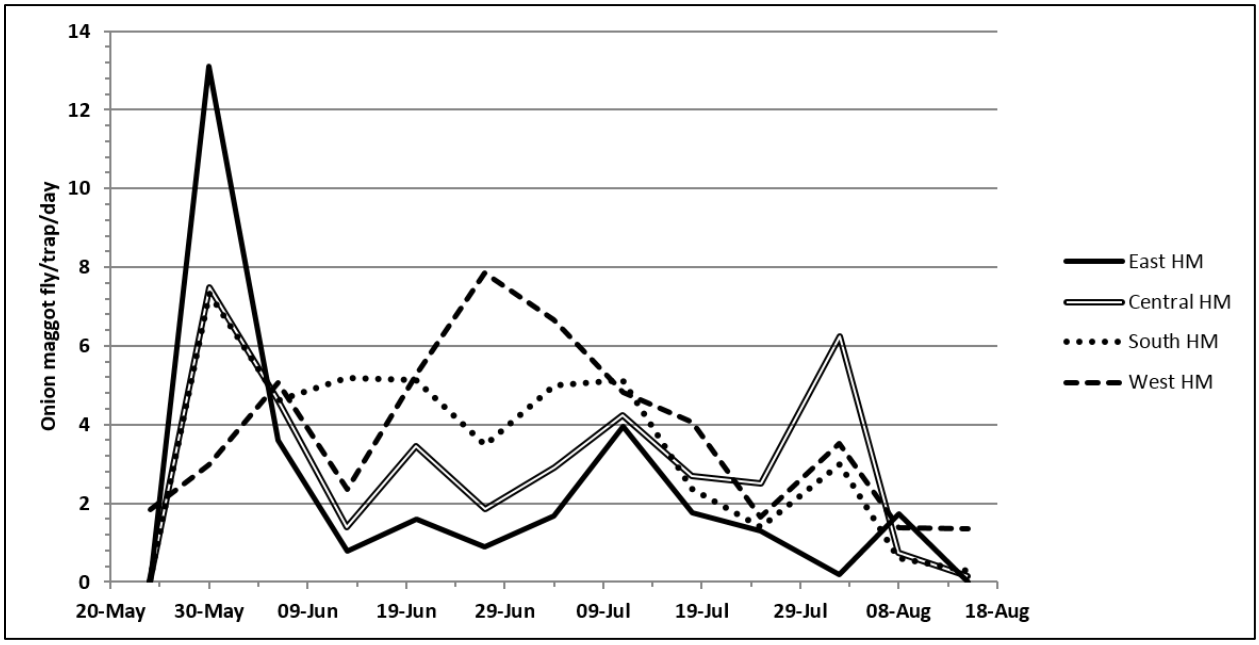

Figure 5. Average onion fly counts/trap/day from fields from various areas of the Holland Marsh, 2016.

Thrips infestation in scouted fields was lower in 2016 compared to 2015. Thrips were first found in two scouted fields on 31 May. Two fields first reached the 1 thrips/leaf spray threshold on 4 July, with 6 fields above threshold by the end of August.

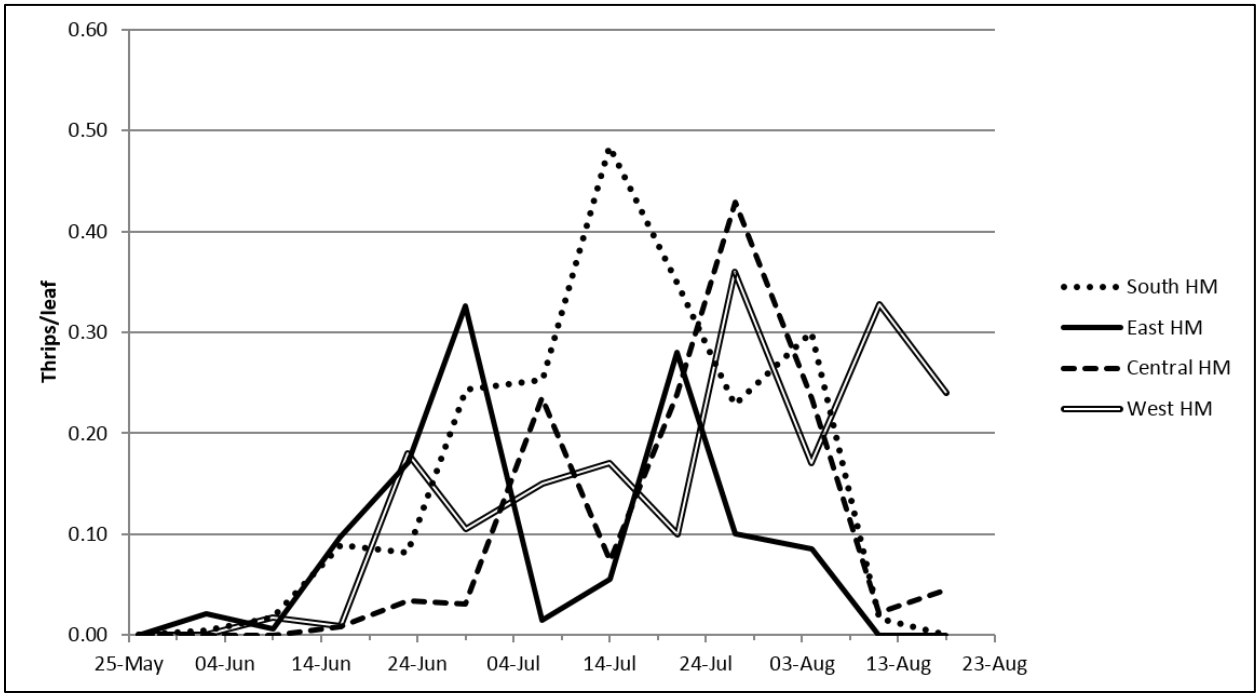

Figure 6. Average thrips counts from scouted fields from various areas of the Holland Marsh, 2016.

Diseases

Onion fields were scouted for botrytis leaf blight (*Botrytis squamosa*), downy mildew (*Peronospora destructor*), purple blotch (*Alternaria porri*), white rot (*Sclerotium cepivorum*), pink root (*Phoma terrestris*), stemphylium leaf blight (*Stemphylium vesicarium*) and other diseases.

The main diseases on onions in 2016 were stemphylium leaf blight and purple blotch. Of all scouted onion fields, 22 out of 37 (59.5%) showed symptoms of stemphylium leaf blight. Spores of *Stemphylium* were first found on 25 July in the spore traps. First symptoms of stemphylium leaf blight in scouted fields was seen on 27 June, followed by 4 July. Purple blotch was first found on onions on 20 June. By the end of the season, 51.4% of scouted fields had purple blotch.

White rot was observed in 6 of 37 fields (16.2%). Seven samples with pink root symptoms were observed late in the season.

Botrytis spores were first detected on June 20. Only two spores of onion downy mildew (*Perenospora destructor*) were caught on spore traps (July 22). None of the scouted fields had botrytis leaf blight or downy mildew symptoms as dry weather was not conducive for the multiplication of the pathogen.

CELERY

Insects

In 2016, four celery fields were scouted for carrot weevil, aster leafhopper, tarnished plant bug (*Lygus lineolaris*) and aphids. Insect traps and degree day models were used to predict the occurrence of the various life stages of carrot weevil, aster leafhopper and tarnished plant bug. In 2016, tarnished plant bug damage as seen in 3 out of 4 fields, but the counts were lower (0.02-0.04/plant) than the tolerance levels (0.1-0.2/ plant). No aster leaf hopper, leaf miner or aphid damage was reported in the 2016 growing season.

Diseases

Celery leaf curl or celery anthracnose (*Colletotrichum fioriniae*), is a relatively new disease threatening celery production in Ontario. Celery leaf curl was found in all four scouted celery fields, andsevere black heart was found in one field. Leaf blight was not seen in celery fields during the 2016 growing season. Bacterial rot was seen in few plants possibly due to heavy irrigation and high temperature.

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