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TITLE: THE INTEGRATED PEST MANAGEMENT PROGRAM SUMMARY FOR MUCK VEGETABLE CROPS, 2017

An Integrated Pest Management (IPM) program is provided to growers in the Holland/Bradford Marsh, Ontario, by the University of Guelph - Muck Crops Research Station. 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 2017, 70 commercial vegetable fields, totalling 788 acres (onion 360 A., carrot 384 A., celery 44 A.), were intensively scouted for 24 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, insect, or weed) 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 4 May to 5 October, 2017, the diagnostic laboratory of the MCRS received 90 samples for diagnosis. Of these, 76% were infectious diseases (68 samples) and 24% physiological disorders (22 in total). These samples were associated with the following crops: onion (42%), carrot (30%), celery (16%), lettuce (3.3%) and other crops (8.9%). Along with plant disease samples, a total of 6 samples of insects or insect damage were assessed. 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 onions were examined or 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 2017, 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, 2017.

Location	% Damaged Carrots	
	Weevil damage	Rust fly damage
West HM	2.1	0.0
South HM	3.4	0.2
Central HM	4.4	0.2
North HM	4.9	0.2
East HM	6.7	0.0
Bradford & surrounding area	4.5	0.0
Average	4.3	0.1

Carrot weevil adults were first found in wooden traps on 23 May in carrot fields (Fig. 1). The threshold of 1.5 or more weevils/trap was reached by 5 June in most regions of the Holland Marsh.

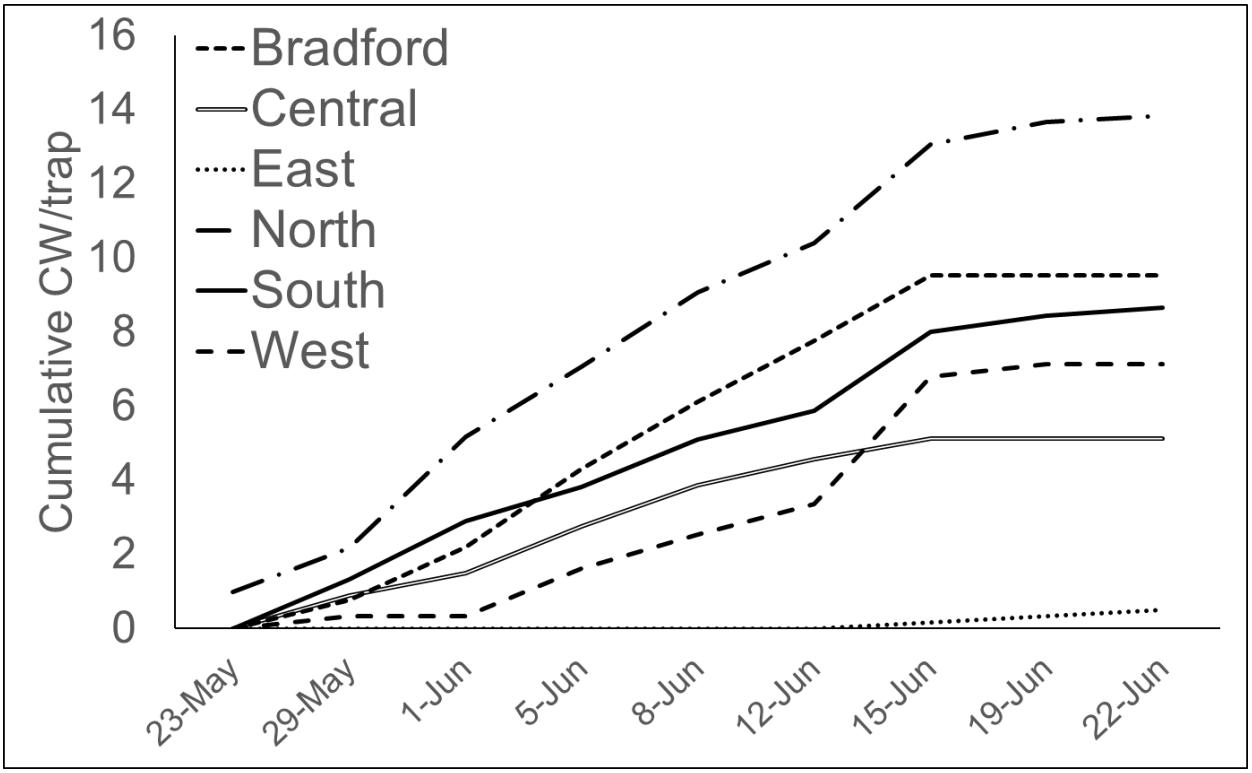

Figure 1. Average cumulative number of carrot weevils/ trap in various areas of the Holland Marsh, 2017.

Carrot weevil counts were slightly lower this year compared to 2014, 2015, and 2016 although extremely wet start to the season slowed both carrot seeding and trap deployment.

Orange sticky traps and degree day models were used to monitor and estimate carrot rust fly (Fig. 2) and aster leafhopper numbers (Fig. 3). 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 11 June in the South region and in late July in the West and Bradford region (Figure 3).

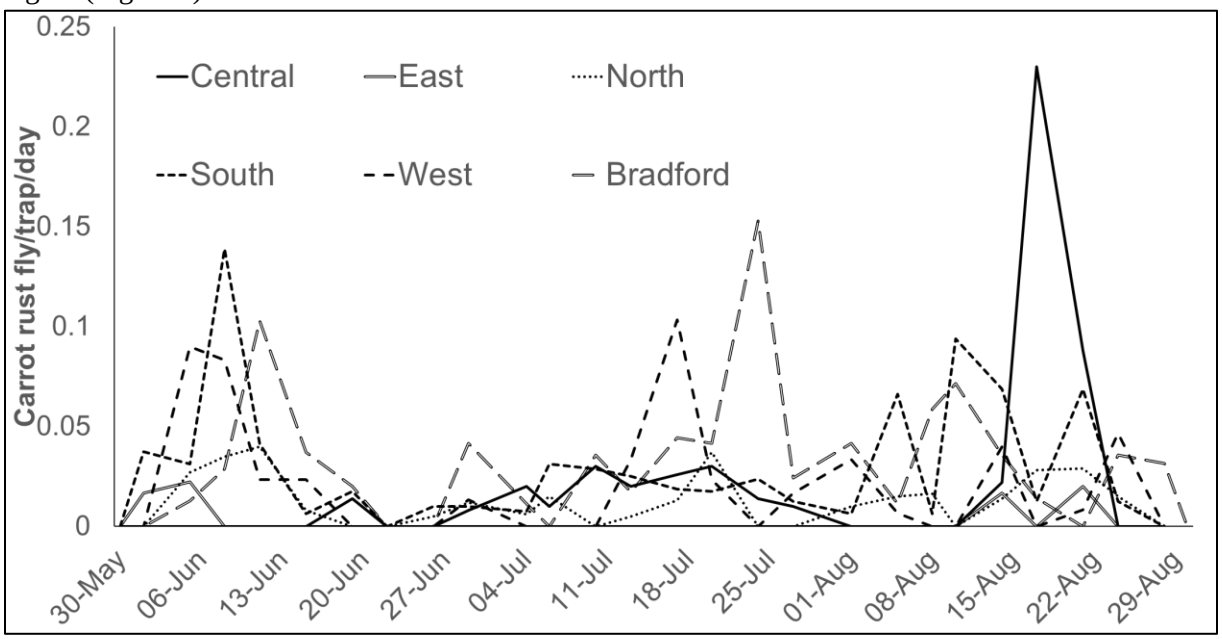

Figure 2. Average carrot rust fly counts/trap/day from fields in different areas of the Holland Marsh, 2017.

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. Counts peaked in the middle of July and generally dropped below threshold for the rest of the season.

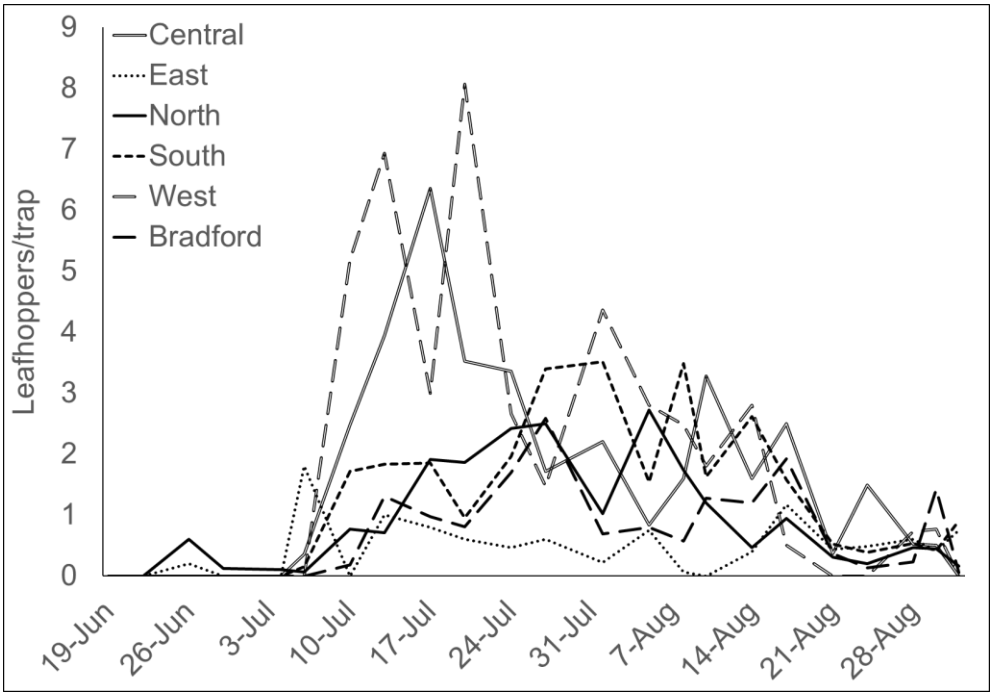

Figure 3. Average aster leafhopper counts/trap from fields in different areas of the Holland Marsh, 2017.

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 6 July with extensive leaf blight development seen in multiple fields by the end of the season.

Samples of 100 carrots were taken from each of the 34 scouted fields and roots were assessed for diseases (Table 2, Fig. 4). Most surveyed fields had cavity spot (*Pythium* spp.) with incidence ranging from 1-28%. Crater rot (*Rhizoctonia carotae*) was present in half of the scouted fields, although incidence was low. Crown gall occasionally affected >30% of carrots in a field. Several fields has some issues with fusarium dry rot and every field had issues with forking and splitting, likely in part due to the flooding that occurred in the marsh on 23 June.

Table 2. Disease incidence on carrot samples collected from commercial fields in the Holland/Bradford Marsh, Ontario in 2017.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Cavity Spot	*Pythium* spp.	75	1-28
Fusarium Dry Rot	*Fusarium spp.*	10	1-14
Crater Rot	*Rhizoctonia* spp.	50	1-16
Rusty Root	*Pythium* spp.	96	1-34
Crown Gall	*Agrobacterium tumefaciens*	36	1-36
Forking/Split	N/A	100	1-39

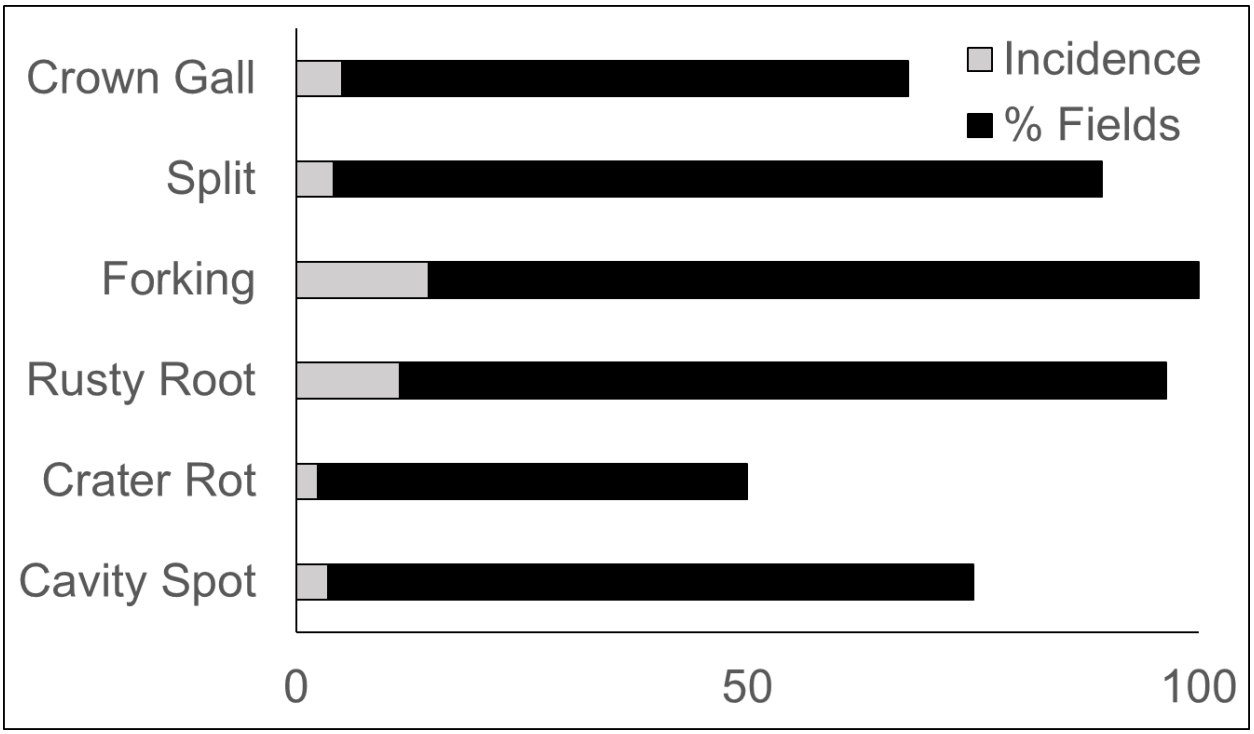

Figure 4. Disease incidence and prevalence on carrot samples collected from commercial fields in the Holland/Bradford Marsh, 2017.

ONION

Insects

Onion fields were scouted for onion maggot (*Delia antiqua*) (Fig. 5), onion thrips (*Thrips tabaci*) (Fig. 6), cutworms and other insect pests. The degree day threshold for emergence of first generation onion flies was reached on 14 May. The first onion flies were found on 30 May and counts were generally low throughout the season (Figure 5).

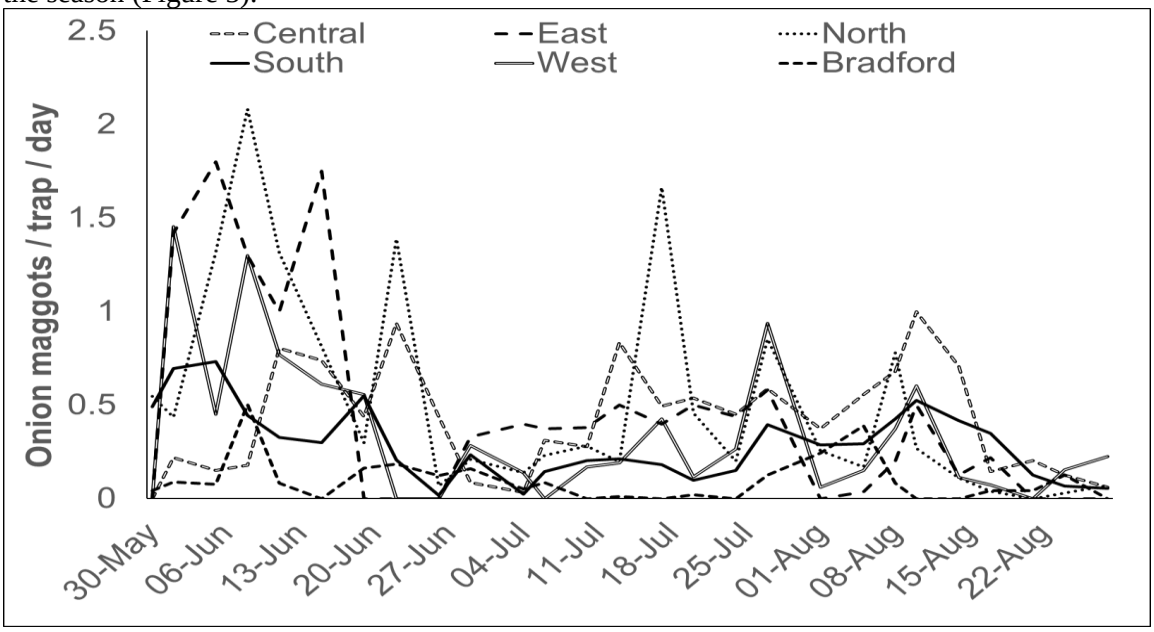

Figure 5. Average onion fly counts/trap/day from fields in various areas of the Holland Marsh, 2017.

Thrips infestation in scouted fields was very low in 2017. On average, all fields were below threshold. Thrips were first found in two scouted fields on 31 May. Two fields first reached the 1 thrips/leaf spray threshold by 20 July, with 7 fields above threshold by the end of August.

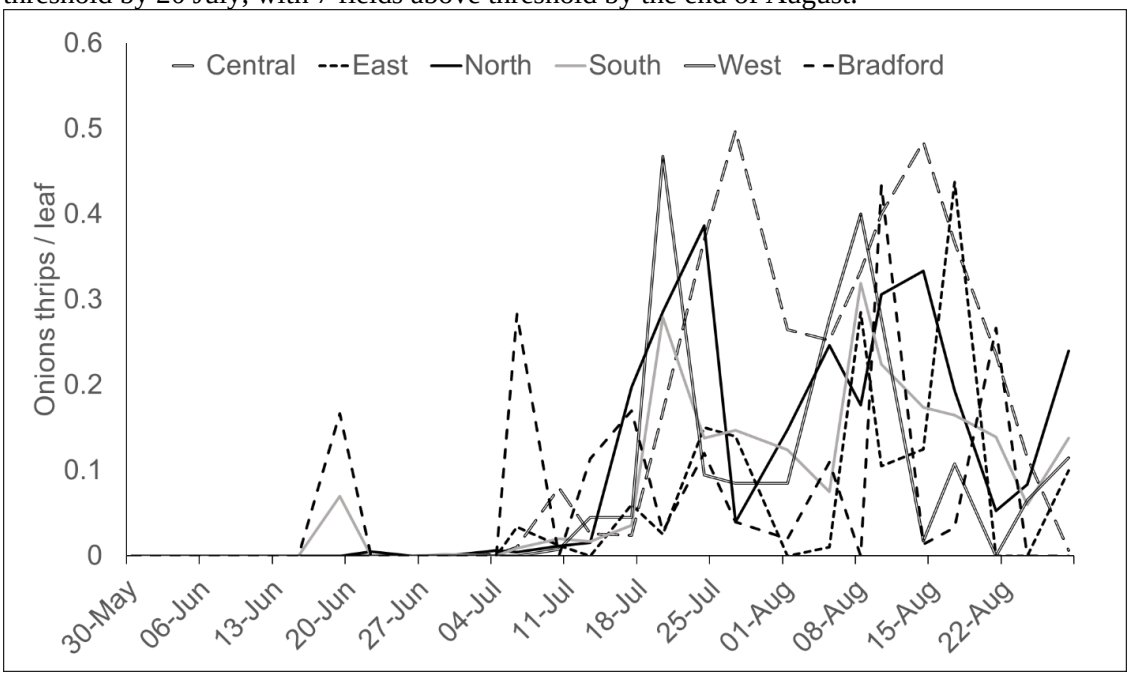

Figure 6. Average thrips counts from scouted fields in various areas of the Holland Marsh, 2017.

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 2017 were stemphylium leaf blight and downy mildew (Table 3). Of all scouted onion fields, 96% of fields showed symptoms of stemphylium leaf blight. First symptoms of stemphylium leaf blight in scouted fields was seen on 27 June. Downy mildew was first detected in the field by 14 July, and continually spread throughout the marsh for the remainder of the season until 75% of scouted fields were infested.

White rot was observed in 32% of fields, with a high incidence in some fields (up to 36%).

Botrytis spores were detected on 9 August, although at no point were any symptoms of botrytis leaf blight seen in the field. Only two spores of onion downy mildew (*Perenospora destructor*) were caught on spore traps (18 August). Our downy mildew forecasting model did not predict the downy mildew outbreak this season, although quick adjustments of the model allowed us to further predict its spread.

Table 3. Disease incidence on onion samples examined in commercial fields in the Holland/Bradford Marsh, Ontario in 2017.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
White rot	*Sclerotium cepivorum*	32	2-36
Bacterial rot/soft rot	*Erwinia carotovora*	25	1-3
Downy mildew	*Peronospora destructor*	75	N/A
Purple blotch	*Alternaria porri*	10	N/A
Smut	*Urocystis cepulae*	32	N/A
Stemphylium leaf blight	*Stemphylium vesicarium*	96	N/A

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 2017, no tarnished plant bug, aster leaf hopper, leaf miner or aphid damage was reported. However, several fields reported noticeable carrot weevil damage.

Diseases

Celery leaf curl or celery anthracnose (*Colletotrichum fioriniae*), is a relatively new disease threatening celery production in Ontario. In one field, extreme symptoms of leaf curl were expressed within two weeks of transplanting, resulting in mortality of a significant number of celery plants. Celery leaf curl was found in two of four scouted celery fields, and black heart was found in two fields. Leaf blight was not seen in celery fields during the 2017 growing season. Bacterial rot was seen in several fields with the wet growing season.

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