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TITLE: THE INTEGRATED PEST MANAGEMENT PROGRAM SUMMARY FOR MUCK VEGETABLE CROPS, 2021

An Integrated Pest Management (IPM) program is provided to growers in the Holland/Bradford Marsh, Ontario, by the University of Guelph Ontario Crops Research Centre - Bradford. This project was funded in part through the Ontario Agri-Food Innovation Alliance. 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 2021, 55 commercial vegetable fields, totalling 540 acres (onion 265 A., carrot 223 A., celery 37 A., potato 10 A.), were intensively scouted for 19 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 participating 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 14 May to 20 October, 2021, the diagnostic laboratory of the OCRC-B received 84 samples for diagnosis. Of these, 70% were diagnosed with infectious diseases (59 samples), 6% with insect issues (5 samples) and 24% were diagnosed with an abiotic disorder (20 samples). These samples were associated with the following crops: onion (42%), carrot (32%), celery (11%) and other crops (15%). For extension services, data collected from growers' fields and research station 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 OCRC-B website (new site - https://bradford-crops.uoguelph.ca/), 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), BREMCAST (for lettuce downy mildew) BSPCAST (for Stemphylium leaf blight of onion), an onion white rot model and a Sclerotinia white mold of carrot model, 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 after lodging or 100 carrot samples were collected from each scouted field and assessed for damage from insects and diseases/physiological disorders. The onion samples were examined by hand pulling 10 onions from 10 random locations throughout each field. The carrot samples were collected by hand pulling 20 carrots near each of the four corners and middle (5 locations total) of each field.

CARROT

Insects

In 2021, 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. Insect damage caused by carrot weevil and rust fly was minimal this season, similar to 2020 (Table 1). However, high populations of aster leafhopper and, presumably, a high aster yellows infectivity, resulted in more fields showing symptoms of infection with aster yellows than in previous years.

Table 1. Average percent carrot weevil and carrot rust fly damage on carrots at harvest in scouted fields in the Holland Marsh, 2021.

Location within Holland Marsh	% Damaged Carrots	
	Weevil damage	Rust fly damage
West	0.0	0.0
South	0.0	0.3
Central	0.1	0.7
North	0.8	0.2
East	0.0	0.0
Average	0.2	0.3

Carrot weevil adults were first found in wooden Boivin traps on 21 May in carrot fields (Fig. 1). The threshold of 1.5 or more weevils/trap was reached by 4 June in most regions of the Holland Marsh. Overall, 52% of fields in the IPM program reached the 1.5 weevil/trap threshold, and 24% of fields reached the 5 weevil/trap threshold.

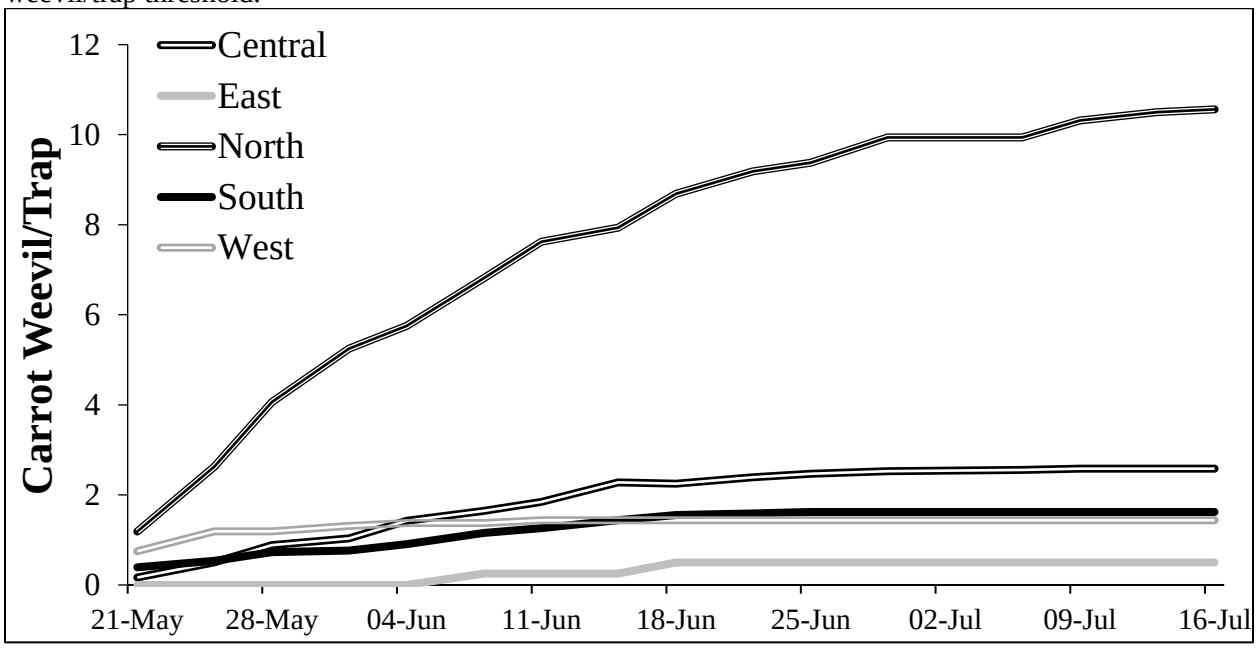

Figure 1. Average cumulative number of carrot weevils/trap in different regions of the Holland Marsh, 2021.

Carrot weevil counts were similar to previous years and damage remained low. The increased uptake of growers now using Rimon and Exirel, which are very effective at controlling carrot weevil, has contributed to decreased carrot weevil damage.

Orange sticky traps and degree day models were used to monitor and estimate carrot rust fly (Fig. 2). Carrot rust flies were first found on sticky traps on 25 May, shortly after the degree day model predicted first generation emergence (21 May). The highest rust fly activity during the first generation, across all regions, was on 29 June, when 52% of scouted fields had exceeded the threshold of 0.1 flies/trap/day. The highest activity during the second generation on 13 August when 40% of scouted fields had exceeded the threshold.

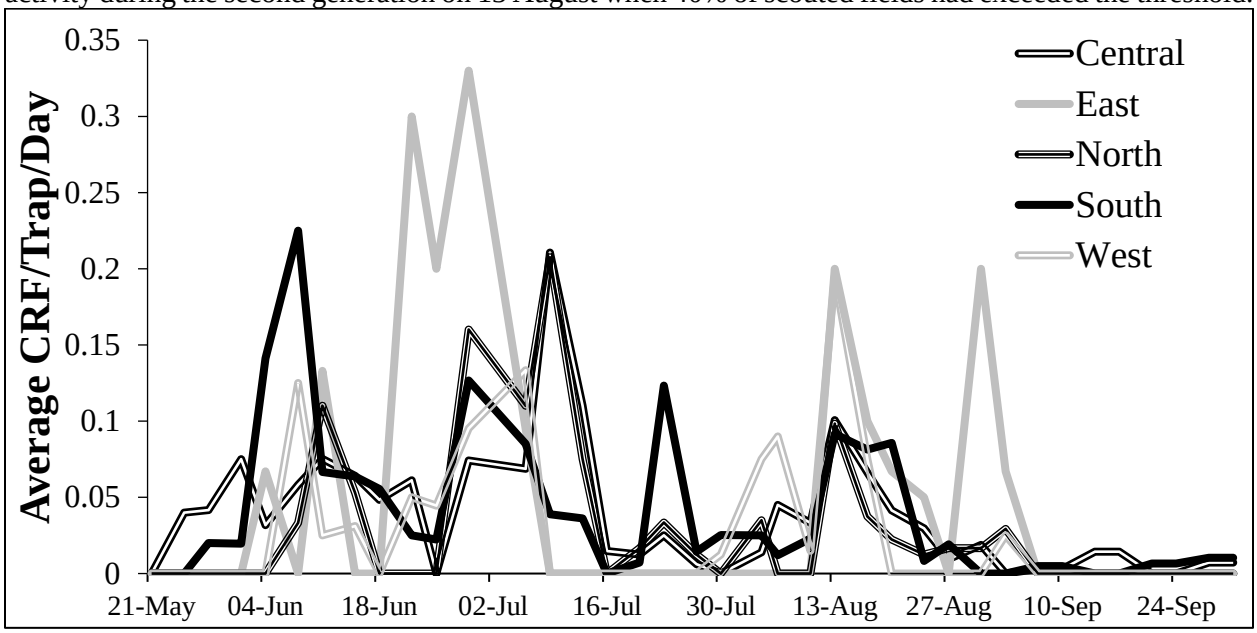

Figure 2. Average carrot rust flies (CRF)/trap/day in different regions of the Holland Marsh, 2021.

Aster leafhoppers are pests of carrots, celery, lettuce and leafy greens. Aster leafhoppers were first found on orange sticky traps on 21 May in carrots and celery (Fig. 3). Sticky traps and sweepnetting (100 sweeps per field) were used to estimate populations occurring within fields. Counts peaked around mid-June to mid-July during which 72% of fields were above the 20 ALH/trap threshold.

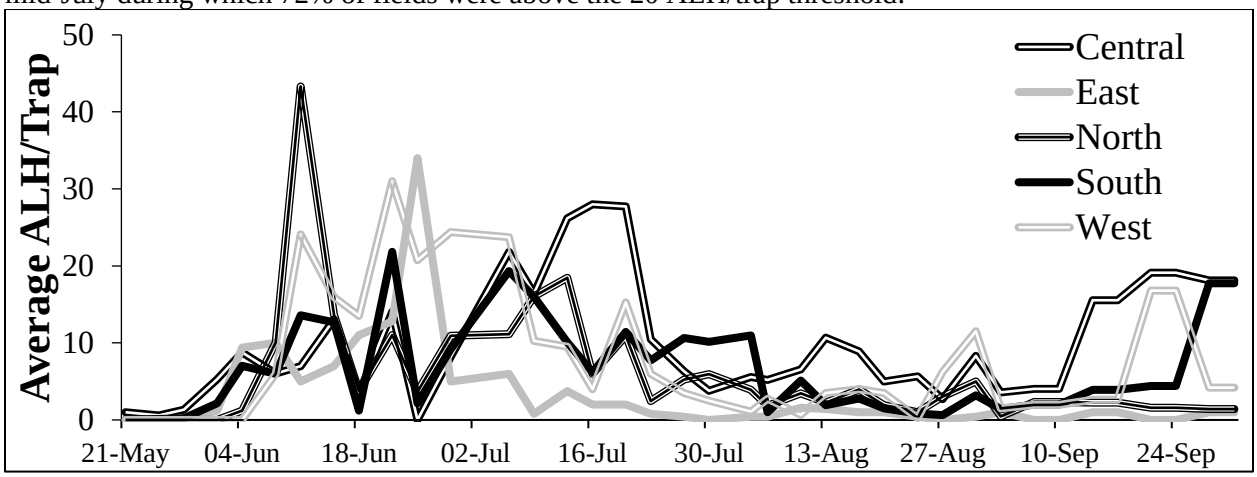

Figure 3. Average aster leafhoppers/trap in different regions of the Holland Marsh, 2021.

Diseases

Carrot fields were scouted for diseases throughout the growing season. Leaf blights, which are caused by the fungi *Alternaria dauci* and *Cercospora carotae*, were first seen on 6 July. Three scouted carrot fields reached the leaf blight threshold of 25% of plants infected during the growing season.

Samples of 100 carrots were taken from each scouted fields and roots were assessed for diseases (Table 2). All fields had multiple diseases; however, disease severity was generally low. Cavity spot (*Pythium* spp.)

and forking (nematodes and/or *Pythium* spp.) were the most common throughout carrot fields, similar to previous years in the Holland Marsh. Crater rot, Fusarium dry rot, aster yellows and crown gall were also present and disease incidence and severity were higher compared to previous years. This is likely due to the wet conditions at the end of the season and high populations of aster leafhopper.

Table 2. Disease incidence on carrot samples collected from commercial fields in the Holland Marsh, Ontario in 2021.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Cavity Spot	*Pythium* spp.	100	1-49
Forking/Split	Nematodes and/or *Pythium* spp.	100	2-19
Crater Rot	*Rhizoctonia* spp.	96	0-30
Fusarium Dry Rot	*Fusarium* spp.	88	0-26
Aster Yellows	*Phytoplasma*	50	0-7
Crown Gall	*Agrobacterium tumefaciens*	21	0-8

ONION

Insects

Onion fields were scouted for onion maggot (*Delia antiqua*) (Fig. 4), onion thrips (*Thrips tabaci*) (Fig. 5), cutworms and other insect pests.

The degree day model predicted first generation onion fly emergence on 16 May. The first onion flies were found on yellow sticky traps on 20 May and counts were low throughout the season, similar to previous years in the marsh (Fig. 4).

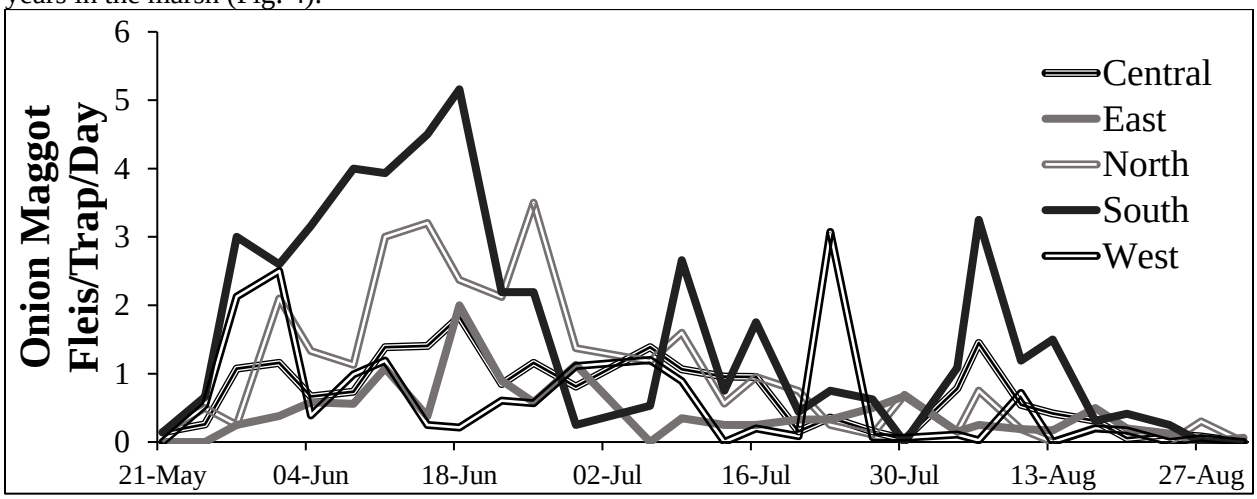

Figure 4. Average onion flies/trap/day in different regions of the Holland Marsh, 2021.

Thrips populations were similar to the 2020 season. Thrips were firsts identified on 17 June and populations fluctuated throughout the season. Thrips counts peaked on 3 August. Two onion fields surpassed the 3 thrips/leaf threshold in July.

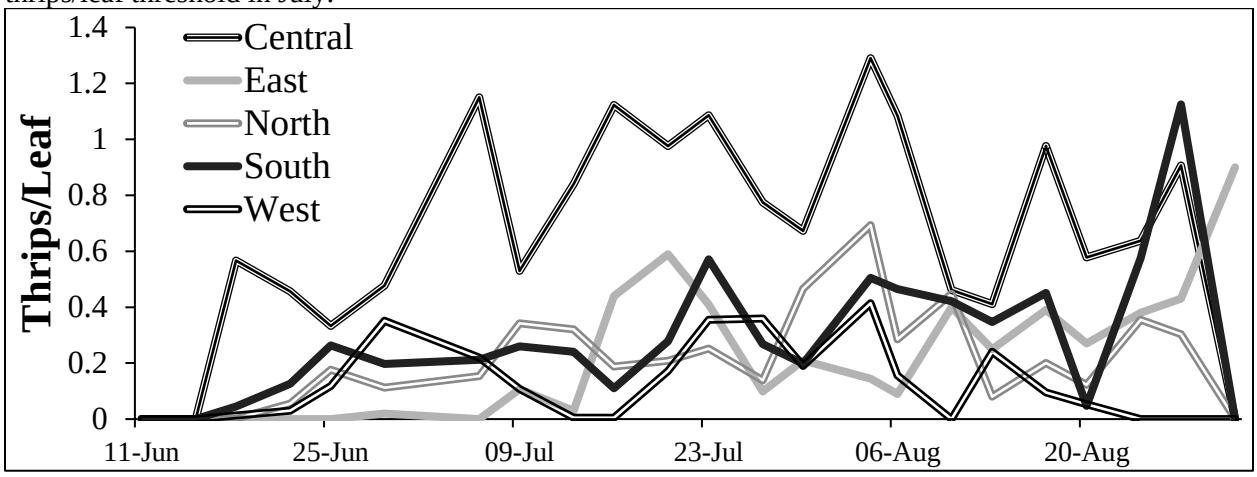

Figure 5. Average thrips/leaf in different regions of the Holland Marsh, 2021.

Diseases

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

Stemphylium leaf blight continued to be the main disease on onions in 2021 (Table 3). First symptoms of Stemphylium leaf blight in scouted fields were seen on 25 June. All scouted onion fields showed symptoms of the disease by the end of the season. Conditions were favourable for onion downy mildew during multiple periods throughout the season, starting at the beginning of July. Disease forecasting indicated a high risk of disease, known as sporulation-infection periods, and recommended sprays several times between the beginning of July to mid-August. Onion downy mildew was found in one scouted onion field. Pink root was found in all onion fields, but disease severity was generally low. Botrytis spores were detected on 18 June, but symptoms of botrytis leaf blight on onions were very rare, although they were found in one onion trial at the Station.

Table 3. Disease incidence on onion samples examined in commercial fields in the Holland/Bradford Marsh, Ontario in 2021.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Stemphylium leaf blight	*Stemphylium vesicarium*	100	12-100
Pink root	*Setophoma terrestris*	100	20-95
Purple blotch	*Alternaria porri*	62	0-15
Smut	*Urocystis cepulae*	54	0-3
Bacterial rot/soft rot	*Pectobacterium carotovorum*	23	0-2
White rot	*Stromatinia cepivora*	15	0-8

CELERY

Insects

In 2021, 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. Tarnished plant bug populations and damage were very low. Carrot weevil damage in celery fields was also very low. Aster yellows was found

in all scouted celery fields due to the high aster leafhopper populations. No leaf miner, aphid, caterpillar or cutworm damage was reported.

Diseases

Celery leaf curl, or celery anthracnose (*Colletotrichum fioriniae*), was found in all scouted celery fields but incidence was low overall with several plants per field infected with the disease, on average. Black heart was also identified in all fields. Leaf blights were common, but disease severity remained relatively low throughout the season.

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