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TITLE: **THE INTEGRATED PEST MANAGEMENT PROGRAM SUMMARY FOR MUCK VEGETABLE CROPS, 2022**

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 2022, 57 commercial vegetable fields, totalling 587 acres (onion 283 A., carrot 250 A., celery 40 A., parsnip 10 A. and potato 4 A.), were intensively scouted for 18 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 9 May to 13 October, 2022, the diagnostic laboratory of the OCRC-B received 70 samples for diagnosis. Of these, 73% were diagnosed with infectious diseases (51 samples), 6% with insect issues (4 samples) and 21% were diagnosed with an abiotic disorder (15 samples). These samples were associated with the following crops: carrot (44%), onion (39%), celery (11%) and other crops (6%). 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 (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 2022, 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 very minimal this season and lower than in 2021 (Table 1). High populations of aster leafhopper were found throughout the season, however, the percent of fields showing symptoms of aster yellows was lower than in 2021 as well.

Table 1. Average percent carrot weevil and carrot rust fly damage on carrots at harvest in scouted fields in the Holland Marsh, 2022.

Location within	% Damaged Carrots	
Holland Marsh	Weevil damage	Rust fly damage
West	0.0	0.0
South	0.0	0.0
Central	0.0	0.3
North	0.2	0.0
East	0.0	0.0
Average	0.04	0.06

Carrot weevil adults were first found in wooden Boivin traps on 9 May in carrot fields (Fig. 1). The threshold of 1.5 or more weevils/trap was reached by 3 June in most regions of the Holland Marsh. Overall, 40% of fields in the IPM program reached the 1.5 weevil/trap threshold, and 16% of fields reached the 5 weevil/trap threshold.

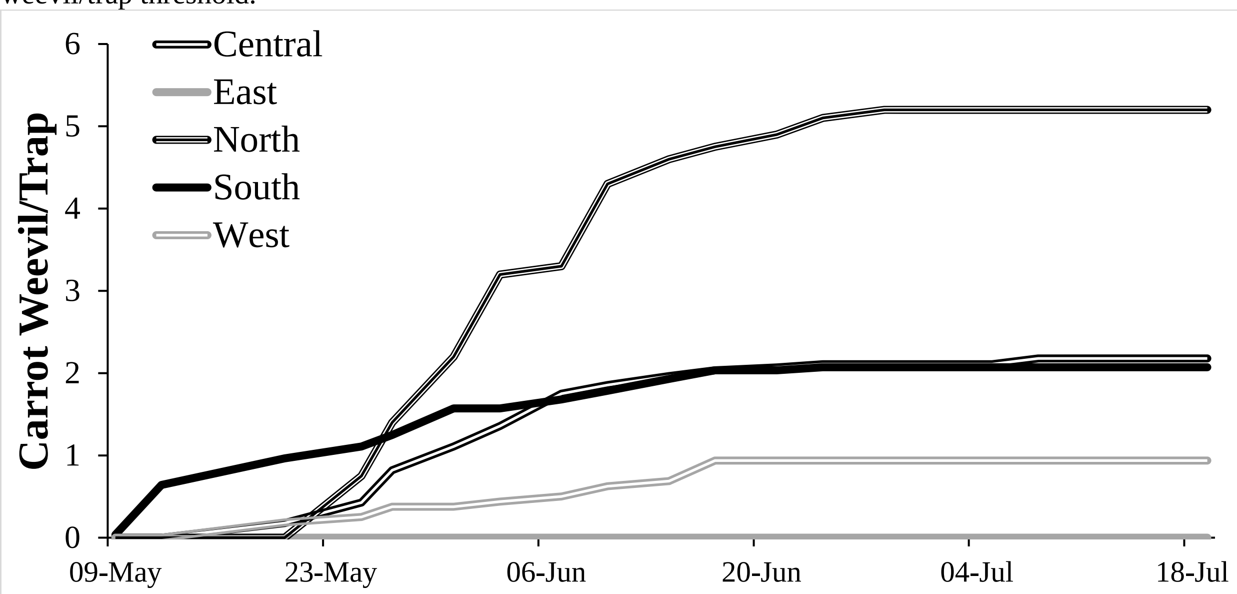

Figure 1. Average cumulative number of carrot weevils/trap in different regions of the Holland Marsh, 2022.

Populations and damage due to carrot weevil were lower than previous years. 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 30 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 3 June, when 40% of scouted fields had exceeded the threshold of 0.1 flies/trap/day. The highest activity during the second generation was on 12 August when 24% of scouted fields had exceeded the threshold.

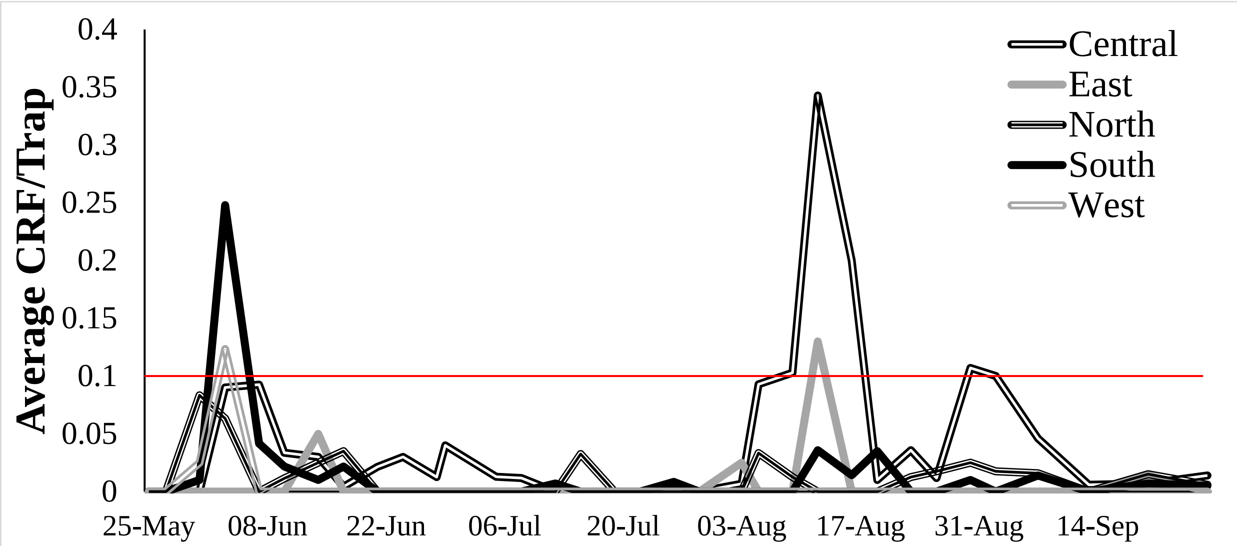

Figure 2. Average carrot rust flies (CRF)/trap/day in different regions of the Holland Marsh, 2022.

Aster leafhoppers are pests of carrots, celery, lettuce and leafy greens. Aster leafhoppers were first found on orange sticky traps on 24 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 96% of fields were above the 20 ALH/trap threshold at some point.

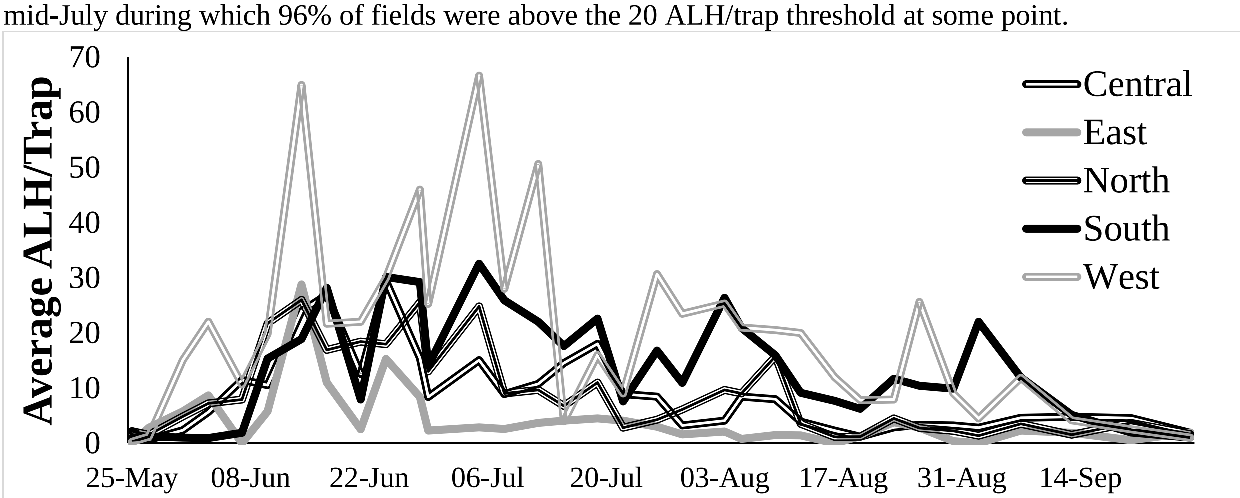

Figure 3. Average aster leafhoppers/trap in different regions of the Holland Marsh, 2022.

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 3 August. No scouted carrot fields reached the leaf blight threshold of 25% of plants infected.

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 2022.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Cavity Spot	*Pythium* spp.	100	1-42
Forking/Split	Nematodes and/or *Pythium* spp.	100	3-24
Fusarium Dry Rot	*Fusarium* spp.	96	0-32
Aster Yellows	*Phytoplasma*	36	0-20
Crater Rot	*Rhizoctonia* spp.	24	0-3
Crown Gall	*Agrobacterium tumefaciens*	16	0-11

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 15 May and first onion flies were found on yellow sticky traps on 19 May. Counts remained low throughout the season, however, a few fields experienced very high numbers in the beginning of July (Fig. 4).

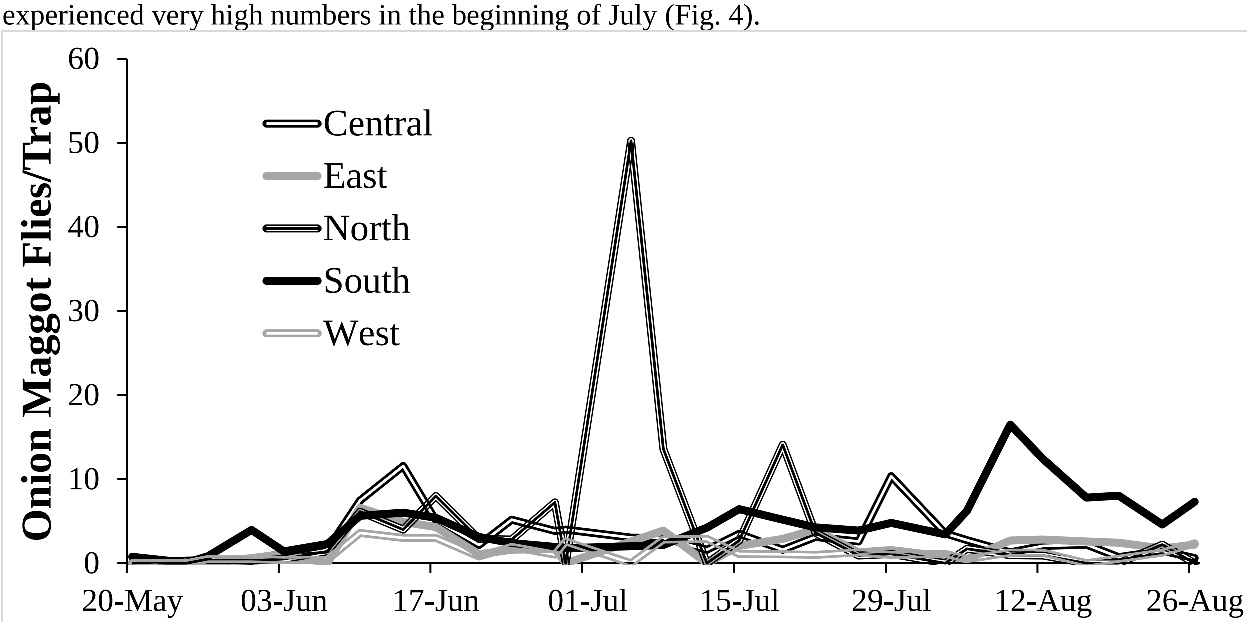

Figure 4. Average onion flies/trap/day in different regions of the Holland Marsh, 2022.

Thrips were firsts identified on 14 June and populations fluctuated throughout the season. Thrips counts peaked on 3 August. Six onion fields surpassed the 3 thrips/leaf threshold between the end of June to mid-August.

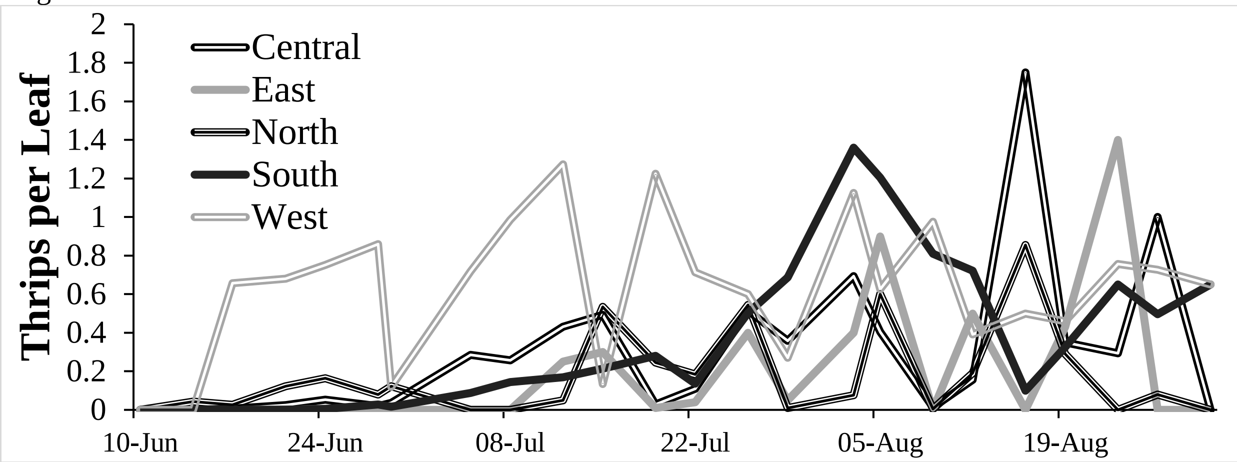

Figure 5. Average thrips/leaf in different regions of the Holland Marsh, 2022.

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 2022, however disease severity was low this year (Table 3). First symptoms of Stemphylium leaf blight in scouted fields were seen on 24 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 around the beginning to mid-July. Disease forecasting indicated a high risk of disease, known as sporulation-infection periods, and recommended sprays a few times between mid-July to mid-August. Although sporangia were identified in roto-rod spore traps on 15 July, downy mildew was not found in any scouted onion fields. This could be attributed to growers applying the proper fungicide at the right time. Pink root was found in all onion fields, but disease severity was generally low.

Table 3. Disease incidence on onion samples examined in commercial fields in the Holland/Bradford Marsh, Ontario in 2022.

DISEASE	CAUSAL AGENT	FIELDS INFECTED (%)	INCIDENCE (%)
Pink root	*Setophoma terrestris*	100	7-95
Stemphylium leaf blight	*Stemphylium vesicarium*	100	5-65
Purple blotch	*Alternaria porri*	59	0-8
White rot	*Stromatinia cepivora*	33	0-16
Bacterial rot/soft rot	*Pectobacterium carotovorum*	26	0-4
Smut	*Urocystis cepulae*	26	0-3

CELERY

Insects

In 2022, 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 low. No carrot weevil damage was found in scouted celery fields this year. Aster yellows low in celery fields despite the higher populations of leafhoppers. No leaf miner, aphid or caterpillar damage was reported and only minor cutworm damage was seen.

Diseases

Celery leaf curl, or celery anthracnose (*Colletotrichum fioriniae*), was found in most scouted celery fields but incidence was very low overall with only a few plants per field infected with the disease. Leaf blights were common later in the season and disease severity remained low throughout the season.

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