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TITLE: THE INTEGRATED PEST MANAGEMENT PROGRAM SUMMARY FOR MUCK VEGETABLE CROPS, 2013

An Integrated Pest Management (IPM) program is provided to growers in the Holland/Bradford Marsh, Ontario, by the Muck Crops Research Station (MCRS). Investment in this project has been provided by Agriculture and Agri-Food Canada through the Canadian Agricultural Adaptation Program (CAAP). In Ontario, this program is delivered by the Agricultural Adaptation Council. Funding was also provided by the Bradford Co-Operative Storage Ltd., growers participated in the IPM program and chemical company sponsors. 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 rotorod spore traps to trap and analyze spores of various vegetable crop pathogens.

SCOUTING

In 2013, 68 commercial vegetable fields, totalling 751 acres (onion 362 A., carrot 279 A. and celery 110 A.), were intensively scouted for 29 growers. Various Asian vegetables grown on 100 A. were also scouted for two months at the beginning of the growing season. Fields were scouted twice a week during the growing season and growers received scouting reports after each field survey.

DIAGNOSTICS, EXTENSION & DISSEMINATION OF INFORMATION

Any grower, whether on the IPM program or not, could bring in samples (plant and/or insect) for diagnosis. On-site tools available for diagnosis were visual inspection and laboratory inspection using a microscope and culturing. Diagnoses were 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 Ministry of Rural Affairs (OMAF and MRA) recommendations for pesticides

From 8 January to 15 November, 2013, the diagnostic laboratory of the MCRS received 252 diseased plant samples for diagnosis. Of these, 78% were infectious diseases (196 in total) and 22% physiological disorders (56 in total). These samples were associated with the following crops: onion (41.5%), carrot (22.1%), celery (11.9%), brassicas (7.5%), lettuce (2.4%), and other crops (14.6%). A total of 24 samples of insects or insect damage were assessed. A total of 18 weed samples were also identified.

For extension services, data collected from growers' fields and the MCRS research plots were compiled twice per week, analyzed and summarized. The results (IPM report) were updated twice per week and circulated to participating growers, academia, industry, OMAF and MRA experts, posted at the MCRS web site (www.uoguelph.ca/muckcrop), and a copy was displayed at the Bradford Co-op. During the 2013 growing season, more than 100 phone inquiries and email requests for information concerning plant problems and recommendations were addressed.

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), and degree day models and insect traps. These disease and insect forecasts alerted growers by predating the potential for disease and insect pest incidence.

CROP PEST SUMMARIES

At the end of the scouting program, carrot samples were collected from each scouted field and assessed for damage from insects (Table 1) and diseases or physiological disorders (Table 2). Similarly, onions were assessed in mid-season and at the end of the scouting program for onion maggot damage and incidence of smut.

CARROT

Insects

In 2013, carrot fields were scouted for carrot weevil (*Listronotus oregonensis*), carrot rust fly (*Psila rosae*) and aster leafhopper (*Macrosteles quadrilineatus*) and other insect pests. Degree day models were used to predict the occurrence of different life stages of these insects.

Table 1. Average percent carrot rust fly and carrot weevil damage on carrots at harvest in scouted fields around the Holland Marsh (HM), 2013.

Location	% Damaged Carrots	
	Weevil damage	Rust fly damage
South HM	0.0	0.0
West HM	0.0	0.0
North HM	1.3	1.0
Central HM	2.0	1.3
East HM	0.3	0.3

Carrot weevil adults were first found in wooden traps on 16 May in carrot fields. The threshold of 1.5 or more weevils/trap was reached by the end of May.

Orange sticky traps and degree day models were used to monitor and estimate carrot rust fly and aster leafhopper numbers. Aster leafhoppers are pests of carrots, celery, lettuce and leafy greens. Aster leafhopper adults were first found on orange sticky traps the first week of June in carrots, lettuce and celery. In 2013, aster leafhopper numbers and aster yellows (the disease caused by the infestation) were moderate.

Carrot rust flies were first found on sticky traps on 7 June, which was 2 weeks later than in 2012 growing season. The spray threshold for fresh market carrots (0.1 flies/trap/day) was reached mid-June. Generally weevil and carrot rust fly damage was lower than in 2012 growing season.

Diseases

Carrot fields were scouted for all the important diseases of carrots around the Holland Marsh. Leaf blight, which is caused by the fungi *Alternaria dauci* and *Cercospora carotae*, was first seen in mid-July and certain fields reached the spray threshold within one week. The timely announcement of leaf blight incidence helped to keep the disease pressure at the threshold of 25% disease incidence.

Weather conditions in the 2013 growing season were conducive for most pathogens including *Pythium*, *Sclerotinia* and *Rhizoctonia.* Total monthly rainfall was above the previous long term 10 years average for May, June, July, August and September, which likely resulted in excessive soil moisture. This excessive soil moisture in turn created ideal conditions for soil borne pathogens, particularly *Pythium* and *Rhizoctonia* spp., resulting in a high incidence of cavity spot, pythium root dieback and crater rot. All of the surveyed fields had cavity spot (*Pythium* spp.) with incidence ranging from 6 to 31% and 92% of the fields had pythium root dieback (*Pythium* spp.) with incidences of 3-11%.

Crater rot (*Rhizoctonia carotae* Rader) was found in 9 of the 26 carrot fields surveyed. In 2013, 19% of the surveyed fields had aster yellows, which was lower compared to the 2012 growing seasons where 64% of the surveyed carrot fields had aster yellows.

Carrots in fifteen (58%) of the fields sampled had crown gall (*Agrobacterium tumefaciens*) with disease incidence ranging from 1 to 19%. Sclerotinia rot (*Sclerotinia sclerotiorum*) development and incidences were observed in carrot fields around the Holland/Bradford Marsh during the growing season. Sclerotinia rot was found on carrots from 3 sampled fields. Fusarium rot (*Fusarium* spp.) was found on carrots from 1 field with an incidence of 2%. In 2013, high incidence (60-100%) of fusarium rot was observed in a field trail conducted in the Holland/Bradford Marsh indicating the prevalence of the disease in the region. Carrot roots from 85-100% of the fields surveyed showed splitting (growth cracks) and forking with mean incidence of 3.4 and 6.9 respectively.

Table 2. Disease incidence on carrot samples collected from 26 commercial fields in the Holland/Bradford Marsh, Ontario in 2013.

Disease	Mean incidence (%) (n = 26)	Fields affected
Cavity spot	12.4	26
Pythium root dieback	3.6	24
Crown gall	4.2	15
Crater rot	0.6	8
Aster yellows	0.2	6
Sclerotinia rot	0.2	3
Fusarium rot	0.1	1
Splitting (Growth cracks)	3.4	22
Forking	6.9	26

ONION

Insects

Onion fields were scouted for onion maggot (*Delia antiqua*), onion thrips (*Thrips tabaci*), cutworms and other insect pests. Damage plots were assessed for onion maggot damage and smut incidence after the first and second onion maggot generation peaks. The average onion maggot damage was 1.6 - 2.3% (first generation) and 0.7 – 1.3% (second maggot generation).

Compared to the 2012 growing season, onion maggot and thrips infestation was moderate in 2013 growing season. Thrips were first found in onion plants in scouted fields on 12 June, two weeks later than in 2012. Very few scouted fields reached the threshold of one thrips per leaf in mid-July.

Diseases

Onions 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.

In 2013, stemphylium leaf blight was the main disease that affected onions. Spores of *Botrytis* spp., *S. vesicarium*, *Alternaria* spp., *Perosnospora destructor* were detected with the spore traps during the growing season. Few incidence of botrytis leaf blight was reported. Downy mildew was found in most scouted onion fields around the Marsh, which was very low or non in the 2011 and 2012 growing seasons. Smut incidence was observed in most of the scouted fields with a mean incidence of 0.1 to 3.8%. A new disease, onion anthracnose (caused by *Colletotrichum* spp.) was found for the first time in onions

around the Marsh. A survey will be conducted in 2014 growing season to determine the spread and severity of the disease.

CELERY

Insects

In 2013, celery fields were scouted for carrot weevil, aster leafhopper, tarnished plant bug (*Lygus lineolaris*), pea leafminer (*Liriomyza huidobrensis),* 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. The scouting results of carrot weevil and aster leafhopper were as discussed in the carrot crop section. Tarnished plant bug pressure was lower than the 2012 growing season. A few fields reached the damage threshold of 6% around early to mid-August. Aphid, carrot weevil and leafminer infestations remained low throughout the growing season.

Diseases

Celery leaf blights in Ontario are caused by the fungi *Cercospora apii* (early blight) and *Septoria apiicola* (late blight) and the bacteria *Pseudomanas syringae* pv. *apii* (bacterial blight). The threshold for pesticide application is disease presence. Incidence of early blight and late blight was observed in most scouted fields. Pink rot (*Sclerotinia sclerotiorum*) incidence remained low throughout the season. Boron deficiency was the main nutrient issue in celery. Leaf curl disease (*Colletortrichum* spp.), which is a relatively new disease was found in celery around the Marsh for the first time in 2013 growing season. Survey will be conducted in 2014 growing season to determine the spread and severity of the disease in the Holland/Bradford marsh.

LETTUCE

Insects

The degree day models were used to predict the occurrence of various life stages of the aster leafhoppers and tarnished plant bug. The scouting results were as discussed in the carrot crop section. The occurrence of tarnished plant bugs and leaf hoppers was moderate this year compared to the 2012 growing season. Aphid numbers were low in lettuce fields.

Diseases

The main disease observed in lettuce fields were downy mildew (*Bremia lactucae*), Sclerotinia drop (*Sclerotinia sclerotiorum* and *S. minor*) and grey mould (*Botrytis cinerea*). BREMCAST, the lettuce downy mildew forecasting model, predicted sporulation infection periods (SIP) during the growing season starting mid-July and the risk of developing downy mildew remained moderate to high until September. Downy mildew on lettuce was confirmed end-July.

WEEDS

In 2013, broad-leaved weed, grass and sedge weed pressure differed among fields mainly depending on field location and management practices. In most fields, weeds were controlled during the critical weed-free period for each crop. Some herbicide resistance redroot pig weed and yellow nutsedge were also problems for growers in all crops around the Holland Marsh.

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