UNIVERSITY of GUELPH

THE 2010 IPM PROGRAM OF THE MUCK CROPS RESEARCH STATION

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TITLE: **THE 2010 IPM PROGRAM OF THE MUCK CROPS RESEARCH STATION**

1. INTRODUCTION

A vegetable crop Integrated Pest Management (IPM) program in the Holland Marsh, Ontario, has been provided by the University of Guelph, Muck Crops Research Station (MCRS) since 2004. The program objectives are to scout growers' fields, provide growers with disease and insect forecasting information and to identify and diagnose diseases, insect pests and weeds.

2. SCOUTING

In 2010, 732 acres were intensively scouted representing four crops: carrot (410 acres), celery (35 acres), lettuce (20 acres) and onion (267 acres), for 29 growers. Compared to the 2009 growing season, fields scouted increased by 150 acres (6% more of the total field) and four more growers participated in the IPM program in 2010. A total of ~2800 acres of land is cultivated in the Holland Marsh by the members of the Holland Marsh Growers' Association (HMGA). The fields scouted under the IPM program are approximately 26% of the fields cultivated by members of the HMGA. The information gathered from the scouted fields was used to manage the insect and disease problems of all the cultivated fields.

Two scouts were hired for the 2010 season. Scout training was conducted at the MCRS with a two day in-class and in-field training session at the beginning of May. Training, re-training and pest updating continued throughout the growing season through in-class and in-field sessions once a week.

The scouting schedule consisted of visiting fields twice a week, either on Mondays and Thursdays or Tuesdays and Fridays. Besides training, Wednesdays were set aside to prepare sticky traps and to scout fields that were skipped due to pesticide application re-entry periods or inclement weather. Beginning in September, field scouting was continued on a weekly basis. During the first six weeks of the scouting season, the IPM supervisor went out once per week with each scout for training and scouting assessment. During the rest of the growing season, the IPM supervisor went out with each scout once every other week.

3. DIAGNOSTICS, EXTENSION & DISSEMINATION OF INFORMATION

Any grower, whether on the IPM program or not, could bring in samples (plant and/or soil) for problem diagnosis. Field visits could also be requested. Two MCRS personnel were available for diagnosis and extension including the IPM Coordinator (Mary Ruth McDonald) and the IPM supervisor (Michael Tesfaendrias). Shawn Janse (Research Station manager) was also available for consultations and recommendations. On-site tools available for diagnosis were visual inspection, laboratory inspection using a microscope and culturing. Diagnoses were made by comparison to known problem symptoms, published descriptions of pathogens, insect pests and weeds and personal experience. Following assessment, the extension advice given was based on OMAFRA guidelines in terms of recommendation of pesticides and other control methods.

From January 7 to November 30, 2010, the MCRS diagnostic laboratory received 378 samples. Of these, 87% were for disease diagnosis (329 in total). Categories of samples received were: Onion (50.8%), carrot (25.8%), lettuce (5.8%), celery (5.8%) and other crops (12.1%). In the 2010 growing season, 34 insect and insect damages, and 15 weed identifications were also completed.

For extension services, data collected from growers' fields were compiled twice per week, analyzed and summarized. The results were disseminated through the MCRS IPM summary (Agrifax) and emailed to all participating growers. The data collected from the MCRS research plots were compiled twice per week, analyzed and summarized. The IPM report was accessible to all growers around the Bradford/Holland Marsh, which covers ~10,000 acres of cultivated fields. The IPM report was posted at the MCRS web site (www.uoguelph.ca/muckcrop) and a copy was sent to the Bradford Co-op for displayed on the notice board. The IPM report and Agrifax also contained additional important data related to pest monitoring and modeling, forecasting and control, relevant weather data, OMAFRA and government notices, and meetings.

4. PEST PREDICTIVE MODELS

A number of predictive models were used to forecast different insect pest and disease problems. Insect pest emergence was predicted with degree day models and confirmed with sticky traps and plant assessments. Disease forecasts were provided based on three forecasting models: BREMCAST for downy mildew (*Bremia lactucae*) of lettuce, BOTCAST for botrytis leaf blight (*Botrytis squamosa*) of onion and DOWNCAST for downy mildew (*Peronospora destructor*) of onion. All of the predictive models required environmental data such as air temperature, relative humidity, rainfall and leaf wetness. The environmental data was collected using various sensors attached to a permanent CR3000 data logger located at the side of the field at the MCRS. An additional CR21X data logger was placed in a MCRS onion research plot to collect environmental data within the crop canopy.

4.1. WEATHER/ENVIRONMENTAL DATA

Compared to the averaged previous 10 years, the air temperatures in 2010 were average for June (18.4ºC), September (15.5ºC) and October (9.4ºC), above average for May (15.1ºC), July (22.3ºC) and August (21.1ºC). The long term previous 10 year average temperatures were: May 13.1ºC, June 18.4ºC, July 20.0ºC, August 19.3ºC, September 15.5ºC and October 8.9ºC. Monthly rainfall was below the previous long term 10 year average for May (51.7 mm), average for October (60.4 mm), and above average for June (170 mm), July (146 mm), August (74 mm) and September (95 mm). The long term previous 10 year rainfall averages were: May 87 mm, June 74 mm, July 76 mm, August 57 mm, September 72 mm and October 58.3 mm.

4.2. DAMAGING WEATHER EVENTS

The recording of damaging weather events is important in IPM programs because these events can have a detrimental effect on normal crop growth and development and increase individual plant susceptibility to certain pests. Often damaging weather events warrant a management response by the grower. In 2010, severe heat injury was observed on onions, particularly onions that were seeded early in the season due to the extreme heat wave and shortage of rain from mid to late May.

5. PESTICIDE REDUCTION

The goal of the MCRS Integrated Pest Management (IPM) scouting program is to provide Holland Marsh growers with timely, accurate and convenient access to insect and disease pest information. As part of the IPM program, disease forecasting models and insect day degree models and trap counts are used to predict pest outbreaks. This information allows the growers to make informed decisions about which pests need to be targeted at appropriate times throughout the growing season. Without accurate information, growers typically rely on calendar based spray programs for pest control. The tables below outline the benefit of accurate pesticide application for growers on the IPM program in relation to calendar based spray programs. Each individual grower’s practices may differ; however, the following tables provide an overall pesticide use pattern of the growers using the MCRS IPM program.

Table 1. A comparison of the number of pesticide applications used in onions for various pests in fields in the Holland Marsh, 2010 when following the guidelines of the Muck Crops Research Station IPM program.

Crop	Pest	Calendar Program	IPM Program	Difference[1]	% pesticide reduction
Onions	Botrytis leaf blight	11	4	-7	64
Onions	Downy mildew	11	5	-6	55
Onions	Onion thrips	10	5	-5	50
Onions	Onion maggot[2]	6	1	-5	83

[1]Difference between the number of pesticide applications in a calendar based spray program and IPM program
[2]Foliar insecticide applications are not recommended as part of our IPM program for onion maggot.

Table 2. A comparison of the number of pesticide applications used in carrots for various pests in fields in the Holland Marsh, 2010 when following the guidelines of the Muck Crops Research Station IPM program.

Crop	Pest	Calendar Program	IPM Program	Difference[1]	% pesticide reduction
Carrots	Leaf blights	7	6	-1	14
Carrots	Carrot rust fly	8	6	-2	25
Carrots	Weevil	2	1	-1	50
Carrots	Aster Leafhoppers	2	0	-2	100

[1] Difference between the number of pesticide applications in a calendar based spray program and IPM program.

The benefits of the MCRS IPM program in reducing the frequency of pesticide applications in onions and carrot in 2010 is evident in Tables 1 and 2. In onions, the number of pesticide applications was reduced an average of 63% over the growing season for all pests. In 2010 onion downy mildew pressure was very low. DOWNCAST, the onion downy mildew predictive model, predicted a sporulation infection period around mid-July. The first downy mildew was confirmed on onion fields in the Holland Marsh east of highway 400 in late July. The risk remained low to moderate. The disease did not spread to other locations in the Marsh. Hence, less fungicide spray for downy mildew was required than in 2009.

In carrots, pressure from disease started early in some areas and pesticide application for diseases was similar in most fields regardless of the program followed. Carrot weevil populations throughout the Holland Marsh vary. Insecticide applications for weevils are based on two thresholds. Scouting individual fields allows growers to apply the correct number of applications to given fields. Of the total scouted fields, only 20% carrot fields needed to apply insecticide twice, while the remaining 80% carrot fields needed to apply insecticide against carrot weevils only once. Aster leafhoppers typically arrive on warm southern winds from the southern United States in July and August, however in 2010, scouting and trapping provided growers with data to show low numbers of aster leafhoppers and therefore no insecticide applications were required. In general, scouting reduced the average pesticide applications in carrots by 47% in 2010.

6. CROP PEST SUMMARIES

For scouting purposes, the Holland Marsh was divided into the following five areas: West (all fields west of highway 400), Centre (fields north of Woodchoppers Lane, south of Strawberry Lane, east of highway 400 and west of Keele Street), North (all fields on North Canal Road, east of highway 400), East (all fields that were not on North Canal Road but east of Keele Street), South (south of Woodchoppers Lane). At the end of the scouting program, carrot samples were collected from each scouted field and assessed for damage from insects, diseases or physiological disorders (Tables 3 and 4). Similarly, onions were assessed in mid-season and at the end of the scouting program for onion maggot damage and incidence of smut (Figs 4 and 5).

6.1. CARROT

6.1.1. Insect

In 2010, carrot fields were scouted for carrot weevil (*Listronotus oregonensis*), carrot rust fly (*Psila rosae*) and aster leafhopper (*Macrosteles quadrilineatus*). Degree day models were used to predict the occurrence of different life stages of all three insects. Due to the warmer spring of 2010, the degree days (DD) accumulated earlier than we had in the last two years. This resulted in early emergence of most insects around the Holland Marsh.

Table 3. Percent damage on carrots at harvest caused by insects and rodents in scouted fields around the Holland Marsh (HM), 2010.

Location	% damaged carrots		
	Weevil damage	Rust fly damage	Rodent damage
West HM	0.3	0.3	1.0
Center HM	2.5	2.4	0.8
North HM	2.3	2.8	0.0
East HM	3.2	3.4	0.0
South HM	0.0	0.5	0.5

CARROT WEEVIL

Carrot weevils are pests of carrots and celery. Carrot weevil adults were first found in wooden traps on 24 May in carrot and celery fields (Fig. 1). The threshold of 1.5 or greater weevils/trap was reached within a week after weevil activity started. The highest average cumulative number of weevils caught anywhere in the Holland Marsh/trap was 4.8, lower than in 2009 where the highest average cumulative weevil was 9.7.

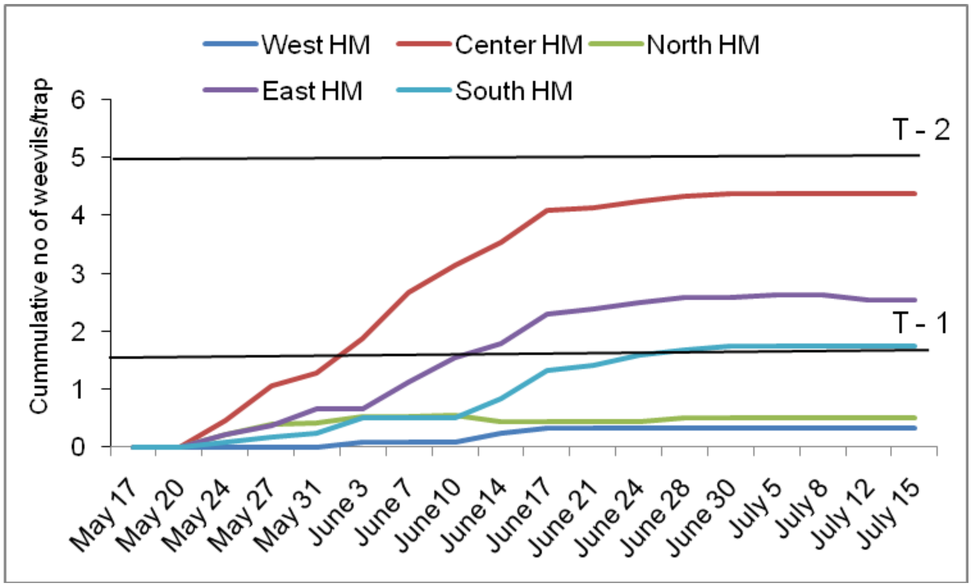

Fig. 1. Cumulative number of carrot weevils/wooden trap averaged over different areas of the Holland Marsh, 2010; (T-1, threshold 1=1.5-5 weevils/trap; T-2, threshold 2 = >5weevils/trap).

CARROT RUST FLY AND ASTER LEAFHOPPER

Orange sticky traps where used to monitor and estimate carrot rust fly and aster leafhopper population numbers. Carrot rust flies were first found on sticky traps on 24 May which coincided with the degree day model prediction of first generation emergence on 20 May. The fresh carrot threshold of 0.1 flies/trap/day was reached in several fields at the end of May. The first generation peak emergence was reached mid-June and 2nd generation emergence began mid to end of July and the peak was towards the beginning of August (Fig. 2).

Aster leafhoppers are pests of carrots, celery, lettuce and leafy greens. Aster leafhopper adults were first found on orange sticky traps on 3 June in carrots, lettuce and celery. The degree day model predicted local adult emergence on 18 June, which was 2-3 weeks earlier than in 2009. The adults caught before 18 June may have been local but could also have migrated from the United States (Fig 3). In 2010, aster leafhopper infestation and the disease caused by the infestation (aster yellows) were low.

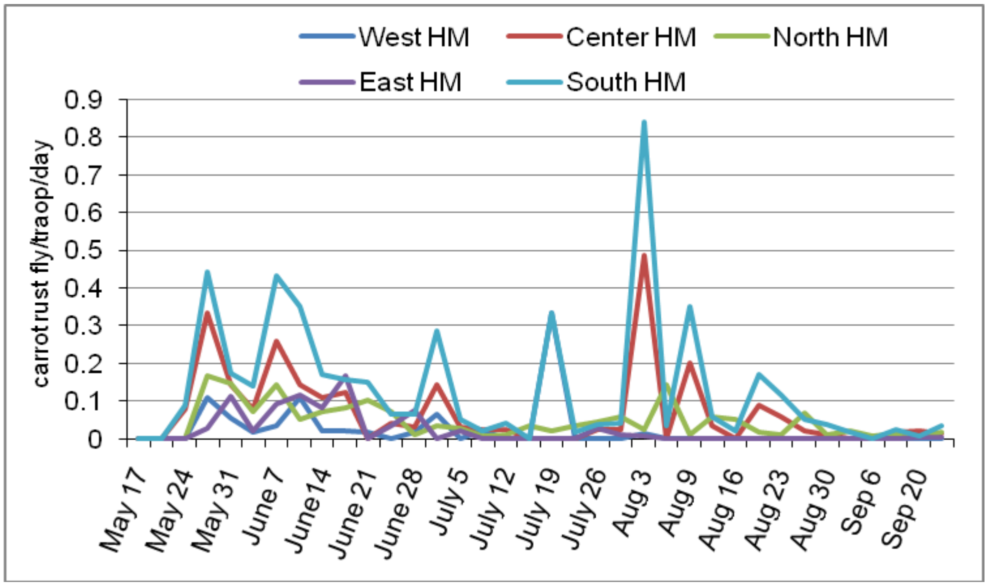

Fig. 2. Number of carrot rust flies caught on orange sticky traps around the Holland Marsh carrot fields, 2010.

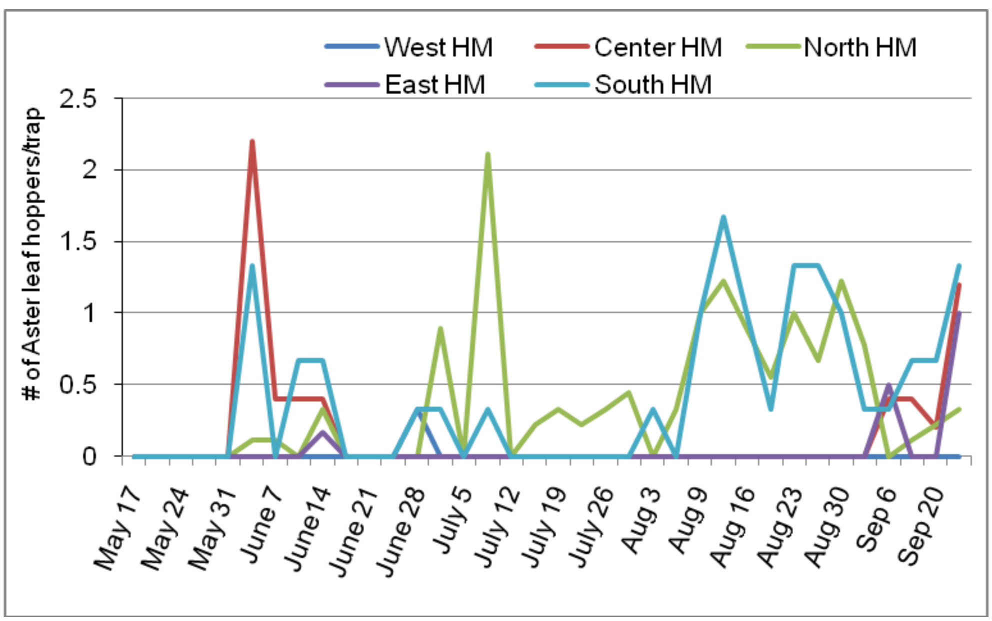

Fig. 3. Highest numbers of aster leaf hoppers caught on any particular day around the Holland Marsh, 2010.

6.1.2. Disease

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

Weather conditions in the 2010 growing season were conducive to most pathogens including *Pythium*, *Sclerotinia* and *Rhizoctonia.* Total monthly rainfall was above average for June, July, August and September compared to the previous 10 year average and likely resulted in excessive soil moisture. This excessive soil moisture in turn created ideal conditions for soil borne pathogens, particularly *Pythium*, resulting in a high incidence of cavity spot and pythium root dieback. Of the fields surveyed, 75 and 100% showed pythium root dieback and cavity spot, respectively (Table 4).

Table 4. Percent damage on carrots at harvest due to diseases and physiological disorder in scouted fields around the Holland Marsh (HM), 2010.

	% carrot damaged							
	Cavity spot	Rusty root	Crown gall	Crater rot	Fusarium rot	Sclerotinia rot	Forking	Splitting
West HM	10.0	3.3	7.3	0.0	0.0	0.0	3.7	3.3
Center HM	14.0	4.1	1.4	1.1	0.3	0.0	4.6	4.9
North HM	10.0	2.3	0.8	1.5	0.0	0.5	3.3	1.8
East HM	11.0	2.0	0.8	0.6	0.4	0.0	2.0	3.0
South HM	6.5	3.5	1.5	0.5	0.0	1.0	5.5	2.0
Mean incidence	11.1	2.9	20.0	0.8	0.2	0.2	3.7	3.1
#fields affected	24.0	18.0	10.0	11.0	2.0	3.0	21.0	15.0
%fields affected	100.0	75.0	42.0	46.0	8.0	13.0	88.0	63.0

6.2. ONION

6.2.1. Insect

In 2010, onions were mainly scouted for onion maggot (*Delia antiqua*), onion thrips (*Thrips tabaci*) and cutworms. A degree day model was used to predict the occurrence of the different life stages of the onion maggot. The degree day model predicted first adult fly emergence on 21 May which appears to coincide with catching the first adults on 18 May (Fig. 4).

Onion fly activity had slowed down at the beginning of the adult fly emergence (end of May to first week of June) due to extreme heat. The first generation peak occurred around mid to end of June. The first generation emergence was long and a definitive peak was not seen in 2010. Damage plots of one hundred onion plants were marked out at four sites throughout each scouted field to assess damage caused by onion maggot. The damage plots in all onion fields were assessed mid-July for onion maggot damage caused from the first generation. Damage plots were also assessed at the end of August to determine the overall damage caused by onion maggots (Fig. 5). The results from the damage assessments were to inform the growers as to the effectiveness of their insecticide at seeding.

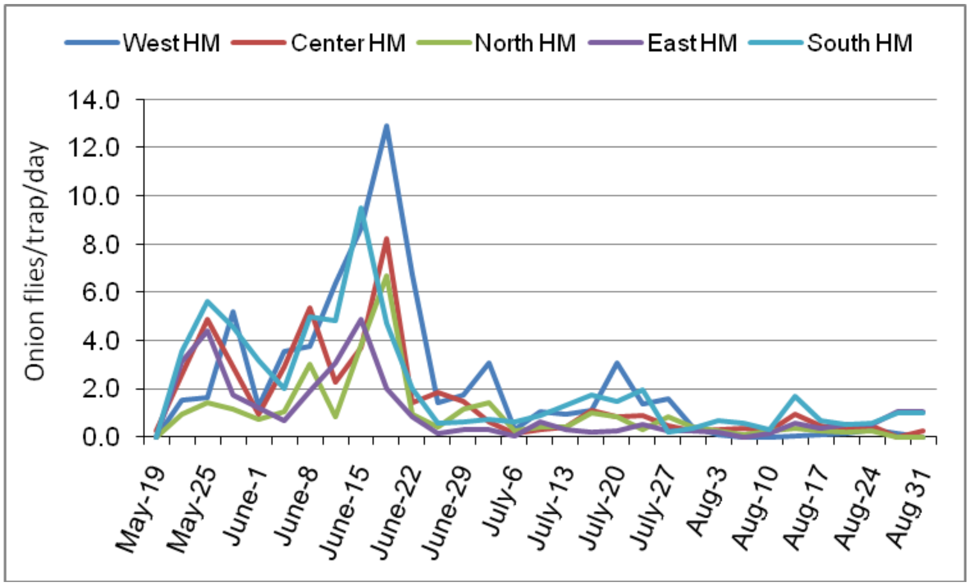

Fig. 4. Number of onion maggot flies caught on yellow sticky traps around the Holland Marsh onion fields, 2010.

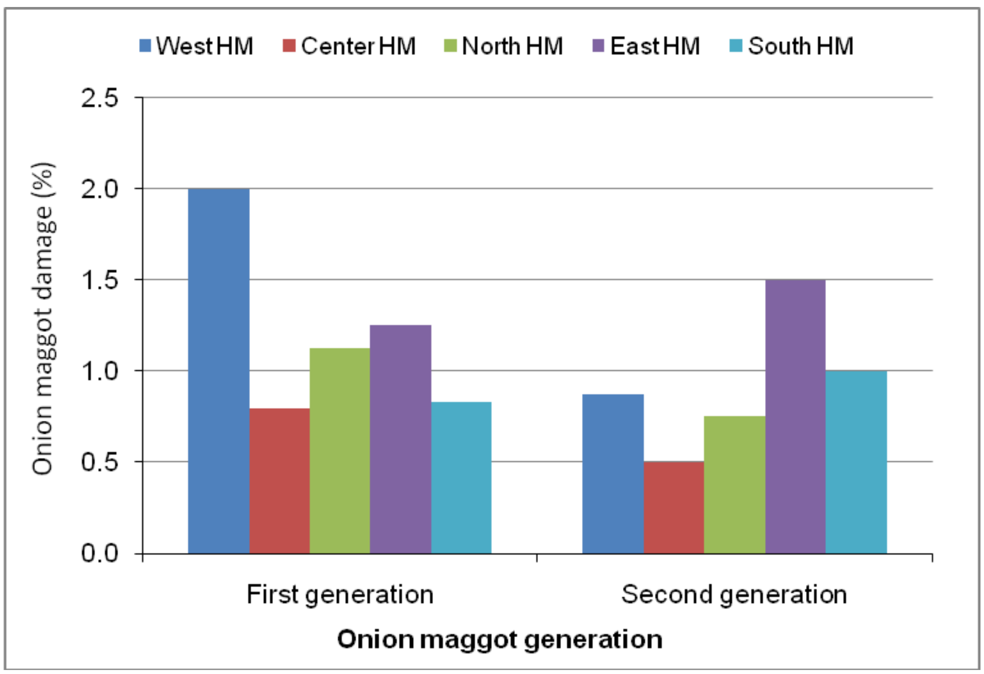

Fig. 5. Percent damage caused by the first and second onion maggot generations around the Holland Marsh, 2010.

White sticky traps were used to determine when onion thrips first entered the fields. After thrips were found on the white sticky traps, plant counts were used to determine population numbers. Thrips were first found in onion plants in scouted fields on 31 May, three weeks earlier than 2009. Several scouted fields reached the threshold of one thrips per leaf mid of July (Fig. 6). Thrips thrive in hot, dry conditions. The weather condition of the 2010 growing season was favourable for thrips infestations.

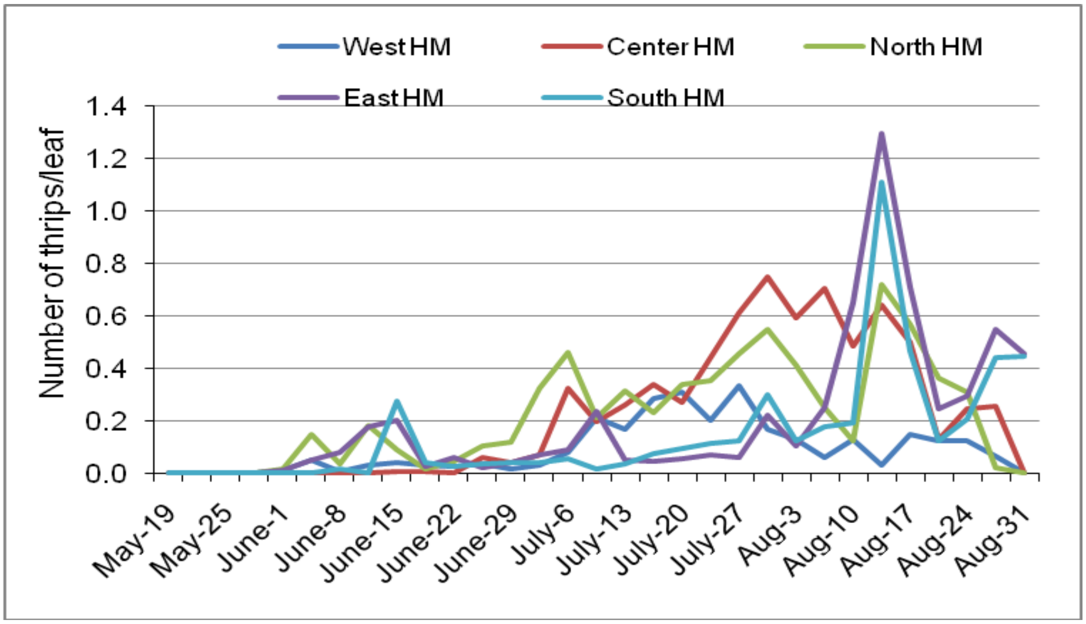

Fig. 6. Number of onion thrips in onion fields around the Holland Marsh, 2010.

6.2.2. Disease

In 2010, onions were scouted mainly for botrytis leaf blight (*B. squamosa*), downy mildew (*P. destructor*), purple blotch (*Alternaria porri*), white rot (*Sclerotium cepivorum*) and pink root (*Phoma terrestris*). During scouting for diseases of onions, a severe leaf blight disease, caused by *Stemphyllium vesicarun* was observed in many onion fields in the Holland/Bradford Marsh area. This disease was first seen by IPM scouts in 2008 in a few fields, and was found in a few more in 2009, but the 2010 season was the first where any yield losses were associated with the disease.

The predictive model, DOWNCAST, was used to forecast downy mildew of onions. In 2010 onion downy mildew pressure was very low. DOWNCAST, the onion downy mildew predictive model, predicted a sporulation infection period around mid-July. The first downy mildew was confirmed on onion fields in the Holland Marsh east of highway 400 in late July. The risk remained low to moderate. The disease did not spread to other locations in the Marsh.

BOTCAST, a disease forecasting program for botrytis leaf blight, was used to predict the severity of *Botrytis squamosa* on onions. The cumulative disease severity index (CDSI) was calculated daily and summed over the season. The CDSI reached 21-30 (first spray threshold) on 23 July to 10 August. Fewer fungicide sprays were recommended compared to the 2009 growing season reached.

In the 2010 growing season, higher incidence of Stemphylium leaf blight which is caused by *Stemphylium vesicarium* was observed in onion fields around the Holland Marsh. Stemphylium leaf blight symptoms are similar to purple blotch and both diseases are managed in the same manner. The incidence and severity of white rot was lower in onion fields around the Holland Marsh compared to the previous season.

In the 2011 growing season, rotorod (spore trap) will be implemented as part of the MCRS IPM program to effectively track new, invasive, or reemerging plant disease causing pathogens. The spore trap analysis will be used in combination with disease forecasting models, lesion counts and weather forecasts to recommend fungicide applications.

6.3. CELERY

6.3.1. Insect

In 2010, the insect pest of celery that were scouted for were carrot weevil (*L. oregonensis*), aster leafhopper (*M. quadrilineatus*), tarnished plant bug (*Lygus lineolaris*), and the pea leafminer (*Liriomyza huidobrensis)*. The degree day models were used to predict the occurrence of different life stages of the carrot weevil, aster leafhopper and tarnished plant bug. The scouting results of carrot weevil and aster leaf hopper were discussed in the carrot crop section. Tarnished plant bugs are pests of celery and lettuce and leafy greens. Using plant inspections, orange sticky traps and sweep nets, tarnished plant bug populations were assessed. Few fields reached a damage threshold of six percent around mid to end of August.

Aphids are pests of celery and lettuce and leafy greens and the scouted data were used across both crops, especially if fields were next to each other, for the best assessment of each area in the Holland Marsh throughout the growing season, for extension purposes. Aphid counts remained low throughout the growing season.

6.3.2. Disease

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. The main issue in the 2010 growing season was bacterial blight. No late blight was observed on scouted celery fields. Pink rot (*Sclerotinia sclerotiorum*) incidence remained low throughout the season. Symptoms related to nitrogen deficiency were seen in certain celery fields.

6.4. LETTUCE

6.4.1. Insect

The main insects that lettuce was scouted for in 2010 were aster leafhopper (*M. quadrilineatus*), tarnished plant bug (*L. lineolaris*) and various aphid species including the green peach aphid (*M. persicae*) and sunflower aphid (*A. helianthi*). The degree day model used to predict the occurrence of different life stages of the aster leafhopper and the scouting results were discussed in the carrot crop section. The occurrence of leaf hoppers, tarnished plant bugs and aphids was low in lettuce fields.

6.4.2. Disease

The main diseases that lettuce was scouted for were downy mildew (*Bremia lactucae*), Sclerotinia drop (*Sclerotinia sclerotiorum* and *S. minor*) and gray 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. Lettuce downy mildew symptoms started to develop around mid to late July in the Holland Marsh. Downy mildew incidence was low in all scouted fields as a result of timely fungicide applications.

Sclerotinia drop, botrytis grey mould and pythium stunt were all first noted early to mid-June. In 2010, incidence of sclerotinia drop was relatively high in mid to end of July probably due to the wet weather (Fig 7). A similarly high incidence of grey mould was observed around mid to end of July which lessened as the season progressed.

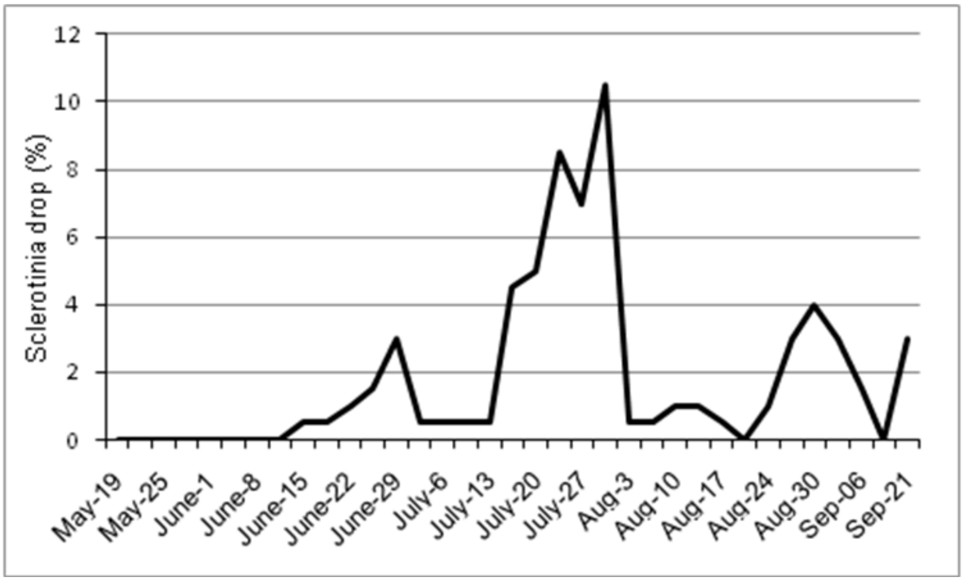

Fig 7. Incidence of sclerotinia drop of lettuce in lettuce fields around the Holland Marsh, 2010.

7. WEEDS

In 2010, broad leaf, 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. The critical weed-free period for carrots is the first three to six weeks after emergence. The critical weed-free period for celery is the first four to eight weeks after transplanting. The critical weed-free period for lettuce and leafy greens is the first three weeks after transplanting and for onion the critical weed-free period is the entire growing season. Although weeds that emerge after the critical weed-free period may not affect yield, growers should control weeds after the critical weed-free period to make harvest more efficient and reduce weed problems in subsequent years. Some herbicide resistant redroot pig weed started to appear in few fields. Yellow nutsedge was a problem for a number of growers in all of the crops around the Holland Marsh.

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