UNIVERSITY of GUELPH

MUCK CROPS RESEARCH STATION
IPM PROGRAM REPORT
2009

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The 2009 IPM PROGRAM OF THE MCRS

The 2009 Integrated Pest Management (IPM) program for vegetable crops in the Holland Marsh, Ontario, was successfully provided by the University of Guelph, Muck Crops Research Station (MCRS). 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. FUNDING SOURCES

A total of ~2800 acres of land is cultivated in the Holland Marsh by the members of the Holland Marsh Growers' Association. The 2009 IPM service was sponsored by Holland Marsh Growers' Association, Lake Simcoe Region Conservation Authority, Bayer Crop Science, DuPont Canada, BASF, Engage Agro and Syngenta Crop Protection. The sponsorship covered the scouting of one field of 10 acres of each member of the Holland Marsh Growers' Association, and paid for the IPM supervisor's and scouts' salaries, costs of maintaining data loggers, disease and insect forecasting, and costs of scouting materials. Additional fields were scouted at $40 per acre.

2. SCOUTING

A total of ~2800 acres of land is cultivated by members of the Holland Marsh Growers' Association. In 2009, 561 acres were intensively scouted representing four crops: carrot (227 acres), celery (45 acres), lettuce (70 acres) and onion (219 acres), for 25 growers. The fields scouted under the IPM program are approximately twenty percent of the cultivated fields within the Holland Marsh. 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 2009 season. The scouts had completed University education related to agriculture. 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 mostly on Wednesdays.

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 of the MCRS personnel were available for diagnosis and extension including the IPM Coordinator and the IPM supervisor. Shawn Janse and Kevin Vander Kooi were 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.

Over 300 diagnostic and extension problems were assessed and addressed between March-December 2009. The data collected from the IPM clients were compiled twice per week, analyzed and summarized. The results were disseminated through the MCRS IPM Agrifax and emailed to all of the IPM clients. The data collected from the MCRS research plots were compiled twice per week, analyzed and summarized. The results were disseminated through the MCRS Agriphone as a recorded phone message accessible to all growers around the Holland Marsh, which covers ~10,000 acres of cultivated fields. The Agriphone was also posted at the MCRS web site (www.uoguelph.ca/muckcrop) and a copy of the Agriphone was sent to the Bradford Co-op. The Agriphone 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

The air temperatures in the 2009 growing season were below the long term (10 year) average for June (16.5°C), July (17.9°C) and October (7.3°C), and average for May (12.6°C), August (19.4°C) and September (14.9°C). The long term (10 year) average temperatures were: May 12.1°C, June 18.2°C, July 19.9°C, August 19.3°C, September 15.5°C and October 8.9°C. Monthly rainfall was below the long term (10 year) average for June (49 mm) and September (51 mm), and above average for May (117 mm), July (135 mm), August (89 mm) and October (62 mm). The long term (10 year) rainfall averages were: May 86 mm, June 74 mm, July 76 mm, August 57 mm, September 72 mm and October 59 mm.

4.2. DAMAGING WEATHER EVENTS

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. A severe rain storm caused pelting rain damage in mid-July. The pelting rain caused bruising of onion leaves and whitish spots along one side of the leaves. This injury made the onions more susceptible to foliar diseases. Excessive soil moisture was an issue in 2009, especially in carrot fields. This created an ideal condition for soil borne pathogens particularly *Pythium* on carrots resulting in high incidence of root die back (rusty root), cavity spot and forking.

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. Comparison of the number of pesticide applications used in onions for various pests in fields in the Holland Marsh, 2009 when following the guidelines of the Muck Crops Research Station IPM program.

Crop	Pest[1]	Calendar Program	IPM Program	Difference[2]
Onions	Botrytis leaf blight	11	7	-4
Onions	Downy mildew	11	9	-2
Onions	Onion thrips	10	2	-8
Onions	Onion maggot[3]	6	1	-5

[1] In wetter than average years such as 2009, pressure from diseases tends to be more problematic than insect pests.

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

[3] Foliar insecticide applications are not recommended as part of our IPM program for onion maggot.

Table 2. Comparison of the number of pesticide applications used in carrots for various pests in fields in the Holland Marsh, 2009 when following the guidelines of the Muck Crops Research Station IPM program.

Crop	Pest[1]	Calendar Program	IPM Program	Difference[2]
Carrots	Leaf blights	7	7	0
Carrots	Carrot rust fly	8	6	-2
Carrots	Weevil	2	1	-1
Carrots	Aster Leafhoppers	2	0	-2

[1] In wetter than average years such as 2009, pressure from diseases tend to be more problematic than insect pests.

[2] 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 2009 is evident in Tables 1 and 2. In onions, the number of pesticide applications was reduced an average 50% over the growing season for all pests. In 2009, conditions for disease development were favorable for most of the growing season and therefore differences between the calendar program and the IPM program were small. Scouting for onion thrips, however, reduced the need for insecticide application by 80% in 2009. In carrots, pressure from disease also started early in some areas and pesticide application for diseases was similar in most fields regardless of 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. Insect pests in carrots in 2009 were also affected by the weather. Aster leafhoppers typically arrive on warm southern winds from the southern United States in July and August, however in 2009 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 25% in 2009.

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 damages associated to 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.

6.1. CARROT

6.1.1. Insect

In 2009, 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.

Table 3. Percent damage on carrots at harvest caused by insects and rodents in scouted fields around the Holland Marsh (HM), 2009

Location	% damaged carrots		
	Weevil damage	Rust fly damage	Rodent damage
West HM	0	0	0
Center HM	3.6	2.4	0
North HM	3.9	3.9	2.9
East HM	3.1	1.6	0
South HM	0	2.0	0

CARROT WEEVIL

Carrot weevils are pests of carrots and celery. Carrot weevil adults were first found in wooden traps on 19 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, which coincided with the degree day model for the beginning of laying eggs on 26 May. The highest cumulative number of weevils caught anywhere in the Holland Marsh/trap was 19 in a carrot field and 5.5 in a celery field.

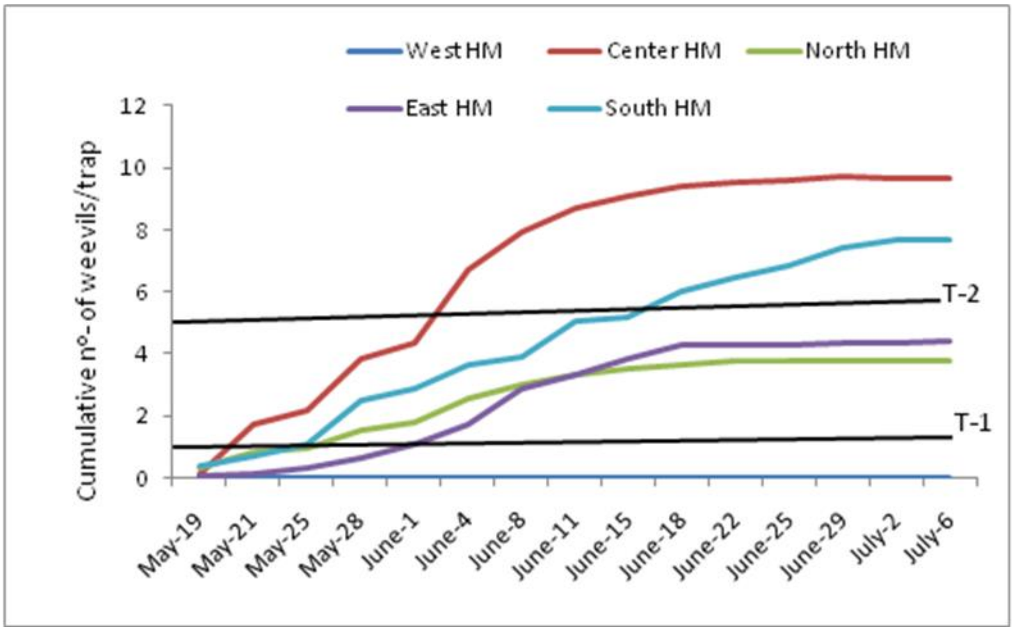

Fig. 1. Cumulative number of carrot weevils/wooden trap averaged over different areas of the Holland Marsh, 2009; (threshold=1.5-5 weevils/trap, threshold 2 = >5weevils/trap).

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 26 May which coincided with the degree day model prediction of first generation emergence on 26 May. The fresh carrot threshold of 0.1 flies/trap/day was reached in several fields at the end of May and first week of June. The first generation peak emergence was reached mid-June and 2nd generation emergence began mid to end of July and the peak was towards mid to end 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 9 June in carrots, lettuce and celery. The degree day model predicted local adult emergence on 7 July. The adults caught before 7 July may have been local but could also have been migrants from the United States. Population peaks occurred mid to end of June (Fig. 3). In 2009, aster leafhopper infestation and the disease caused by the infestation (aster yellows) were low. The cool, wet summer may have limited the influx of migrating leaf hopper population form the US.

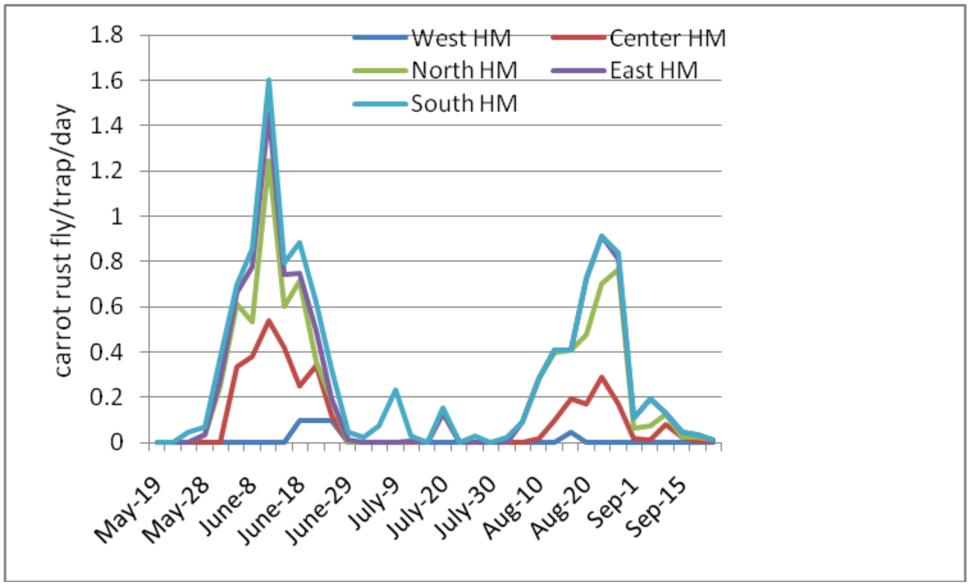

Fig. 2. Number of carrot rust flies caught on orange sticky traps around the Holland Marsh carrot fields, 2009.

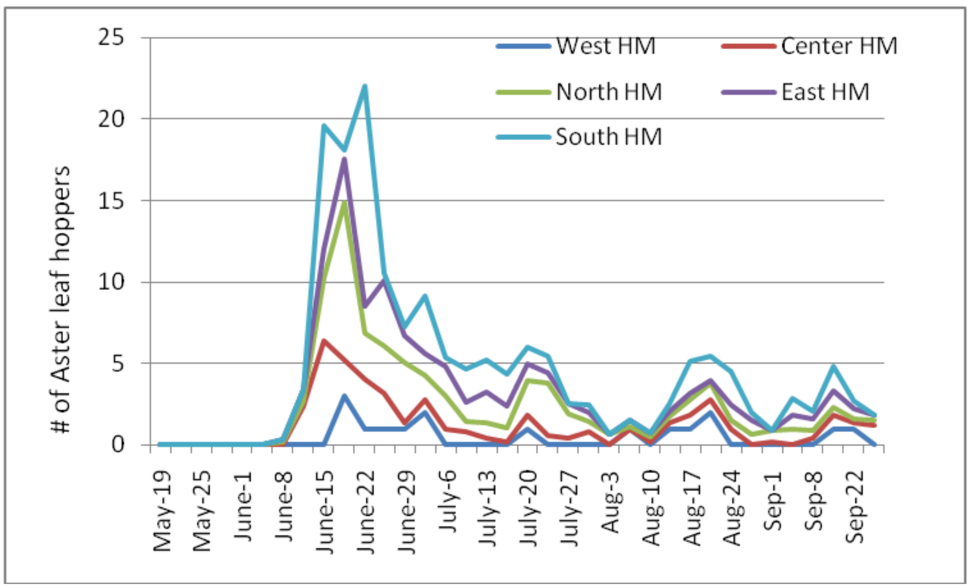

Fig. 3. Highest numbers of aster leaf hoppers caught on any particular day around the Holland Marsh, 2009.

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.

The wet weather experienced during in the 2009 growing season provided ideal conditions for the development of root dieback (rust root), cavity spot and forking resulting from *Pythium* infection. Crown gall, caused by a bacterium (*Agrobacterium tumefaciens*), was found in several fields around the Holland Marsh. There was low incidence of Sclerotinia rot despite the wet conditions.

Table 4. Percent damage on carrots at harvest due to diseases and physiological disorder in scouted fields around the Holland Marsh (HM), 2009

Location	% damaged carrots				
	Rusty root	Crown gall	Aster yellows	Bacterial rot	Splitting
West HM	6.0	2.0	0	0	0
Center HM	19.2	9.2	1.2	0	4.4
North HM	19.3	2.4	0	0	1.9
East HM	13.7	1.6	0.8	2.4	3.1
South HM	10.0	30.0	0	0	4.0

6.2. ONION

6.2.1. Insect

In 2009, onions were scouted: onion maggot (*Delia antiqua*), onion thrips (*Thrips tabaci*) and cutworms. A degree day model was used to predict the occurrence of different life stages of the onion maggot. The degree day model predicted first adult fly emergence on 15 May which appears to coincide with catching the first adults on 19 May (Fig. 4).

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 2009. 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 data 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 and for the effective use of the action thresholds for insecticide application during the second and third generation.

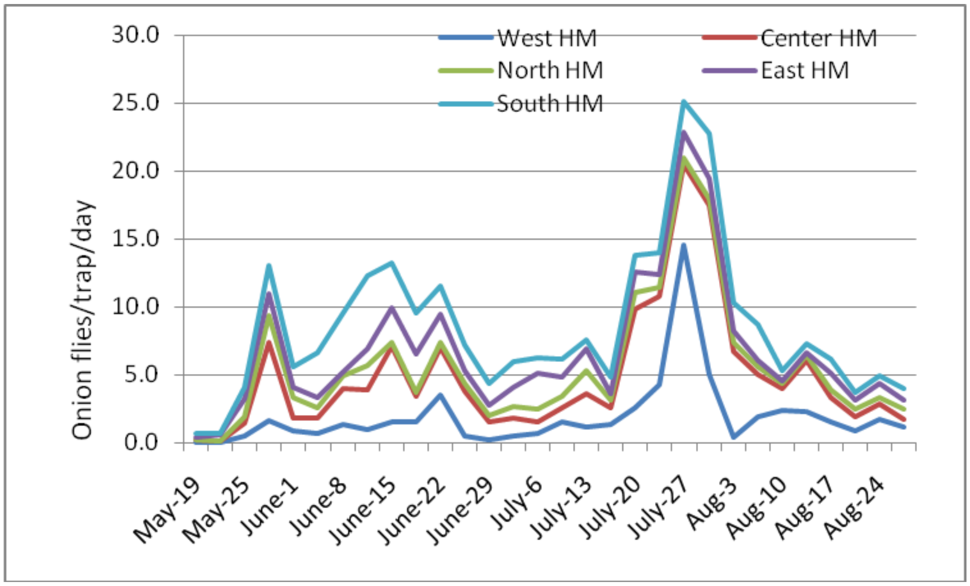

Fig. 4. Number of onion maggot flies caught on yellow sticky traps around the Holland Marsh onion fields, 2009.

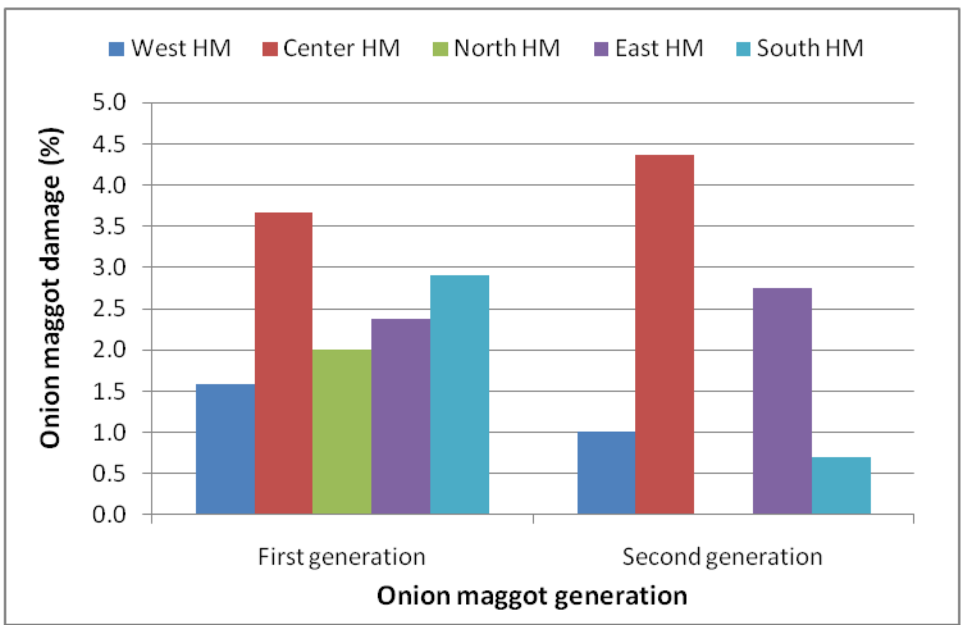

Fig. 5. Percent damage caused by the first and second onion maggot generations around the Holland Marsh, 2009.

White sticky traps were used to determine when onion thrips first entered the fields. After thrips were found on the white sticky traps (22 May), plant counts were used to determine population numbers. Thrips were first found in onion plants in scouted fields on 20 June, although they were found on sprouted culls and sticky traps before this date. Several scouted fields reached the threshold of one thrips per leaf at the end of July. Thrips thrive best in hot, dry conditions. The weather condition of the 2009 growing season was not favourable for thrips infestations (Fig. 6).

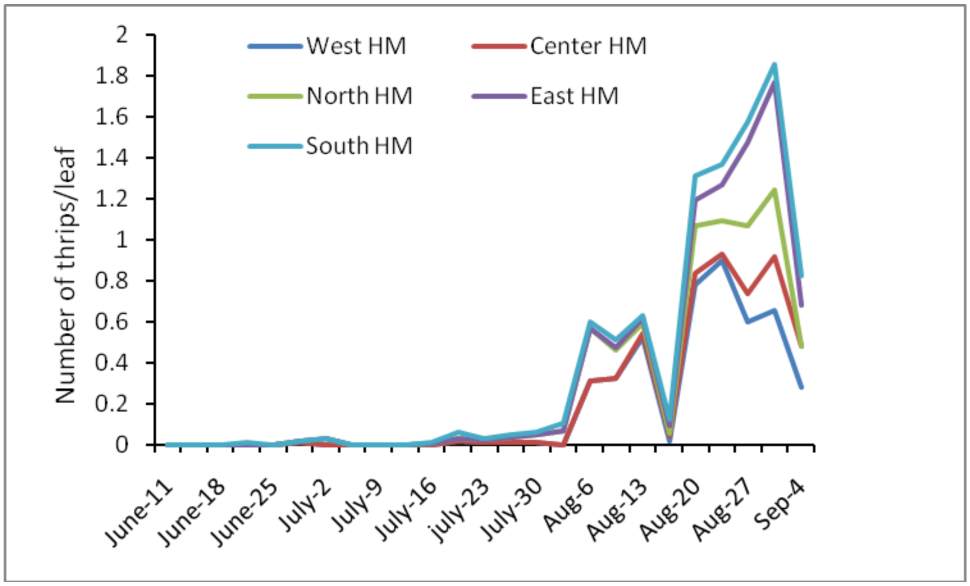

Fig. 6. Number of onion thrips in onion fields around the Holland Marsh, 2009

6.2.2. Disease

In 2009, onions were scouted for botrytis leaf blight (*B. squamosa*), downy mildew (*P. destructor*), purple blotch (*Alternaria porri*), white rot (*Sclerotium cepivorum*) and pink root (*Phoma terrestris*).

The predictive model, DOWNCAST, was used to forecast downy mildew of onions. Most of the 2009 growing season was optimum for a downy mildew epidemic. The first downy mildew sporulation infection period (SIP) based on forecasting occurred on 29 June. Symptoms of onion downy mildew were first seen around the Holland Marsh on 14 July. This corresponds well to the latent period which can be 10-14 days. All scouted onion fields in the Holland Marsh had visible symptoms of downy mildew during the growing season. Risk of disease development was low to moderate until mid July. Disease development and risk of downy mildew was high until the end of the growing season.

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 10-26 July and a few fields reached the threshold of 1 botrytis lesion/leaf during the first week of August. Fungicide sprays were recommended once the threshold was reached.

Botrytis squamosa spore traps were tested in scouted onion fields for integration into the MCRS IPM program. The spore counts were used in combination with BOTCAST, lesion counts and weather forecasts to recommend fungicide applications. The spore traps were also important tools in tracking downy mildew spores in 2009.

In the 2009 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. White rot occurred in certain onion fields around the Holland Marsh and was severe in some cases.

6.3. CELERY

6.3.1. Insect

In 2009, insects that celery was 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. The threshold for insect counts, 0.1 tarnished plant bugs per plant, and a damage threshold of six percent, was not reached in any of the scouted fields.

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 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. In older celery plantings, early blight and bacterial blight symptoms were first seen at the end of June and beginning of July. Late Blight symptoms were first seen in scouted celery fields around mid to end of July.

Pink rot (*Sclerotinia sclerotiorum*) was found in scouted celery field by mid-July. Pink rot disease incidence remained low throughout the season. Symptoms related to nitrogen deficiency were seen at certain celery fields.

6.4. LETTUCE

6.4.1. Insect

The main insects that lettuce was scouted for in 2009 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. Occurrence of leaf hoppers, tarnished plant bugs and aphids was low in lettuce fields.

6.4.2. Disease

The main diseases that lettuce and leafy greens were scouted for were downy mildew (*Bremia lactucae*), drop or white Mold (*Sclerotinia sclerotiorum* and *S. minor*) and gray mould (*Botrytis cinerea*). BREMCAST was used to predict occurrence of downy mildew on lettuce. The first sporulation infection period (SIP) of the 2009 growing season was June 7, but the risk was low. No SIP occurred until June 20 where the risk remained moderate. The SIP that occurred on July 2 resulted in the first visible infection symptoms seen on July 9. The data from the BREMCAST model resulted in low Downy mildew disease incidence in lettuce in 2009 as a result of timely fungicide applications.

Sclerotinia drop, botrytis grey mould and Pythium stunt were all first noted early to mid-June. In 2009, incidence of sclerotninia drop was relatively high probably due to the wet weather (Fig 7). Similarly high incidence of grey mould was observed around mid to end of July and reduced as the season progressed.

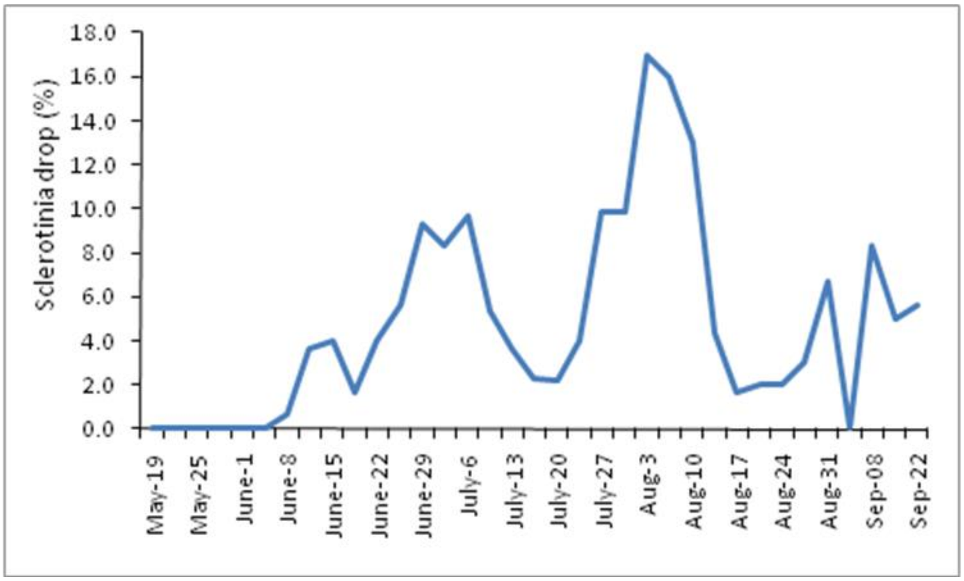

Fig 7. Incidence of sclerotinia drop of lettuce in lettuce fields around the Holland Marsh, 2009.

7. WEEDS

Broad leaf, grass and sedge weed issues differed among growers mainly depending on the importance each grower placed on weed control versus yield. In most fields, weeds were controlled during the critical weed free period for each crop. The critical weed free period for carrots was the first three to six weeks after seeding. The critical weed free period for celery was the first four to eight weeks after transplanting. The critical weed free period for lettuce and leafy greens was the first three weeks after transplanting and for onion the critical weed free period was the entire growing season. Yellow Nutsedge (*Cyperus esculentus*) was a problem for a number of growers in all of the crops around the Holland Marsh.