RUTGERS COOPERATIVE EXTENSION

NEW JERSEY AGRICULTURAL EXPERIMENT STATION

2000 Annual Report

Vegetable Integrated Pest Management Program

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INTRODUCTION

Mission

The Vegetable IPM Program is dedicated to developing and improving integrated pest management techniques and practices that will enhance vegetable production in the state of New Jersey. Program objectives are accomplished through the development and delivery of pest monitoring and field scouting programs, grant-funded and sponsored research, and educational outreach.

Rutgers Cooperative Extension Vegetable IPM Working Group

The Vegetable IPM Working Group meets every other month during the winter to advise and direct the Vegetable IPM Program personnel on programming and research efforts. Members include:

Dr. George Hamilton	RCE Specialist in Pest Management
Mr. Joseph Ingerson-Mahar	RCE Vegetable IPM Coordinator
Mr. Kristian Holmstrom	RCE Vegetable IPM Program Associate
Ms. Sarah Walker	RCE Vegetable IPM Program Associate
Dr. Wesley Kline,	Agricultural Agent, RCE of Cumberland County
Mr. Peter J. Nitzsche	Agricultural Agent, RCE of Morris County
Ms. Michelle Infante-Casella	Agricultural Agent, RCE of Gloucester County
Mr. Richard Vanvranken	Agricultural Agent, RCE of Atlantic County
Mr. Peter Probasco	Agricultural Agent, RCE of Salem County
Mr. William Sciarappa	Agricultural Agent, RCE of Monmouth County
Mr. Ray Samulis	Agricultural Agent, RCE of Burlington County
Mr. William Tietjen	Agricultural Agent, RCE of Warren County
Mr. Winfred Cowgill	Agricultural Agent, RCE of Hunterdon County
Dr. Gerald M. Ghidiu	RCE Specialist in Entomology
Dr. Stephen A. Johnston	RCE Specialist in Plant Pathology
Dr. Melvin Henninger	RCE Specialist in Vegetable Crops
Dr. Stephen A. Garrison	RCE Specialist in Vegetable Crops
Dr. Bradley Majek	RCE Specialist in Weeds
Ms. Martha Maletta	Research Associate, RCE of Hunterdon County
Dr. Marilyn G. Hughes	Program Associate, Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA)

Web Sites

The Vegetable IPM Program has direct involvement or materials listed in the following web sites:

1. **Rutgers Cooperative Extension.** Visit the Pest Management Office link to find information about the Vegetable IPM Program.
   www.rce.rutgers.edu/ag/index.html
2. **Center for Remote Sensing & Spatial Analysis.** Visit the CEW/ECB Integrated Pest Management link to see the current and historical vegetable pest maps.
   www.crssa.rutgers.edu/projects/gps/web_page/web_page.html
3. **Shelby's Sweet Corn Pest Alert.** The New Jersey Vegetable IPM Program forwards weekly blacklight trap data to be represented on regional pest maps published by Penn State University.
   www.ento.psu.edu/vegetable/sweetcorn/default.html
4. **USDA/OPMP Crop Profiles Database.** The Vegetable IPM Program is participating in the development of vegetable crop profiles for NJ. This web site contains the completed crop profiles for all states.
   http://cipm.ncsu.edu/cropprofiles/

IMPACT AND SUCCESS STORIES

Development of an IPM Poster for Farm Markets

Several Vegetable IPM Program participants who deal directly with the consumer through farm stands or tailgate markets suggested that materials were needed to educate the consumer about IPM. These growers were often asked by consumers about their pesticide use, and they wanted to be able to give the consumer university produced materials to explain the complexities of their pest management practices. In cooperation with the Morris and Gloucester County agricultural agents, the Vegetable IPM Program sought and received a grant from the Northeast Center for Rural Development to support for the development and display of an IPM poster at ten roadside vegetable markets in New Jersey. The objectives of the poster were to educate the markets' clientele and to encourage patronage of farms that practice IPM.

In order to gauge the success the poster, a fact sheet and a short pre-addressed and stamped postcard survey accompanied the poster display at the farm market site. Sixty-seven percent of the respondents said that they were not aware of Integrated Pest Management as a farm practice. Even though 33% said they were familiar with IPM, 97% of the respondents said that the poster helped them to learn about and become more acquainted with IPM. And 76% of the respondents were inspired to learn more about IPM. Only 5% knew that the particular farm at which they were purchasing produce practiced IPM. Ninety-eight percent thought that IPM was a positive farm practice.

The IPM Poster appears to be an effective educational tool to teach consumers about IPM. A follow-up survey of the farm stand owners is currently being conducted to determine the effectiveness of the IPM from the standpoint of the growers who displayed it at their farm markets.

Mapping Vegetable Pest Populations

The RCE Vegetable IPM Program continued its collaboration with the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA) in creating and disseminating time sensitive maps of adult European corn borer (ECB) and corn earworm (CEW) populations. ECB and CEW are pests of many vegetable crops including sweet corn, snap and lima beans, peppers, tomatoes, lettuce, and white potatoes. In New Jersey, these crops account for over 25,000 acres and are valued at approximately $91,700,000. Growers annually apply approximately $862,000 in insecticides to control these pests on vegetable crops. The pest population maps provide the necessary information for growers to forecast pest problems and improve timing of pest control treatments. Maps are published weekly in the Vegetable Crops edition of the RCE Plant and Pest Advisory Newsletter, and are posted on the web within hours of production so that the data is timely for grower use. The high resolution of these insect maps and their acceptance by the agricultural community have resulted in this program's appearance in several publications and presentations in 2000, including *Hort Technology*, and the International Congress of Entomology at Iguassu Falls, Brazil.

The NJ pest population data is also important for a regional pest mapping project. This past season the RCE Vegetable IPM Program participated in Shelby's Sweet Corn Pest Alert, a website devoted to timely, geographical representations of sweet corn pests in the Northeast and Mid-Atlantic states. Participating states provide weekly blacklight and pheromone trap information for three major sweet corn insect pests, corn earworm, fall armyworm, and European corn borer. The data is compiled and mapped by Penn State personnel. The Sweet Corn Pest Alert website provides a unique picture of the pest population from a regional perspective, and is particularly valuable for tracking movements of migratory pests such as corn earworm and fall armyworm. The high trap density in our state adds valuable data to this regional mapping effort.

Pumpkin IPM Trial/Demonstration

At 2,300 harvested acres, and retail values as high as $0.45 per pound, pumpkins are a highly valuable crop in NJ. Heavy fungicide requirements also make pumpkins an expensive crop to produce. These factors sparked grower interest in the development of an IPM program for pumpkins. In 2000, seven

northern New Jersey vegetable growers were enlisted as volunteers in a trial pumpkin IPM program. Each grower was asked to choose one field (or partial field) of jack-o-lantern type pumpkins for participation. Plantings of powdery mildew (PM) resistant varieties were not included in the trial.

In two cases during the season growers were asked to treat for insects. In one case, aphids had reached excessive numbers. In the other case, a high, late season population of spotted cucumber beetle threatened to cause injury to maturing fruit. No other insecticide or miticide treatments were recommended. PM reached threshold levels (1 lesion per 50 leaves) in all scouted fields within the span of one week beginning 7/31/00. In all cases, PM fungicide schedules were started 3-4 weeks after the standard recommendation dictated (begin when vines run). Downy mildew (DM) infections in southern New Jersey were first found on 8/11/00. The Downy Mildew Forecast System of North Carolina State University first reported the Mid-Atlantic States to be at high risk for downy mildew infections on 8/31/00. By this time, all pumpkin growers in the trial were on protectant fungicide programs in response to PM infections. Had the threat of DM preceded a PM infection in any field, commencement of the protectant fungicide program on that field would have been suggested.

Foliar disease and insect control in fields were good in all cases. Despite excessive rainfall at times during the season, DM did not adversely affect fields due to the timeliness of protectant fungicide schedules in response to the appearance of PM. Grower use of imidacloprid as a soil insecticide was common. This resulted in very low incidence of cucumber beetles on early stage plants. As a consequence, bacterial wilt infections were relatively rare in scouted fields.

As well as demonstrating pumpkin IPM to growers, RCE IPM staff participated in the second year of a two-year trial with RCE of Hunterdon County and Snyder Farm staff to evaluate disease scouting and varietal tolerance to PM. Results of these trials show that protectant fungicide schedules may be delayed 1-2 weeks by scouting for PM on a susceptible variety, and up to 4 weeks if scouting is combined with varietal resistance. The combination of disease scouting and a PM tolerant variety may result in savings of up to $84 per acre in fungicides over the standard recommendation.

The RCE Vegetable IPM Program will continue pumpkin scouting activities in the 2001. The most significant threats to crop health are the foliar diseases. These are adequately addressed by the powdery mildew scouting procedure and by the forecast system in place for downy mildew. With powdery mildew in particular, field scouting has the added benefit of allowing the grower to start the protectant fungicide schedule later than the standard recommendation in most cases, thus saving one or more applications. While insects are potential threats to crop health, they often do not require additional pesticide applications. If insect status in fields is documented on a regular basis, many of the protectant insecticide applications that are commonly made may be eliminated. Overall, the program appears effective in both addressing pest problems, and allowing pesticide reductions in some cases. Refinements to the scouting procedure will be made in 2001 regarding types of insect pests monitored, insect pest thresholds, and frequency of visits.

The Effect of European Corn Borer Damage on Potato Yields

In past years European corn borers (ECB) were considered a sporadic pest of secondary importance to white potatoes in NJ. In recent years, however, ECB infestations have become more noticeable since imidacloprid has become the main potato insecticide. Imidacloprid is a very effective systemic insecticide for control of Colorado potato beetles and other potato insects, but it does not control ECB. The at-planting use of this insecticide has resulted in a significant decrease in the number of foliar insecticide applications that were likely controlling ECB as well as the targeted insect pest. Due to rising grower concern about the effect of ECB damage to yields, studies were initiated in 1999 on large plots in commercial potato fields to determine the effect of European corn borer (ECB) infestations on yield.

The results from a preliminary study conducted in 1999 in one commercial field suggested that ECB infestations reduced yields in untreated blocks compared to blocks that were treated twice for ECB. The yield increase in the treated blocks was significant enough that it more than paid for the cost of the insecticide applications. A follow-up study was conducted in 2000 on two commercial fields in the Cohansey and Shirley potato growing areas. Again, two insecticide applications for ECB significantly increased yield and decreased ECB stem infestations at the Cohansey site, confirming the 1999 results from

the same location. The yield increase averaged around 30 cwt per acre, which at an average price of $6 per cwt corresponds to approximately $180 per acre. The insecticide costs range from $12 to $38 per acre for two applications, resulting in a minimum economic benefit of $142 per acre.

Although good results were obtained at the Cohansey site for two successive years, three insecticide applications for ECB did not affect stem infestations or potato yields at the Shirley location. The Shirley field was planted three weeks later than the Cohansey field, and both the level of ECB activity in the field and the resulting plant damage were very low. The Shirley results showed that not all fields will be affected by ECB despite the area wide activity of ECB moths recorded in the traps. Factors at the time of ECB activity such as plant growth, weather conditions, and the status of alternate hosts like corn will affect the level and extent of the infestation in individual potato fields.

Overall these studies were important to confirm grower suspicions that in some fields ECB was a significant yield-reducing pest. It was also important to show that this pest has very complex habits and that not all fields will be susceptible at the time of ECB activity. The IPM program has been operating blacklight traps to track ECB moth populations for potato growers for a number of years, and these studies show that this monitoring effort is important information for growers to use in deciding whether or not to treat for this pest. Field scouting was also helpful to confirm population activity in individual fields but since this is a difficult pest to scout, management of ECB strictly based on field scouting is probably not practical or effective on most farms. As in the case of most IPM programs, multiple strategies including field and trap monitoring in combination with an assessment of plant growth, weather conditions, and the status of alternate hosts should be used to determine whether or not ECB treatments are needed.

Field Scout Training

A key component of on-farm IPM programs is regular monitoring of pest conditions in the field. Field scouting may be conducted by individual growers or their employees, or by a consultant that is hired by the farm. Both the RCE IPM Program and private consultants hire summer help to carry out field scouting on farms. Since most people do not have experience in this area, educational training is extremely important to ensure successful pest monitoring programs.

During the 2000 field season two formal field scout training sessions were conducted in Gloucester County. Consultants and farmers were solicited to participate through the county newsletters and direct mailings. Although the format included some lecture, the educational emphasis was practical hands-on activities held in the field. The first session, an introduction to field scouting, was organized and taught by RCE IPM personnel and the agricultural agents of Cumberland and Gloucester counties. Eight people attended this field session, including three field scouts (one RCE and two private scouts), two commercial nursery employees, two vegetable industry field representatives, and one farmer. In the second session four field scouts (two private, two RCE scouts) were trained on mid-season field scouting techniques for tomatoes, sweet corn, cucurbits, and peppers. In addition to the formal training sessions, RCE personnel conducted numerous individual training sessions for growers, private scouts, and Vegetable IPM Program scouts.

Program Support of Private Consultants

Private consultant scouted acreage continues to increase throughout the state, with most growth occurring in the central and southern counties. RCE IPM Program personnel are committed to providing educational and technical support to the private sector as necessary. In 2000, formal field scout training sessions were offered to all private consultants and their scouts in the southern counties. Four private scouts/consultants attended the introductory training session and 2 attended the midseason training session. Individual training sessions for both private and RCE scouts were also conducted by RCE personnel. Six scouts were trained in this manner (4 RCE, 2 private). In addition, the IPM Program provided pest management information services to the private industry. Blacklight and pheromone trap monitoring and information were delivered to consultants and industry field representatives to help them manage certain pests of sweet corn, lima and snap beans, peppers, fall spinach and greens, white and sweet potatoes, and lettuce.

In the central counties, RCE personnel continued the cooperative effort with the private consultant to provide blacklight and scouting services to growers in those counties. In return for the use of the blacklight traps the private consultant provided the RCE IPM Program with the trap information and also provided a summary of pest activity in his area. As a result, RCE was able to obtain essential information without the cost of hiring summer help, which saved the RCE program approximately $5000 in salary and mileage expenses. The benefit to the private consultant was that he could provide necessary services to growers with equipment that otherwise would have been prohibitively expensive for a small businessperson, since the 19 traps would have required a start up cost of approximately $10,500.

Pest Alerts

Through weekly monitoring activities, the RCE Vegetable IPM Program is able to provide advanced warning of significant pest occurrences. While warnings to individual growers regarding specific pest occurrences are commonplace, occasionally regional warnings are warranted. A significant alert was issued in the September 6, 2000 issue of the Plant and Pest Advisory Vegetable Crops edition after a steady pattern of southerly weather resulted in a major migratory influx of corn earworm adults. Corn earworm is a pest that damages sweet corn, beans, peppers, tomatoes, and lettuce crops. These alerts allow the agricultural community to alter management strategies in time to reduce potential crop losses on crops such as sweet corn, white potatoes, snap and lima beans, peppers and tomatoes having a total value of approximately $91,727,000.

PROGRAM DELIVERY

Blacklight Trap Program

A statewide network of eighty blacklight traps was maintained for monitoring the levels of several major agricultural insect pests, including European corn borer (ECB) and corn earworm (CEW). ECB and CEW are important pests of vegetable crops including sweet corn, lettuce, snap and lima beans, tomatoes, white potatoes, and peppers. The value of these commodities is approximately $91,727,000. Blacklight trap counts provide information for growers to forecast pest problems and improve the timing of pest control treatments. Growers in the blacklight trap and/or scouting programs received twice weekly reports of pest levels at their trap location as well as information from one to three nearby trap locations. Grower and industry (agrichemical companies, processors, and private consultants) support to fund summer field scout hours and mileage was obtained at a cost of $300 per blacklight trap (see industry sponsored programs for more details).

The blacklight trap network information reaches a wider audience than individual growers and industry program participants. The trap information is compiled and presented in the Plant and Pest Advisory Vegetable Crops Edition newsletter as weekly pest distribution maps. The maps are produced in cooperation with Marilyn Hughes at the Center for Remote Sensing and Spatial Analysis (CRSSA) at Cook College using Global Positioning Systems (GPS) and Geographic Information Systems (GIS) technologies. The maps provide a dynamic visual picture of local and regional pest levels that growers and other interested parties can utilize to help improve pest management. In 2000, the Plant and Pest Advisory Vegetable Crops Edition reached 253 people through the subscription, and the newsletter web site was accessed 4,233 times during the production period (February through early November). As well as being published in the Plant and Pest Advisory, pest maps were posted at the CRSSA and RCE web sites.

Field Scouting Program

The Vegetable IPM Program actively supports the development of private consulting to deliver field scouting to farmers. At this time two independent companies and one chemical company are offering pest management services to growers in the southern and central counties. IPM personnel collaborate with the consultants by providing trap information, sharing insect traps in return for trap data, and providing field scout educational training. Growers in areas where consultants are not operating provided the funding for the Vegetable IPM Program to hire field scouts. In 2000, RCE IPM personnel provided scouting services to 25 growers for 833 acres of vegetables. The primary crops scouted were sweet corn, tomatoes, peppers, eggplant, and cole crops. Greater than 36,000 acres were impacted by Vegetable IPM Program activities through the use of traps, and other IPM information provided to the agricultural community via newsletters, CRSSA and RCE websites, and IPM Program supported crop consultants.

Disease Forecasting Program

Disease forecasting programs use weather station data in combination with computer models of target plant diseases to generate information for growers to treat fields based on the likelihood of infection rather than on a preventative calendar-based schedule. Growers and industry help to fund disease forecasting programs for certain diseases of tomatoes and white potatoes. In the northern counties the grant-funded disease forecasting program for fresh-market tomatoes was transitioned to a grower supported program. In 2000, growers interested in receiving the TomCast forecasting program for tomatoes contracted the service directly with private company. In the southern counties, in cooperation with the RCE Vegetable Pathologist, BliteCast and TomCast disease forecasting programs were produced for white potato and tomato growers.

For the 2000 season, the BliteCast fax report for forecasting late blight for white potatoes and tomatoes was delivered to 25 industry people including 12 potato growers with 2,200 acres as part of the Potato IPM Fax program. A total of 30 reports were sent to subscribers from mid-April through mid-August. Sixteen applications would have been recommended according to a calendar-based schedule. BliteCast information

generated from two weather stations forecasted 12 fungicide applications for the Cohansey area and 17 for the Shirley location. Since it was a cool wet year the potential for late blight infections was high and more fungicide applications were predicted by BliteCast than in more normal, dryer years. No late blight was detected in the region in 2000, and the program was considered a success.

Data from four weather stations located in Salem and Cumberland counties were used to generate the TomCast disease forecasts for foliar diseases and anthracnose on processing tomatoes. Thirty-six TomCast fax reports with disease control recommendations were provided to two processing tomato companies who forwarded the report to their growers. Overall TomCast recommended 5 fungicide applications for the control of foliar diseases and anthracnose on processing tomatoes compared to 13 fungicide applications needed for growers following a calendar (7-day schedule) program. Foliar disease and anthracnose incidence was light in participating grower's fields, and participants considered the program beneficial.

RESEARCH PROJECTS

Vegetable IPM Program personnel, in cooperation with industry, university, and other government partners, conducted a total of 26 studies on various crops for 2000. In addition, funding was provided by outside sources for 7 programs that were delivered to vegetable growers and others in the agricultural industry. These programs and projects were supported with grower, industry, grant, and other IPM funds. Specific research projects impacted a wide range of vegetable crops, including sweet corn, tomatoes, peppers, eggplant, white and sweet potatoes, pumpkins, and spinach. Short summaries of the external and internal grant funded projects and industry supported programs that were conducted in 2000 are listed below.

External Grant Funded Projects

1. **Development of Crop Profiles for Asparagus, Spinach and Alfalfa**.
   J. Ingerson-Mahar, P. Hastings and G. C. Hamilton. Funded by the Special Research Grants- Pest Management Alternatives, USDA ($12,000).
   Crop profiles are being developed nationwide to provide the Environmental Protection Agency (EPA) with detailed accounts of crop production and typical pest management and pesticide use information for crops in certain states. The EPA will use this information to evaluate pesticides in accordance with the Food Quality Protection Act. The crop profiles for asparagus and alfalfa for New Jersey are completed and the spinach profile is nearing completion. The finalized crop profiles for all states can be found on the USDA/OPMP Crop Profiles web site (http://cipm.ncsu.edu/cropprofiles/).

2. **Integrated Crop Management (ICM) Training for Tomato Producers**.
   J. Ingerson-Mahar, W. Kline, M. Infante-Casella, W. Sciarappa, R. Samulis, K.E. Holmstrom, S.D. Walker. Funded by the Natural Resources Conservation Service ($4750).
   This grant project was received in 2000 and the majority of the work will be completed in 2001. The objective of this grant is to provide an educational training program for tomato producers, consultants, Certified Crop Advisors, and others. The focus of the training will be on integrated crop management (ICM) philosophy and practices, recognition of tomato pests and their management, record-keeping strategies, and the economic benefits of ICM practices. The educational program will consist of a one-day workshop to be held in two locations (North and South Jersey) in February and March of 2001. Participants of the workshop will receive a manual containing tomato ICM information. In addition there will be three supplemental field-training sessions for both northern and southern farmers during the 2001 growing season to address specific pest and crop problems. These informal field sessions will allow participants to ask questions and are designed to help farmers with pest identification, sampling techniques, and control strategies. The tomato ICM training program will serve as a model for future crop-specific vegetable training programs.

3. **Wireworm Management in White Potatoes**.
   M. Henninger, G. Ghidiu, J. Ingerson-Mahar, P. Probasco, S.D. Walker. Funded by the 2000 Charles E. and Lena Maier Research Award ($1600).
   Two experiments were conducted at the Snyder Research Farm in a research plot from a previous year that had a large population of wireworms present. The first experiment involved consecutive harvests (10 total from August through October) to determine when wireworms were causing damage to the tubers. There was very little damage until the 4th harvest on August 30th, when 11% wireworm injury was recorded. Injury increased to a high of 56% on October 5th. Although the yield by September 7th was acceptable (375 cwt/acre), the wireworm damage (46%) was not acceptable for commercial growers indicating that early harvest was not beneficial. In the second experiment 11 chemical treatments and an untreated check were evaluated to determine which materials are effective against wireworms. Each plot was four rows wide and 21' long with four replications. There were no

significant differences among any of the treatments with respect to yield or tuber size. The untreated check had 35% of the tubers with at least one wireworm hole. Mocap, Dyfonate, and Thimet significantly reduced the percent wireworm damaged tubers compared to the untreated check. However, the average damage of the three best treatments was still 15%. This amount of damage is too high to grow potatoes in a profitable way in NJ.

4. **Effect of European Corn Borer (ECB) Damage on Potato Yields in Grower Fields**.
M. Henninger, G. Ghidiu, S.D. Walker, J. Ingerson-Mahar, W. Kline. Funded by the 2000 Charles E. and Lena Maier Research Award ($1300).
Results from a preliminary study conducted in one commercial potato field in 1999 suggested that European corn borer (ECB) infestations reduced yields in large untreated blocks compared to blocks that were treated twice for ECB. The objective of this project was to conduct a more comprehensive study to evaluate the effect of ECB damage on potato yields under commercial growing conditions. Early fields of the Superior variety of white potato were chosen in two areas, Cohansey and Shirley. Two insecticide applications targeting ECB larvae significantly increased yields at the Cohansey site, which confirmed the 1999 results at the same location. The yield benefit was much greater than the cost of the treatments, so that it was economically advantageous both years to treat for ECB at the Cohansey site. However, three treatments for ECB did not affect infestations or yields at the Shirley location. Greater ECB activity was observed in the Cohansey field compared to the Shirley field despite higher adult blacklight trap populations in the Shirley area. The Cohansey field was planted more than three weeks earlier than the Shirley site, and the first generation ECB moth activity occurred almost three weeks earlier than is typical. The Cohansey field conditions were likely more favorable for infestation than the Shirley field at the time of the moth activity. The Shirley results demonstrated the importance of factors such as plant growth and environmental conditions in ECB management decisions.

5. **Development of an IPM Poster for Farm Markets**.
J. Ingerson-Mahar, K. E. Holmstrom, S. D. Walker, P. J. Nitzsche, and M. Infante. Funded by Northeast Center for Rural Development ($1,000).
The Northeast Center for Rural Development provided support for the development and display of an IPM poster at ten roadside vegetable markets in New Jersey during the 2000 growing season. The objectives of the poster were to educate the markets' customer clientele and to encourage purchasing of IPM produced vegetables. Surveys on pre-addressed, stamped postcards were available at the site of the poster, which could be filled out by the customers of each market. Sixty-seven percent of the respondents said that they were not aware of Integrated Pest Management. Even though 33% said they were familiar with IPM, 97% of the respondents said that the poster helped them to learn about and become more acquainted with IPM. Seventy-six percent were inspired to learn more about IPM. Only 5% knew that the particular farm at which they were purchasing produce practiced IPM. Ninety-eight percent thought that IPM was a positive farm practice. A follow-up survey of the farm stand owners is currently being conducted.

6. **Testing *Bacillus Thuringiensis* (*Bt*) Corn for Wireworm Resistance**.
J. Ingerson-Mahar. Funded by Mycogen Corporation ($1000).
Two greenhouse studies and one field study were conducted to determine the effectiveness of corn hybrids incorporating the *Bt* gene in controlling wireworms (*Melanotus communis* and *Agriotes mancus*). Six hundred individual plants were grown in cups with one wireworm in each cup for the green house studies. *Bt* and non-*Bt* isolines and a non-*Bt* variety of corn were used. In the field, seeds of *B*t and non-*Bt* isolines were planted in six 25 foot long rows in a field known to have extreme levels of wireworms. Contact Mycogen Seed Company for results.

7. **Determination of Insect Injury on Sweetpotato Roots**. J. Ingerson-Mahar, S.D. Walker, G. Ghidiu, M. Henninger, R. Vanvranken. Funded by UAP Northeast ($300).
   The second year of an industry sponsored sweetpotato project was conducted. The objective of this project was to determine the causal pest of a particular kind of root injury that has in recent years been increasing in the Vineland production area. Growers reported damage exceeding 90% injured roots in certain fields in 1998. Blacklight and pheromone traps were placed near certain fields to track populations of cutworm moths, oriental beetles, and carrot beetles. Oriental beetle adults came to both blacklight and pheromone traps in late June to early August peaking about mid-July. Adult carrot beetles were caught from June until late August in the blacklight traps. Fields were inspected regularly for the presence of soil insects surrounding the sweetpotato roots from late June through harvest (late August to October) of both years. Only the white grubs of oriental beetle were found in the soil at any time through the growing season. Densities of oriental beetle grubs at harvest in fields where damage occurred were 1 to 3 larvae per cubic foot under potato roots. Carrot beetle adults were also observed in some fields, but damaged only the potato roots in close proximity to common ragweed. The results from this two year study suggest that the primary pest responsible for the root injury is the oriental beetle.

8. **Evaluation of Controls for Flea Beetle on Eggplant in an Organic Production System**
   M. Maletta, K.E. Holmstrom, W. Tietjen, W. Cowgill, G. Ghidiu. Funding provided by the Englehard Corporation ($1170) and a Snyder Farm Special Local Needs Grant ($1500).
   A planting of oriental type eggplant was established at the Snyder Research Farm to evaluate several organically acceptable insecticides for flea beetle control. The products were Pyola, Rotenone, and Surround (a kaolin clay material). Another treatment consisted of fabric row covers. A commercial treatment of Admire drench and an untreated check were the controls. The absence of flea beetles early in the study and the heavy population of green peach aphid necessitated evaluating products for aphid control. Results indicated that Admire, Rotenone, and to a lesser degree Pyola, increased marketable yield over the untreated check. The appearance of flea beetles late in the trial allowed one evaluation of damage from these pests. Admire, Rotenone, and Surround resulted in the least amount of flea beetle injury relative to the untreated control.

Internal Grant Funded Projects

1. **New Jersey IPM Pumpkin Trial 2000 - Pumpkin Foliar Disease Control Results**.
   W. Cowgill, K. E. Holmstrom, M. Maletta, S. A. Johnston, and E. Dager. Funded by the Snyder Farm Local Needs grant and the Hunterdon County Board of Chosen Freeholders ($1500).
   Field scouting of powdery mildew (PM), a standard PM susceptible variety (Howden) and a PM tolerant variety (Magic Lantern) were evaluated in conjunction with the standard fungicide recommendation (Quadris/Bravo+Nova) and a lower cost program (Champ+Maneb). Using an action threshold for PM (1 lesion/50 older leaves) permitted 2 fewer treatments on the PM tolerant variety. In the susceptible variety, scouting would have permitted 1 fewer spray had wet weather not prevented the initial conventional spray from being applied. In both varieties, the IPM schedule with Quadris resulted in statistically similar disease ratings, marketable fruit weights, and handle quality. The Champ+Maneb treatment was better than the UTC in both varieties, but not as good as the Quadris program. Downy mildew control with Champ+Maneb was not as good as with Quadris on either variety. Fungicide schedules may be delayed through the use of field scouting for PM, and/or a tolerant variety resulting in fewer treatments without loss of crop quality.

2. **Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers**.
   K.E. Holmstrom, P.J. Nitzsche, W. Cowgill, J. Ingerson-Mahar, and S.A. Johnston. Funded by the RCE IPM Program.
   The second year of a demonstration IPM pumpkin program on grower farms was undertaken in 2000. Field scouts monitored for insect and foliar disease pests of pumpkins on growers selected fields.

Protectant fungicide schedules were begun based on a powdery mildew action threshold, which delayed schedules by 3-4 weeks over the standard recommendation. Insect pressure was found to be light, requiring only 2 total insecticide applications on 7 farms. Grower satisfaction with the demonstration was good, and expectations are that RCE IPM will make the pumpkin IPM program available in 2001, as part of the overall IPM program.

3. **Evaluation of a Squashbug Threshold and Injury on Pumpkins**.
P.J. Nitzsche, K. E. Holmstrom. Funded by a Snyder Farm Local Needs Grant ($1030).
Jack-O'lantern type pumpkins (Magic Lantern) were evaluated for squash bug injury during the time fruit were hardening off and becoming orange. On August 31, 2000, ten leaves per replicate were observed for squash bug egg masses and nymph groups. An insecticide application was made on the same date. An untreated control was maintained. Plots were re-evaluated on Sept. 7. The insecticide application reduced squash bug nymph groups from 1.8 per 10 leaves to 1 per 10 leaves. Egg masses were reduced from 2.2 per 10 leaves to 0 per 10 leaves. Pumpkins were harvested in October, 2000. No significant injury from squash bug was observed on fruit from either treated or untreated control plots.

4. **Evaluation of Historical ECB Populations Using GIS/GPS Technologies**.
K.E. Holmstrom, M.G. Hughes, J. Ingerson-Mahar, S.D. Walker, W. Kline. Sponsored by NJAES, the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), and the RCE Vegetable IPM Program.
RCE IPM staff and Marilyn G. Hughes of the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA) continued work on a predictive model for ECB activity in New Jersey. This project involves analysis of 7-year average ECB flight data relative to average growing degree-day accumulations from the same regions. Ultimately this analysis will result in accurate predictions of ECB activity in different regions of the state, allowing the agricultural community to practice pest avoidance when possible, and plan monitoring and control activities for ECB.

5. **Mapping ECB and CEW Populations Using GIS/GPS Technologies**.
K.E. Holmstrom, M.G. Hughes, S.D. Walker. Sponsored by NJAES, the Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), and the RCE Vegetable IPM Program.
The RCE Vegetable IPM Program continued its efforts with CRSSA in creating and disseminating time sensitive maps of adult European corn borer (ECB) and corn earworm (CEW) populations. Maps are published weekly in the Vegetable Crops edition of the Plant and Pest Advisory Newsletter, and are posted on the web (http://www.crssa.rutgers.edu/projects/gps/web_page/web_page.html). The high resolution of these insect maps and their acceptance by the agricultural community have resulted in this program's appearance in several publications and presentations in 2000, including *Hort Technology*, and the International Congress of Entomology at Iguassu Falls, Brazil.

6. **Penn State Sweet Corn Pest Monitor Web Site**
K.E. Holmstrom, S.D. Walker, J. Ingerson-Mahar. Funded by the Vegetable IPM Program.
RCE IPM personnel contributed weekly trap data to be included in a regional map of sweet corn pest populations that is coordinated and produced by Penn State personnel. Weekly geo-referenced adult ECB and CEW blacklight trap data was forwarded throughout the season to the lab of Dr. Shelby Fleischer of Penn State. The New Jersey trap data was displayed graphically along with other northeastern and mid-Atlantic states in a web site called the Shelby's Sweet Corn Pest Alert (www.ento.psu.edu/vegetable/sweetcorn/default.html). Other contributing states were Pennsylvania, Maryland, Delaware, and New York. The information, displayed as color coded points, showed pest activity and general population trends over a large geographical area and is useful especially on a regional basis for tracking movement of the migratory pests.

7. **Monitoring Exotic Insects for the New Jersey Department of Agriculture**.
J. Ingerson-Mahar, K.E. Holmstrom, S.D. Walker. Funded by the RCE Vegetable IPM Program.
Vegetable IPM personnel forwarded the collections from approximately 80 blacklight traps from two separate weeks during the field season to the New Jersey Department of Agriculture. These blacklight trap catches will be evaluated by the NJDA for the presence of exotic insect pest species including the long-horned wood boring beetles and bark beetles.

8. **Evaluation of Natural Enemy Populations in Bell Peppers**.
J. Ingerson-Mahar, S.D. Walker, K.E. Holmstrom. Funded by the RCE IPM Program.
In the 2000 growing season, we began sampling sprayed and unsprayed peppers on a South-Jersey vegetable farm for predator/parasite populations in order to better understand how the farmer is able to produce sufficient quantities of marketable peppers without spraying for European corn borer (ECB). Sampling for beneficial and pest insects was conducted by visual inspection of plants and fruit, deploying pitfall and pheromone traps, and using a leaf vacuum to collect foliar insects. The results demonstrated that the unsprayed peppers contained more beneficial insects, however, they had higher ECB injury to the fruit. Nevertheless, the farmer had sufficient quantities of marketable fruit. High yields and the ability of the farm workers to discard a high level of the infested fruit may be the primary reasons for the peppers not requiring routine insecticide treatments.

9. **Identification of an Unknown Insect in Fall Processing Spinach**.
S.D. Walker, J. Ingerson-Mahar. Funded by the RCE Vegetable IPM Program.
Selected processing spinach fields were monitored for insect levels in the fall of 2000 as part of a trapping study conducted in cooperation with Seabrook Bros. and Sons. One of the pests discovered in the field was a maggot causing damage to the meristematic leaf tissue of the spinach plant. The maggots were white or yellowish white, one-quarter inch or less in length, and were found mostly in the center whorl of new leaves or in the leaf petioles. The maggots were similar to the larvae of root maggots (onion, cabbage, and seed corn maggot). Damaged leaves appeared ragged, distorted, sometimes with a burned appearance. Leaf petioles were often damaged from the maggots boring into the petiole. Only one maggot was found per plant. A few pupal cases were found on plants, not on or in the soil. The maggots infested about 5% of the plants on the average with higher infestation rates occurring in some areas of the fields. The damage was observed primarily in the first growth and only sporadically after the first cutting. Maggots were collected in the field and reared to the adult fly stage in the lab. The flies were sent to USDA experts at Beltsville, MD for identification.

10. **Sampling Wireworms in White Potatoes**.
J. Ingerson-Mahar. Funded by the RCE Vegetable IPM Program.
Wireworms, particularly the species *Melanotus communis*, are a pest of white potatoes in southern New Jersey. For the past two years, bait traps have been used to help determine the presence of wireworms in fields. Bait trap results, however, may be altered by the amount and degree of cool weather. The cooler the soil, 50 degrees F or less, the more the wireworm population will be underestimated, which limits the usefulness of bait traps. A potentially more reliable indicator of wireworm activity may be sampling the grain cover crop that most potato farmers use in the fall. A wire frame representing an area of 2 square feet was used to sample 6 fields in the fall of 1999. The frame was randomly tossed at least 5 times in each field. All the grain plants were counted within the frame and the percentage of damaged plants was determined. One field with a known history of wireworm infestation had 2% of the cover crop plants damaged. Based on previous experience and observations the farmer was advised not to raise potatoes or corn in this field.

11. **Evaluation of Larval Weights as a Method of Determining Wireworm Instars**
J. Ingerson-Mahar. Funded by the RCE Vegetable IPM Program.

Melanotus wireworms are known to live five to six years in the soil. By knowing the age of the field population, better management decisions could be made. In particular, a determination could be made as to whether the population is increasing or declining. No method is currently available to determine the age of a wireworm larva. A total of 400 field-collected *Melanotus communis* wireworms that were used in greenhouse and field studies were evaluated to determine if a relationship existed between weight and instar. No relationship was found.

12. **Pheromone and Blacklight Trap Population Levels of Cutworms in White Potatoes**
S.D. Walker, J. Ingerson-Mahar, G. Ghidiu. Funded by the RCE Vegetable IPM Program.
Significant damage to potato yields in past years has been attributed to various cutworm species, particularly black and variegated cutworms. At the Potato Grower Research Advisory meeting, growers questioned whether traps could be used to track cutworm moth populations to better determine when large influxes of moths were possibly laying eggs in the fields. Since blacklight traps are currently being used on potato farms to track European corn borer moth levels, adding these two species was feasible except that some of the species, particularly the variegated cutworm moth, are difficult to correctly identify in the trap. Since pheromone traps are available for black and variegated cutworm moths, these traps were utilized to provide adult population information to potato growers. Two sets of pheromone traps were established next to potentially susceptible fields at two locations in the main potato areas of Shirley and Cohansey. The pheromone trap data was graphed and sent to the Potato IPM Fax subscribers twice a week. No significant flight pattern emerged for either pest, and no growers reported having problems with cutworms for the 2000 season.

13. **Evaluation of Blacklight Traps and Yellow Sticky Cards for Monitoring Stinkbugs in Tomatoes**
K.E. Holmstrom, S.D. Walker. Funded by the RCE Vegetable IPM Program.
In recent years stinkbugs have emerged as a significant pest of tomatoes in New Jersey, primarily due to the general reduction in broad-spectrum foliar insecticide use. In previous studies, blacklight and pheromone traps have been utilized to track stinkbug population activity. In 2000 a modified stinkbug pheromone trap was designed by the North Jersey Program Associate and tested in two tomato fields. The modified stinkbug pheromone trap was not effective in capturing stinkbugs at either location. Stinkbug species were also surveyed in most of the blacklight traps in the statewide trap network. The blacklight trap has been effective in capturing the damaging *Euschistus spp*., and reduced catches in 2000 indicated a lower level of population activity than was typical. Growers and consultants reported that fruit damage from stinkbug was significantly lower in 2000 compared to 1999, supporting the information from the traps. More seasonal data for this pest is needed to determine if blacklight traps can be used as a monitoring tool for tracking population activity and making pest management decisions.

14. **Stinkbug Tomato Feeding Study**
K.E. Holmstrom, J. Ingerson-Mahar. Funded by the RCE Vegetable IPM Program.
In the summer of 2000, breeding colonies of two stinkbug species were established in the greenhouse. *Cosmopepla bimaculata*, the black and red stinkbug, and *Euschistus variolarius*, the brown stinkbug, were reared on diets of sweet corn, tomatoes, and green beans. Colonies were established to provide individuals for a cage study to determine what type of damage fresh market tomatoes sustained from feeding of both species. *C. bimaculata* and *E. variolarius* were introduced into cages containing one fruiting tomato plant (cvar. 'Celebrity'). Cages received either 0, 5, or 10 bugs. Observations were taken regarding insect distribution on plants and fruit damage for a period of 2 weeks. At the end of the observation period it was concluded that *C. bimaculata* did not cause significant fruit injury, preferring to feed on foliage. What little fruit injury did result from *C. bimaculata* feeding was considered superficial. In contrast, *E. variolarius* feeds almost exclusively on tomato fruit, and causes the characteristic "cloudy spot" injury commonly found in mid-season tomato fields. This type of injury can significantly reduce yield and quality of fresh market tomatoes.

15. **Identification of an Unknown Insect in Fall Processing Spinach.**
S.D. Walker, J. Ingerson-Mahar. Funded by the RCE Vegetable IPM Program.
Selected processing spinach fields were monitored for insect levels in the fall of 2000 as part of a trapping study conducted in cooperation with Seabrook Bros. and Sons. One of the pests discovered in the field was a maggot causing damage to the meristematic leaf tissue of the spinach plant. The maggots were white or yellowish white, one-quarter inch or less in length, and were found mostly in the center whorl of new leaves or in the leaf petioles. The maggots were similar to the larvae of root maggots (onion, cabbage, and seed corn maggot). Damaged leaves appeared ragged, distorted, sometimes with a burned appearance. Leaf petioles were often damaged from the maggots boring into the petiole. Only one maggot was found per plant. A few pupal cases were found on plants, not on or in the soil. The maggots infested about 5% of the plants on the average with higher infestation rates occurring in some areas of the fields. The damage was observed primarily in the first growth and only sporadically after the first cutting. Maggots were collected in the field and reared to the adult fly stage in the lab. The flies were sent to be identified by USDA experts at Beltsville, MD.

16. **Fall Spinach and Greens Insect Trapping Study.**
S.D. Walker, J. Ingerson-Mahar, K.E. Holmstrom, J. VanDerwerken, A. Carpenter. Funded by Seabrook Bros. and Sons ($200).
At the request of the processor, beet armyworm pheromone traps were established and monitored on two farms in Burlington and Cumberland and Salem Counties. Traps were checked once to twice a week, and the growers and processor received the trap data. Fields next to the traps were also monitored for beet armyworm activity. The beet armyworm moth population in the traps was extremely low at both locations compared to previous years, and the field levels were correspondingly low. In years where beet armyworm populations are high, several insecticide applications are needed to control this pest. Very few applications were made this year due to the low levels reported in the traps. The trap results were used by Seabrook Bros. as an aid in pest management decisions for 1300 acres spinach and 200 acres of processing greens.

Industry Sponsored Programs

1. **The Potato IPM Fax Program**.
S. Johnston, S.D. Walker, W. Kline, G. Ghidiu, R. Carpenito. Funded by the White Potato Association ($1100), Helena Chemical Company ($250), and UAP Northeast ($250).
The Potato IPM Fax is a twice weekly seasonal report of current disease and insect information and recommendations for potato growers and others in the agribusiness industry. The funding supports two weather stations, two blacklight traps, and the time and mileage of a summer field technician to collect the data and send out the faxes. The weather stations provide the data for the BLITECAST disease forecasting program, which provides growers with the necessary information to time fungicide applications to prevent late blight. The blacklight trap data provides information for growers to time insecticide applications for European corn borer. The IPM fax is produced from May through August and impacts approximately 12 growers with 2200 acres of potatoes.

2. **TomCast Disease Forecasting Program for Processing Tomatoes**.
S.A. Johnston, W. Kline, S.D. Walker, R. Carpenito. Funded by Furman Foods ($500) and Violet Processing Co. ($500).
The TomCast disease forecasting program generates information to help grower's time fungicide applications for certain foliar tomato diseases. Four weather stations located in Cumberland and Salem Counties were maintained and downloaded by RCE personnel to provide the data for the TomCast disease forecasting program. The data was summarized in chart form with written recommendations and faxed twice a week from June through October to two processing companies who then forwarded the information to 15 growers with approximately 1200 acres.

3. **Cooperation with Garden State Pest Management Company**
   K.E. Holmstrom, F. Spieker. Funded by participating growers, Garden State Pest Management, and the RCE Vegetable IPM Program.
   RCE Vegetable IPM personnel continued the cooperative program with the Garden State Pest Management consulting company to provide blacklight trap and scouting services to growers in the central NJ counties. In return for the use of the blacklight traps the private consultant provided the RCE IPM Program with the trap information that otherwise would have to be collected by RCE hired summer help. As a result, RCE was able to obtain essential information without the cost of hiring summer help, which saved the RCE program approximately $5000 in salary and mileage expenses. The benefit to the private consultant was the ability to provide necessary services to growers with equipment that otherwise would have been prohibitively expensive for a small businessperson ($10,000+ for the traps currently in use). The company also provided a summary of pest activity that was used in the RCE newsletter column, the IPM Update. In 2000, GSPM expanded grower services and hired summer help. RCE IPM Program personnel met with the GSPM field scout several times throughout the season to provide educational training in vegetable IPM methods.

4. **Insect Trapping for Seabrook Bros. and Sons**. S.D. Walker, J. VanDerwerken, A. Carpenter. Funded by Seabrook Bros. and Sons ($1200).
   A vegetable processing company supported the IPM program through the purchasing of blacklight trap monitoring services for 4 locations. In 2000 the IPM program provided twice weekly trap monitoring and data reporting from May through September. The trap data was utilized to help make pest management decisions concerning two important pests (CEW and ECB) for 2,300 acres of snap and lima beans contracts.

5. **Insect Trapping for McConnell Agronomics**. S.D. Walker, L. McConnell. Funded by McConnell Agronomics and participating growers.
   Insect data from several blacklight trap locations was faxed twice weekly from May through September to McConnell Agronomics, a private consulting company offered pest management services affecting approximately 6500 acres of sweet corn and other vegetables and grain.

6. **North Jersey Staked Tomato Scouting Program**.
   K.E. Holmstrom, The New Jersey Tomato Council. Funded by the New Jersey Tomato Council ($120).
   The New Jersey Tomato Council provides field scouting services for all of its growers. Since there are no private consultants located in the northern part of the state, and the acreage and number of growers is few, the Tomato Council contracts the service with the Vegetable IPM Program. This year, among the tomato acreage scouted, were four acres for one Tomato Council grower in Hunterdon County.

EDUCATIONAL OUTREACH

Part of the educational outreach beyond the direct affect we have on growers participating in our programs is the presentations that are conducted throughout the state at local and regional meetings. In 2000, the RCE Vegetable IPM Program personnel provided information on vegetable IPM programs or research at 3 national, 3 regional, and 34 state or local grower, industry, or other educational meetings. In addition, numerous publications for both growers and others in the agricultural and scientific community were produced, including 2 book chapter, 3 journal articles (2 refereed), and 13 state and regional proceedings article. The major source of NJ current pest management information is published in the RCE Plant and Pest Advisory. IPM personnel contributed 27 articles (including pest population maps) to the Vegetable Crops Edition and 4 articles to the Organic Crops Edition of the newsletter. Several workshop folders and other informational materials were compiled to supplement presentations.

International, National, or Regional Presentations

1. Hamilton, G.C., M.G. Hughes, K.E. Holmstrom, S.D. Walker. **Spatial Mapping of Two Pest Populations in New Jersey Sweet Corn**. Poster presentation. International Congress of Entomology. Iguassu Falls, Brazil. August 21-25, 2000.
2. Lashomb, J., G. Hamilton, J. Ingerson-Mahar, J. Chang. **Carabid Beetle Trapping on Ornamentals**. Poster presentation. International Congress of Entomology. Iguassu Falls, Brazil. August 21-25, 2000.
3. J. Ingerson-Mahar, D. L. Lee, M. F. Huffaker, M.G. Hughes. **Analysis of the Distribution of Fall Bait Trapping of Wireworms in New Jersey Corn Fields Using GPS/GIS Technology**. Second International Conference on Geospatial Information in Agriculture and Forage. Florida. Jan.10-12, 2000.
4. Holmstrom, K.E., M.G. Hughes, S.D. Walker, W.L. Kline, J. Ingerson-Mahar. **Insect Population Maps: Production and Dissemination**. Mid-Atlantic Vegetable Workers Conference. Newark, DE. November 8-9, 2000.
5. Malletta, M., K.E. Holmstrom, W. Tietjen, W. Cowgill, G. Ghidiu. **Evaluation of Controls for Flea Beetle on Eggplant in an Organic Production System**. Mid-Atlantic Vegetable Workers Conference. Newark, DE. November 8-9, 2000.
6. Walker, S.D, M. Henninger, G. Ghidiu, W.L. Kline, J. Ingerson-Mahar. **The Effect of European Corn Borer on Potato Yields in a Commercial Field**. Mid-Atlantic Vegetable Workers Conference. Newark, DE. November 8-9, 2000.

Statewide or Local Presentations

1. Kline, W.L. **New Jersey's 3-Year Pepper IPM Project: What We Have Learned** Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
2. Ingerson-Mahar, J., S.D. Walker, K.E. Holmstrom. **Vegetable IPM Workshop**. Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
3. Walker, S.D. **The Effect of European Corn Borer on Potato Yields in a Commercial Field and The National White Potato IPM Protocol: New Jersey Grower Survey Results**. Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
4. Ingerson-Mahar, J., K.E. Holmstrom, S.D. Walker. **Vegetable IPM Program Display**. Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
5. Ingerson-Mahar, J. **Managing Wireworms in Potato Fields**. Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
6. Holmstrom, K.E. **Assessing Stinkbug Populations and Damage Potential on Fresh Market Staked Tomatoes in NJ**. Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
7. Ingerson-Mahar, J. **Pest Management in Organic Production**. NOFA-NJ Annual Winter Meeting. New Brunswick, NJ. January 29, 2000.

8. Walker, S.D. **Bell Pepper Integrated Pest Management (IPM) Monitoring Strategies**. Vegetable Growers Association of New Jersey Annual Meeting. Atlantic City, NJ. January 18-20, 2000.
9. Walker, S.D. **IPM Pepper Program**. Central Jersey Grower's Vegetable Meeting. Freehold, NJ. February 4, 2000.
10. Ingerson-Mahar, J., S.D. Walker. **Integrated Pest Management**. Gloucester County Master Gardener Program Seminar. Glassboro, NJ. February 9, 2000.
11. Walker, S.D. **Summary of 1999 Pepper IPM Research**. Pepper IPM Grower Advisory Committee. Bridgeton, NJ. February 10, 2000.
12. Holmstrom, K.E., W. Cowgill. **Pumpkin IPM – Where Are We?** North Jersey Vegetable Production Meeting. February 17, 2000.
13. Holmstrom, K.E. **Review of Tomato IPM and Stinkbug Research**. Tomato Council Annual Meeting. Bridgeton, N.J. February 28, 2000.
14. Walker, S.D. **Potato IPM Update**. White Potato Association and Council Meeting. Elmer, NJ. March 8, 2000.
15. Holmstrom, K.E. **Vegetable IPM in N.J.: Insect Mapping and an Overview of IPM for Three Crops**. Lecture in Agricultural Entomology and Pest Management at Cook College. New Brunswick, NJ. April 4, 2000.
16. Walker, S.D. **South Jersey IPM Program Update**. New Jersey Agribusiness Meeting, Extension Roundup. Downstown, NJ. May 12, 2000.
17. Ingerson-Mahar, J. **Statewide IPM Program Update**. New Jersey Agribusiness Meeting, Extension Roundup. Downstown, NJ. May 12, 2000.
18. Walker, S.D. **How to Scout Lettuce**. South Jersey Vegetable Twilight Meeting. Cedarville, NJ. May 15, 2000.
19. Ingerson-Mahar, J. **The Importance and Collection of Insects**. Six classes, Woodstown High School. Woodstown, NJ. May 18, 2000.
20. Ingerson-Mahar, J. **Back to School Science Night: Basic Entomology**. Alloway Township School. Alloway, NJ. May 23, 2000.
21. Ingerson-Mahar, J., S.D. Walker, W.L. Kline, M. Infante-Casella. **Introduction to Vegetable Field Scouting**. Scout Training Session held in Mullica Hill, NJ. June 8, 2000.
22. Ingerson-Mahar, J. **Vegetable IPM Program Update**. Sussex County Vegetable Twilight Meeting. Newton, NJ. June 12, 2000.
23. Ingerson-Mahar, J., S.D. Walker, W. Kline, M. Infante-Casella. **Mid-Season Vegetable Field Scout Training**. Scout Training Session held in Mullica Hill, NJ. July 13, 2000.
24. Walker, S.D. **Update on Current Pest Activity**. New Jersey Agribusiness Meeting, Extension Roundup. Downstown, NJ. July 14, 2000.
25. Ingerson-Mahar, J. **Update on Current Pest Activity**. New Jersey Agribusiness Meeting, Extension Roundup. Downstown, NJ. July 14, 2000.
26. Holmstrom, K.E. **IPM Techniques for the Home Gardener with Emphasis on Biological Control**. Snyder Research and Extension Farm Twilight Meeting. Pittstown, NJ. July 19, 2000.
27. Holmstrom, K.E. **RCE IPM Program Activities**. Hunterdon County Farmer's and Businessmen's Picnic, Snyder Research and Extension Farm. Pittstown, NJ. July 26, 2000.
28. Walker, S.D. **Vegetable IPM Tour**. Half day tour for Quebec Agribusiness and Government people. Salem County, NJ. September 13, 2000.
29. Ingerson-Mahar, J. **IPM Training for NRCS Employees**. NRCS In-Service Training. Trenton, NJ. September 14, 2000.
30. Walker, S.D. **Update on Current Pest Activity**. South Jersey Vegetable Twilight Meeting. Swedesboro, NJ. September 18, 2000.
31. Ingerson-Mahar, J. **Entomology Training for Master Gardeners in Somerset County**. Master Gardener Training Session. Bridgewater, NJ. September 26, 2000.
32. Walker, S.D. **East Vineland Insect Trapping Study**. South Jersey Vegetable Twilight Meeting. East Vineland, NJ. October 16, 2000.

33. Ingerson-Mahar, J. **IPM in Organic Production**. Lecture in Organic Crop Production Class. Cook College. New Brunswick, NJ. November 9, 2000.
34. Holmstrom, K.E. **Pumpkin Disease Control Results**. The Seventh Annual New Jersey Pest Control and Soil Fertility Conference. Bridgeport, NJ. November 29, 2000.

Meetings Organized

1. **Pepper Grower Advisory Meeting**. W. Kline and S.D. Walker. Upper Deerfield, NJ. February 10, 2000.
2. **Scout Training Sessions**. J. Ingerson-Mahar, S.D. Walker, W. Kline, M. Infante-Casella. Mullica Hill, NJ. June 8 and July 13, 2000.

National or Regional Publications

1. Ingerson-Mahar, J. **Relating Diet and Morphology in Adult Carabid Beetles**. Chapter in Carabids in Agriculture. In press.
2. Walker, S.D., K.E. Holmstrom, G.M. Ghidiu. 2000. **Occasional Insect and Mite Pests in the Southern Portion of the Northeast Region**. Pages 91-97 in 'Northeast Pepper Integrated Pest Management (IPM) Manual'. T. J. Boucher and R. A. Ashley, eds. University of Connecticut Communications and Information Technology, Storrs, CT.
3. Singer, J.W., J. R. Heckman, J. Ingerson-Mahar, M. L. Westendorf. 2000. **Hybrid and Nitrogen Source Affect Yield and European Corn Borer Damage.** Journal of Sustainable Agriculture, v. 16, pp. 5-15.
4. Cowgill, W., K.E. Holmstrom, M. Maletta, S.A. Johnston, E. Dager. **Evaluation of Fungicides and a Tolerant Cultivar with an IPM Program for Control of Foliar and Fruit Diseases of Pumpkins**. Vegetable Plant Pathology Research Results for 1999, Report No. 24.
5. Holmstrom, K.E., M.G. Hughes, S.D. Walker, W.L. Kline, J. Ingerson-Mahar. **Spatial Mapping of Adult Corn Earworm and European Corn Borer Populations in New Jersey**. *Hort Technology*. In press.
6. Holmstrom, K.E., S.D. Walker, G. Ghidiu, P. Nitzsche, W. Kline. **Assessing Stinkbug Population Levels and Damage Potential on Fresh Market Staked Tomatoes in New Jersey**. Proceedings of the 30th Annual Meeting of the Mid-Atlantic Vegetable Workers' Conference.
7. Walker, S.D., K.E. Holmstrom, T. J. Boucher. **The Relationship Between Trap Catches and Larval Infestations in Unsprayed Bell Peppers**. Proceedings of the 30th Annual Meeting of the Mid-Atlantic Vegetable Workers' Conference.
8. Ingerson-Mahar, J., S. Walker. **1999 Report on Sweet Potato Findings**. Proceedings of the 30th Annual Meeting of the Mid-Atlantic Vegetable Workers' Conference.
9. Cowgill, W. P., Holmstrom, K. E., Johnston, S. A., Maletta, M., and E. Dager. 2000. **Evaluation of Fungicides and a Tolerant Cultivar For Powdery and Downy Mildew Control of Pumpkins**. Fungicide and Nematicide Tests.

New Jersey Publications

1. Ingerson-Mahar, J., S.D. Walker, K.E. Holmstrom, G.M. Ghidiu. **Vegetable IPM Program Summary – IPM Workshop**. Proceedings of the New Jersey Annual Vegetable Meeting January 18-20, 2000.
2. Kline, W.L. 2000. **New Jersey's 3-Year IPM Project: What We Have Learned** Proceedings of the New Jersey Annual Vegetable Meeting January 18-20, 2000.
3. Walker, S.D., J. Ingerson-Mahar, W.L. Kline. **The National White Potato IPM Protocol: New Jersey Grower Survey Results**. Proceedings of the New Jersey Annual Vegetable Meeting January 18-20, 2000.
4. Walker, S.D., M. Henninger, G.M. Ghidiu, W.L. Kline, J. Ingerson-Mahar. **The Effect of European Corn Borer on Potato Yields in a Commercial Field**. Proceedings of the New Jersey Annual Vegetable Meeting January 18-20, 2000.

5. Holmstrom, K.E., S.D. Walker, G.M. Ghidiu, P.J. Nitzsche, W.L. Kline. **Assessing Stinkbug Populations and Damage Potential on Fresh Market Staked Tomatoes in NJ**. Proceedings of the New Jersey Annual Vegetable Meeting January 18-20, 2000.
6. Walker, S.D. 2000. **Bell Pepper Integrated Pest Management (IPM) Monitoring Strategies**. Proceedings of the New Jersey Annual Vegetable Meeting January 18-20, 2000.
7. Ingerson-Mahar, J., M. Henninger. **Managing Wireworms in Potato Fields**. Proceedings of the New Jersey Annual Vegetable Meeting January 18-20 2000.
8. Ingerson-Mahar, J., K.E. Holmstrom, S. Walker, W. Kline, P. Nitzsche. **1999 Annual Report Vegetable Integrated Pest Management (IPM) Program**. February 2000.
9. Holmstrom, K.E., S.D. Walker. **Vegetable IPM Update**. 21 articles in the *2000 RCE Plant and Pest Advisory Vegetable Crops Edition*. April – November 2000.
10. 2000 RCE Plant and Pest Advisory Vegetable Crops Edition feature articles:
    - Tocco, P., J. Ingerson-Mahar. **Using Degree Days in Crop Production**. April 5, 2000.
    - Ingerson-Mahar, J., K. E. Holmstrom, S.D. Walker. **RCE Vegetable IPM Program in 2000**. April 12, 2000.
    - Walker, S.D. **Who to Contact for Vegetable IPM Scouting Services**. April 19, 2000.
    - Walker, S.D., K.E. Holmstrom. **Scouting Tips: Sweet Corn**. July 19, 2000.
    - Walker, S.D., K.E. Holmstrom. **Scouting Tips: Using Pheromone Traps for Monitoring BAW and FAW Populations in Vegetables**. July 26, 2000.
    - Ingerson-Mahar, J. **Crop Residue Management**. October 4, 2000.
11. 2000 RCE Plant and Pest Advisory Organic Crops Edition articles:
    - Tocco, P., J. Ingerson-Mahar. **Using Degree Days in Crop Production**. April 14, 2000.
    - Ingerson-Mahar, J., K.E. Holmstrom, S.D. Walker. **RCE Vegetable IPM Program in 2000**. April 14, 2000.
    - Ingerson-Mahar, J. **Tracking Populations of European Corn Borer**. July 14, 2000.
    - Ingerson-Mahar, J. **Crop Residue Management**. October 13, 2000.

Other Educational Materials

1. Ingerson-Mahar, J., K. E. Holmstrom, S.D. Walker. **1999 Annual Report of the Vegetable IPM Program**. Presented to RCE Vegetable Agricultural Agents and Specialists.
2. J. Ingerson-Mahar, G. Ghidiu, K.E. Holmstrom, S.D. Walker. **Vegetable IPM Workshop Folder**. Presented to attendees of the IPM Workshop at the 2000 Vegetable Growers Meeting.
3. Walker, S.D., J. Ingerson-Mahar. **Vegetable Scout Training Manual Materials**. Presented to attendees of the Introduction to Vegetable Field Scouting training session.
4. Walker, S.D., J. Ingerson-Mahar. **Integrated Pest Management - Materials for Master Gardeners**. Presented to Gloucester County Master Gardener attendees of the IPM seminar.
5. J. Ingerson-Mahar, S.D. Walker. **An IPM Training Module – A Hands-on Exercise Demonstrating IPM Philosophy**. A component of the following presentations: Gloucester County Master Gardener Training Session, NRCS In-Service Training, and Cook College Organic Production Class.
6. J. Ingerson-Mahar, S.D. Walker. **IPM Glossary**. Information sheet used in Master Gardeners materials and the Field Scout Training manual.
7. Walker, S.D. **Vegetable IPM Resource Materials**. Information sheet for the Vegetable Growers Meeting booth, Vegetable Growers Meeting IPM Workshop, Master Gardeners materials, Field Scout training materials.
8. Walker, S.D., J. Ingerson-Mahar, W. Kline. **The National White Potato IPM Protocol: New Jersey Grower Survey Results**. Presented to the White Potato Association Meeting attendees in March 2000.

COOPERATORS

Rutgers Cooperative Extension

1. Evan Branosky, RCE IPM field technician
2. Richard Carpenito, RCE IPM field technician
3. Brad Lovett, RCE IPM field technician
4. Mike Sheets, RCE IPM field technician
5. Marilyn G. Hughes, Program Associate, Grant F. Walton CRSSA
6. Martha Maletta, Research Associate RCE of Hunterdon County
7. Winfred Cowgill, Agricultural Agent, RCE of Hunterdon County
8. Michelle Infante-Casella, Agricultural Agent, RCE of Gloucester County
9. Wesley Kline, Agricultural Agent, RCE of Cumberland County
10. Peter J. Nitzsche, Agricultural Agent, RCE of Morris County
11. Peter Probasco, Agricultural Agent, RCE of Salem County
12. Ray Samulis, Agricultural Agent, RCE of Burlington County
13. William Sciarappa, Agricultural Agent, RCE of Monmouth County
14. Richard Vanvranken, Agricultural Agent, RCE of Atlantic County
15. William Tietjen, Agricultural Agent, RCE of Warren County
16. Gerald M. Ghidiu, RCE Specialist in Entomology
17. George Hamilton, RCE Specialist in Pest Management
18. Stephen A. Johnston, RCE Specialist in Plant Pathology
19. Melvin Henninger, RCE Specialist in Vegetable Crops
20. Stephen A. Garrison, RCE Specialist in Vegetable Crops
21. Edwin Dager, Farm Superviser, Snyder Research and Extension Farm

Other Research Institutions

1. Dr. Shelby Fleischer, Penn State University.
2. Chris Harding, Penn State University.

Grower Cooperators

Cape May County

1. Bolton Legates, Legates Farm. RCE Blacklight Trap Program; Development of an IPM Poster for Farm Markets
2. Bob Conover, Conover Farms. RCE Blacklight Trap Program.
3. Tom Buganski, Buganski Farms. RCE Blacklight Trap Program.

Cumberland County

1. David Sheppard, Sheppard Farms Inc. RCE Blacklight Trap Program; Evaluation of Blacklight Traps and Yellow Sticky Cards for Monitoring Stinkbugs in Tomatoes.
2. Fred VanMeter, VanMeter Farms. Potato IPM Fax Program; Surveying Wireworm Populations to Determine the Reliability of Bait Trapping to Predict Damage in White Potato; Pheromone and Blacklight Trap Population Levels of Cutworms in White Potatoes.
3. Tom Scrivani, Scrivani Farms. RCE Blacklight Trap Program.
4. Lou and Robert Tolloti. RCE Blacklight Trap Program.
5. Kevin and Robert Flaim. RCE Blacklight Trap Program.
6. Cruzandale Farms. Potato IPM Fax Program.
7. Lee Mixner. RCE Blacklight Trap Program.

Salem County

1. Henry Dubois, H & S DuBois. RCE Blacklight Trap Program; Fall Spinach and Greens Trapping Study.

2. Tom Bishop, Bishop Farms. Effect of ECB Damage on Potato Yields in Grower Fields.
3. Dan Hitchner. Effect of ECB Damage on Potato Yields in Grower Fields.
4. Andy Buzby, Buzby Farms. Evaluation of Natural Enemy Populations in Bell Peppers.
5. John Coombs. RCE Potato IPM Fax Program.
6. Charles Paulaitis. RCE Blacklight Trap Program.
7. Marty Catalano. RCE Blacklight Trap Program.
8. Ken Porch. RCE Blacklight Trap Program.
9. Bill Brooks. RCE Potato IPM Fax Program.
10. Bill and Martin Kelly, Kelly Farms. RCE Blacklight Trap Program.
11. George Wright. RCE Scouting Program (peppers).
12. Grant Hitchner. RCE Blacklight Trap Program.

Atlantic County

1. Charles Muzzerelli. Determination of Sweet Potato Tuber Damage.
2. George, J.D., Lori Ruggero, Homestead Farms. RCE Blacklight Trap Program.
3. Joe Deficcio. Deficcio Farms. RCE Blacklight Trap Program.
4. David Rizzotte, Glossy Fruit Farm. RCE Blacklight Trap Program; Development of an IPM Poster for Farm Markets.
5. Ed and August Wuillermin. RCE Blacklight Trap Program.
6. Russell Franceschini. RCE Blacklight Trap Program.

Gloucester County

1. Genoa Farms. Determination of Sweet Potato Tuber Damage.
2. Dick Nixholm. Determination of Sweet Potato Tuber Damage.
3. Chuck and Mike Visalli, Visalli Farms. RCE Blacklight Trap Program; Farm Host for Scout Training Sessions; Development of an IPM Poster for Farm Markets.
4. David Duffield, Duffields Farm Market. RCE Blacklight Trap Program; Development of an IPM Poster for Farm Markets.
5. Glen and Gary Stecher. RCE Blacklight Trap Program.
6. Charles Zimmerman. RCE Blacklight Trap Program.
7. Bob Muth. RCE Blacklight Trap Program.

Camden County

1. John Rigolizzo, Johnny Boy Farms. RCE Scouting Program (sweet corn).
2. Dennis Donio, Donio Farms. RCE Scouting Program (peppers).
3. Tom Jarvis, Springdale Farms. RCE Scouting Program (sweet corn); Development of an IPM Poster for Farm Markets.

Burlington County

1. Ray and Ron Abrams, Homestead Farms. RCE Blacklight Trap Program; Fall Spinach and Greens Trapping Study.
2. Everett Abrams. RCE Scouting Program (sweet corn).
3. John Abrams. RCE Blacklight Trap Program.
4. Bill, Eric, Peter Johnson. Johnson Corner Farm. RCE Blacklight Trap Program.
5. Lester Eckert. RCE Blacklight Trap Program.
6. Tom Sutton. RCE Blacklight Trap Program.
7. John Hunter. RCE Blacklight Trap Program.
8. Ray Hlubik. Development of an IPM Poster for Farm Markets.
9. Walt Katona, Katona Farms. RCE Blacklight Trap Program. Private scouting.
10. Herb Angel, Angel's Acres. RCE Blacklight Trap Program. Private scouting.
11. Nick and Mike Russo. RCE Blacklight Trap Program. Private scouting.

Ocean County
1. Peter DeWolf, DeWolf's U-Pick Farm. RCE Blacklight Trap Program. Private scouting.
2. Doug and Charlie Hallock, Hallocks U-Pick Farm. RCE Blacklight Trap Program. Private scouting.

Monmouth County
1. Carmine Infante. RCE Blacklight Trap Program. Private scouting.
2. John Samaha. RCE Blacklight Trap Program. Private scouting.
3. Don Pyle. RCE Blacklight Trap Program. Private scouting.
4. Angelo and George DiGregorio. RCE Blacklight Trap Program. Private scouting.

Mercer County
1. Joe Ruggieri. RCE Scouting Program (sweet corn).
2. Gary Mount. RCE Scouting Program (sweet corn, tomatoes).
3. Scott Ellis. RCE Blacklight Trap Program. Private scouting.

Middlesex County
1. Mickey Protinick. RCE Blacklight Trap Program. Private scouting.
2. Bob VonThun. RCE Blacklight Trap Program. Private scouting.
3. Jim and Sue Giamarese. RCE Blacklight Trap Program. Private scouting.
4. Pete Sigle, Clare's Market. RCE Blacklight Trap Program. Private scouting.

Somerset County
1. John Lyman. RCE Scouting Program (sweet corn).

Hunterdon County
1. Peter and George Melick, Towne Farm. RCE Scouting Program (sweet corn); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers; North Jersey Staked Tomato Scouting Program.
2. George Perehinys, Sweet Valley Farm. RCE Scouting Program (sweet corn); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers.
3. Mike Matthews. RCE Scouting Program (sweet corn, peppers).
4. Ken Ravenberg. RCE Scouting Program (sweet corn).
5. Marc Phillips. RCE Scouting Program (sweet corn, cole crops, tomatoes, peppers).

Morris County
1. Larry Ashley, Ashley's Turkeys and Produce. RCE Scouting Program (sweet corn, tomatoes); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers.
2. Kurt Alstede, Alstede Farms. RCE Scouting Program (sweet corn, tomatoes, peppers, cole crops); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers
3. Ken Wightman, Wightman's Farms. RCE Scouting Program (sweet corn); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers
4. Jeff O'Hara. RCE Scouting Program (sweet corn, tomatoes, cole crops, peppers); Development of an IPM Poster for Farm Markets.
5. Harvey Ort. RCE Scouting Program (sweet corn).
6. Roy Hildebrant, Iona Hill Farm. RCE Scouting Program (cole crops, tomatoes, peppers)

Warren County
1. Larry Freeborn, Freeborn Farms. RCE Scouting Program (sweet corn); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers.
2. Jim Parks. RCE Scouting Program (sweet corn, tomatoes, peppers).
3. Carl Race. RCE Scouting Program (sweet corn, cole crops).

4. Gary Donaldson. RCE Scouting Program (sweet corn, tomatoes, peppers); Development of an IPM Poster for Farm Markets
5. Piazza Bros. RCE Scouting Program (sweet corn).

Sussex County

1. George Fetzer, Valley View Farm. RCE Scouting Program (sweet corn, tomatoes, peppers); Trial Project to Develop a Comprehensive Pumpkin IPM Program for NJ Growers; Development of an IPM Poster for Farm Markets.

Agricultural Industry

1. The Englehard Corporation. Evaluation of Controls for Flea Beetle on Eggplant in an Organic Production System
2. Furman Foods. TomCast Disease Forecasting Program for Processing Tomatoes.
3. Garden State Pest Management. RCE Blacklight Trap Program.
4. Helena Chemical Co. Potato IPM Fax System.
5. McConnell Agronomics. RCE Blacklight Trap Program.
6. Mycogen, Inc. Testing Bt Corn for Wireworm Resistance.
7. New Jersey Tomato Council. North Jersey Staked Tomato Scouting Program.
8. Seabrook Bros. and Sons. RCE Blacklight Trap Program; Fall Spinach and Greens Insect Trapping Study
9. UAP Northeast. Potato IPM Fax System; Determination of sweet potato tuber damage; Effect of European corn borer damage to white potatoes.
10. Violet Packing. TomCast Disease Forecasting Program for Processing Tomatoes.
11. White Potato Association. Potato IPM Fax System.