Horticultural News

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Horticultural News

Editors: Winfred P. Cowgill, Jr. & Wesley R. Autio

The New Jersey State Horticultural Society was organized on August 17, 1875 at Geological Hall, Rutgers College, New Brunswick, NJ. It remains the oldest Horticultural organization in New Jersey.

Horticultural News began as the *The New Jersey State Horticultural Society News*, in October of 1920. The Society began "collecting paid membership in order to obtain funds to promote new features of the society and extend the usefulness of the society. The Horticultural Society News was started to be the official society publication." Published M. A. Blake, Professor at Rutgers College was the first president and chair of the publication committee.

Editors served as follows:

MA Blake	1920 - 1947
Norman F Childers	1948 - 1980
Win Cowgill	1981 - 1988
Emily Brown Rosen	1988 - 1990
Linda Butenis Vorsa	1991 - 1995
Jerry Frecon	1995 - 2010

June 2010: *Horticultural News* has moved to an online web-based format. The New Jersey State Horticultural Society has partnered with the University of Massachusetts *Fruit Notes*, Dr. Wesley Autio, Editor. Cowgill and Autio will be the new editors of *Horticultural News* and *Fruit Notes*.

Horticultural News is distributed to growers, extension personnel and researchers and libraries across North America. Horticultural News focuses primarily on tree-fruit culture, but addresses small-fruit cultural issues as well. Most reports are from current research at Rutgers University, University of Massachusetts, and other universities.

Horticultural News is published four times per year by the New Jersey State Horticultural Society. It is provided as a benefit to membership in the society. Membership costs $40 per year. Each one-year subscription begins January 1 and ends December 31. Payments via check must be in United States currency and should be payable to the New Jersey State Horticultural Society . Horticultural News Electronic subscriptions are available as benefit of membership in the NJ State Horticultural Society. A hidden link will be mailed immediately after publication to members. Issues will be made freely available on this website six months after publication.

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Cover photo: Rising Sun Fuji on Super Spindle (2.5' x 10', 6th leaf) (photo by Winfred P. Cowgill).

NEW JERSEY STATE HORTICULTURAL SOCIETY

Post Office Box 116   Clayton, New Jersey 08312
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December 10, 2010

Dear Members:

This is the time of year to reflect on our past years endeavors and to plan for the upcoming year. Hopefully all of you had a successful 2010 and are anxiously looking forward to 2011.

It has been a year of change as we transition from the old copy and format to our new electronic copy and format of NJ Horticultural News. As publication and mail costs rise we felt it was necessary to take this big step in publication. We will still try to send hard copies to those not able to access NJ Hort News on the internet at this time. http://www.umass.edu/fruitadvisor/hortnews/

We have enclosed the full program of the Mid Atlantic Fruit and Vegetable Convention and Trade Show. This continues to be one of the most popular projects we undertake. The program is bigger and better than ever. We continue to honor the program with the Ernest Christ Memorial Lecture on Wednesday afternoon February 2 in the peach session. Thanks to your contributions to this fund Dr. John Clark will be recognized as he discusses the Arkansas peach and nectarine varieties and his breeding and development program.

Please remember to stay at the Hershey Lodge when you come to the conference as the prices we charge for the program are in part subsidized by the number that stay at "the Lodge". A registration form was not enclosed because you must register on lodge or call the lodge to get the reduced convention rate. The Lodge number for registration is 717 533-3311 or the web site is www.mafvc.org/html/ .

All of us are aware of the tight financial times we are in and our universities and agricultural research facilities are also feeling this same pinch (to put it mildly!). One of the Horticultural Societies primary goals is to assist in fruit research thru direct financial grants to our New Jersey fruit researchers. This money comes from the interest we earn, excess revenues over expenses and from direct contributions from our members towards fruit research. This is the area where you can make a tremendous impact on your own future via a financial contribution to The New Jersey Horticultural Society earmarked for fruit research. On your membership renewal application is a line entitled "Research Contribution' and I hope you will all think seriously about putting some of your hard-earned dollars to work supporting the individuals whose research is contributing to the success of your operation and its bottom line.

Wishing you all a most joyous Holiday Season and successful 2011 and I sincerely hope to see all of you at Hershey in February.

Sincerely yours,

Ken Wightman

Ken Wightman
President

Evaluation of Low-volume, Non-recycling Drenches for Controlling Postharvest Diseases and Disorders of Apples

Dave Rosenberger, Anne Rugh, Albert Woelfersheim, Lindsay DeWitt, and Frederick Meyer
Connell University, Hudson Valley Laboratory, Highland, NY

This research report was prepared for the N.Y. Apple Research and Development Program, the grower-funded initiative that provided support for the project.

Editors Note: *Dr. Rosenberger offered the following guidelines and comments for grower applications: "For a commercial grower, the grower should mix up DPA at the appropriate labeled rate for the variety involved and then just spray 2.5 quarts of that solution over the top of the usual 20 bushel field bins. A handgun sprayer or even a solo sprayer would work if one can maintain an constant output, determine the time to deliver 2.5 quarts, and then just spray over the top of the bin for that predetermined amount of time. I just poured the solution over our minibins last year, but we used a sprayer this year and I think that we get more even distribution across the top of the bin by using a sprayer rather as opposed to just pouring the solution over the apples. Growers may find it necessary to cover bins to retain the volatiles if growers are treating only a few bins in a larger room. At the this time (October 2010) we are still not certain if one really needs a fungicide added to the drench when using this method. I don't think that a fungicide should be needed in most situations."*

Abstract

Diphenylamine (DPA) and postharvest fungicides were applied to apples using either a low-volume non-recycling drench (NRD) or a traditional high-volume recycling drench (RD). Effectiveness of the two application systems were compared by evaluating decay control in wounded Cortland fruit and by observing fruit for storage scald and carbon dioxide injury after cold storage. Each treatment was replicated four times by applying treatments to fruit in specially constructed minibins that were 15 inches square but equal in height to commercial harvest bins. Fruit treated with water (controls) via RD developed blue mold decay at 69% of puncture wounds whereas water applied as via NRD resulted in decay at only 24% of puncture wounds. However, Scholar/Captan/DPA and Penbotec/Captan/ DPA mixtures applied via RD provided >99% control of decay whereas those same combinations applied via NRD provided only 86-92% control of decay. Where fungicides were applied via NRD, the incidence of decay was 3 to 5 times greater in fruit at the bottom of the bin than in fruit located near the tops of the bins. Although fungicide treatments applied via NRD were not as effective as RD treatments, the NRD treatments may be effective enough to provide acceptable decay control under commercial conditions where fruit would be exposed to lower levels of inoculum than those used for this trial, and where relatively few fruit would have wounds. In treatments where diphenylamine (DPA) was applied via either NRD or RD to control superficial scald, the two different treatment methods were equally effective. When a fluorescent dye was added to DPA, the dye could be detected on only 40% of the fruit surface, but this method may under-estimate actual coverage. Results suggest that DPA treatment via NRD is effective because the vapor action from DPA is sufficient for suppressing scald on portions of the fruit that receive incomplete coverage.

Methods

Experiments were designed to compare the effectiveness of postharvest treatments applied to apples in a low-volume non-recycling drench (NRD) with results from the same treatments applied using a conventional high-volume recycling drench (RD). Because NRDs involve only small quantities of solution, we were specifically concerned about whether enough treatment solution would reach apples in the bottom of bins to control decays on those fruit.

To avoid the difficulties inherent in using full bins of apples as experimental units, we designed and constructed 24 plywood mini-bins that were 15 inches square (interior measurements) by 36 inches high so that we could work with “columns” of fruit equal in depth to those in full-size commercial storage bin. Each minibin held roughly 2.4 bushels of fruit and had an interior footprint area equal to 12% of that found in a MacroPlastic model 32FV bin. Data were collected from 50 fruit in the bottom of each mini-bin, 25 fruit from the mid-height part of the bin, and 25 fruit from the top of the bin. We used Cortland fruit as data fruit and Golden Delicious to fill the intervening spaces. The color difference between the two cultivars allowed us to quickly separate “data fruit” from filler fruit when experiments were being evaluated.

Fruit used in these trials were picked and transported to the Hudson Valley Lab on September 21. Fruit were held at ambient temperature until they could be transferred into our mini-bins on September 22 and 23. Maturity analyses performed on September 22 showed that Cortland fruit used for this trial had an average starch-iodine rating of 3.0 and mean pressure of 14.9 lb. However, seven of the 24 fruit in the random sample used for maturity evaluations had moldy core. When fruit with moldy core were excluded, the average starch-iodine rating for the remaining fruit was

Left: Filling minibins with alternating layers of Cortland "data fruit" and Golden Delicious filler fruit. Although bins were 36 inches deep, six inches of headspace was left at the top to minimize splashing of treatment solutions. The full-size field bin in the rear was elevated on cement blocks for easier access to fruit. **Right:** A high-volume recycling drench is applied to fruit in a filled minibin while an assistant tracks time for the 30-second drench treatment.

2.2 and mean pressure was 14.7 lb. Cortland destined for CA storage are considered mature enough to harvest when they have a starch index of 2.5-3.5 and internal firmness greater than 15.0 lb (from Mike Fargione's Apple Maturity Report for September 23, 2009). We specifically tried to get Cortland fruit harvested toward the beginning of the maturity window so as to increase the probability that untreated fruit would develop scald during storage.

For logistical reasons, we divided the research into three separate trials. Trial 1 was designed to compare the efficacy of two DPA-fungicide combinations applied either via RD or via NRD. Trial 2 was designed to assess effectiveness of those same treatments for controlling storage scald and carbon dioxide injury. Trial 3 was a dye experiment designed to assess fruit coverage achieved with RD and NRD.

Trial 1: The Cortland fruit used in the experiment were wounded three times on each of three sides by puncturing the skin using a large cork fitted with three finishing nails that produced wounds that were 3 mm deep and 2 mm in diameter. Groups of 25 wounded fruit were held in plastic half-bushel "handle bags" until they could be placed in bins. After all fruit were wounded, 50 wounded fruit (2 bags) were placed in the bottom of each minibin and a layer of Golden Delicious was added to bring the fruit level to about 15 inches from the floor of the bin. A third bag of wounded Cortland fruit was added at the mid-level in the bin, then more Golden Delicious were added to bring the fruit level close to the 30-inch mark on the bin, and finally a fourth bag of wounded Cortland fruit was added to top off the fruit column while keeping the top layer of fruit at about 30 inches from the floor. The number of data fruit in the bottom of the bin was double that used for the top and middle levels of the bin because we anticipated that we might need more data points to sort out treatment differences at the bottom of bins where NRD treatments were expected to result in incomplete coverage of fruit surfaces. To minimize the amount of treatment solution that might be absorbed by dry bins, the plywood minibins were thoroughly hosed down with water several times over a 4-hr period before fruit were placed into them.

Inoculum was prepared by removing spores from 10-day old cultures of *Penicillium expansum* isolate 301, an isolate that is not controlled by benzimidazole-plus-DPA treatments. Hemacytometer counts revealed that the inoculum suspension contained 19.5×10^6 spores/ml. The inoculum suspension was poured into a plastic finger-pumped spray bottle. Before bags of wounded fruit were emptied into bins, the open bag was misted with one squirt (ca. 3.2 ml) of the spore suspension. One additional squirt was applied over top of each layer of Cortland apples after they had been transferred from the bags into the minibins. We used four bags of 25 wounded fruit per minibin (2 bottom, 1 center, 1 top) and had 3 layers (bottom, center, top) of data fruit within the bin. Thus, we applied seven inoculum squirts per bin for a total application of 22.4 ml of inoculum per minibin or a total of 439.9 million spores per minibin. We opted to apply the inoculum by misting fruit rather than dipping fruit into inoculum suspensions so as to more closely simulate exposure to airborne spores that might contaminate fruit during harvest and transport to storages under commercial conditions.

For recycling drenches (RD), we placed minibins in a fiberglass catch basin that had a large drain hole cut into one corner and that was supported on cement blocks so that solutions draining from the catch basin could be recaptured. Treatment solutions were mixed in a volume of 9 gal of water held in a 10-gal plastic garbage pail. The pail containing treatment solutions was placed beneath the catch basin drain. A sump pump in the garbage pail delivered 48 gal/min through a 1.75-in diameter flexible hose. Solution that ran through the minibins was rapidly recirculated back to the sump pump via the drain in the catch basin. We directed flow from the hose over the top of the minibin for 30 seconds and then allowed the minibin to drain before removing it from the fiberglass catch basin. The same treatment solution was used for treating four replicate bins for each treatment. The pump and catch basin were rinsed with clean water between treatments.

For non-recycling drenches (NRD), we used products at the same concentrations as those used for the recycling drenches. A double-layer of window screen was placed over the top of each bin and 500 ml of clean treatment solution was applied to each bin by pouring it through the double layer of screening in such a way that all apples on the upper layer were evenly wetted by the treatment solutions. Solution that drained from the bottoms of the minibins was recaptured in the catch basin and was measured to determine how much of the 500 ml/bin was retained by the fruit and bin surfaces.

Treatments in Trial 1 were applied on September

22 as follows:

1. NRD: Water control
2. NRD: No Scald DPA 1500 ppm plus Scholar 230SC 10 fl oz/100 gal plus Captan 80 1.25 lb
3. NRD: No Scald DPA 1500 ppm plus Penbotec 16 fl oz/100 gal plus Captan 80 1.25 lb
4. RD: Water control
5. RD: No Scald DPA 1500 ppm plus Scholar 230SC 10 fl oz/100 gal plus Captan 80 1.25 lb
6. RD: No Scald DPA 1500 ppm plus Penbotec 16 fl oz/100 gal plus Captan 80 1.25 lb

Treatments 4-5-6 were applied first. Roughly an hour after those treatments were applied, the fruit from these bins was removed so that the bins could be re-used. The Cortland data fruit were placed on spring cushion trays that were labeled to indicate treatment, rep, and position (top, center, bottom) within the bin. The Golden Delicious filler fruit were discarded. After they were emptied, the bins were washed with a high pressure washer, refilled with apples used for treatments 1-2-3, and the NRD treatments were applied as described above. Because we wanted to know if the orientation of wounds on fruit in the bin would affect the control achieved with NRD treatments, treatments 1-2-3 were left in the bin and moved to cold storage along with the fruit from treatments 4-5-6 that were boxed on spring cushion trays. All of the bins and boxes were placed into plastic bags. All fruit had been moved into cold storage at 35° F by 4:00 PM on September 22. We bagged the containers to maintain high humidity that would favor decays and to ensure that volatiles produced by the treatments would be retained within the treated fruit and would not be diluted by air movement through the boxes/bins.

Fruit from treatments 4-6 were removed from cold storage on November 12 and were evaluated for decays. The number of wounds on each fruit was recorded. Fruit from treatments 1-3 were removed from cold storage on November 16 Fruit were removed from the bins with careful attention to maintaining the exact orientation of the fruit within the bin so that we could assess the number of wounds and number of infections that occurred on the upward-facing one-quarter of the fruit, on the downward facing quarter of the fruit, and on the sides of the fruit that represented the center half of the fruit.

Trial 2: Three treatments were applied to fruit in minibins on September 23 to evaluate effects of treatments on development of storage scald and CO_2 injury. Minibins were filled as described for Treatments 1-6 above except that none of the fruit were wounded and no inoculum was applied. Treatments were as follows:

1. NRD: Water control
2. NRD: No Scald DPA 1500 ppm plus Scholar 230SC 10 fl oz/100 gal plus Captan 80 1.25 lb
3. HVRD: No Scald DPA 1500 ppm plus Scholar 230SC 10 fl oz/100 gal plus Captan 80 1.25 lb

Each treatment was applied to four replicate minibins. Treated fruit were left in the minibins, and the bins were enclosed in large plastic bags and moved into the same cold room as the other fruit within an hour of the time that treatments were applied.

Trial 3: This experiment was conducted in a greenhouse on February 16, 2010. Golden Delicious fruit from cold storage were placed into minibins and were given a non-recycling drench treatment No-Scald DPA at 1500 ppm to which a fluorescent dye had been added. Immediately after treatment, fruit were removed from the bin and placed on spring cushion trays while keeping the same fruit orientation that fruit occupied in the bin (i.e., the upward facing side of the fruit in the bin was also upward facing on the spring cushion trays). Fruit were evaluated for surface coverage under a black light.

Results

Trial 1: Means were calculated by averaging the incidence of decay for fruit at the bottom, middle, and top of the bin, thereby providing an equal weighting for each of the three fruit positions within bins even though there were twice as many data apples at the bottom of the bins as compared to the other two positions. Fruit in the RD water control (trt 4) developed decay at 68.7% of the wounds whereas fruit in the NRD water control (trt 1) developed decay at only 24.3% of the wounds (Figure 1). Thus, the recycling water picked up the spores that we had misted over the fruit and effectively inoculated other fruit in the bins whereas that occurred to a much lesser extent in the NRD treatment. The fruit inoculation effects of the recycling water in treatment 4 is further illustrated by the fact that the first bin treated with recycling water

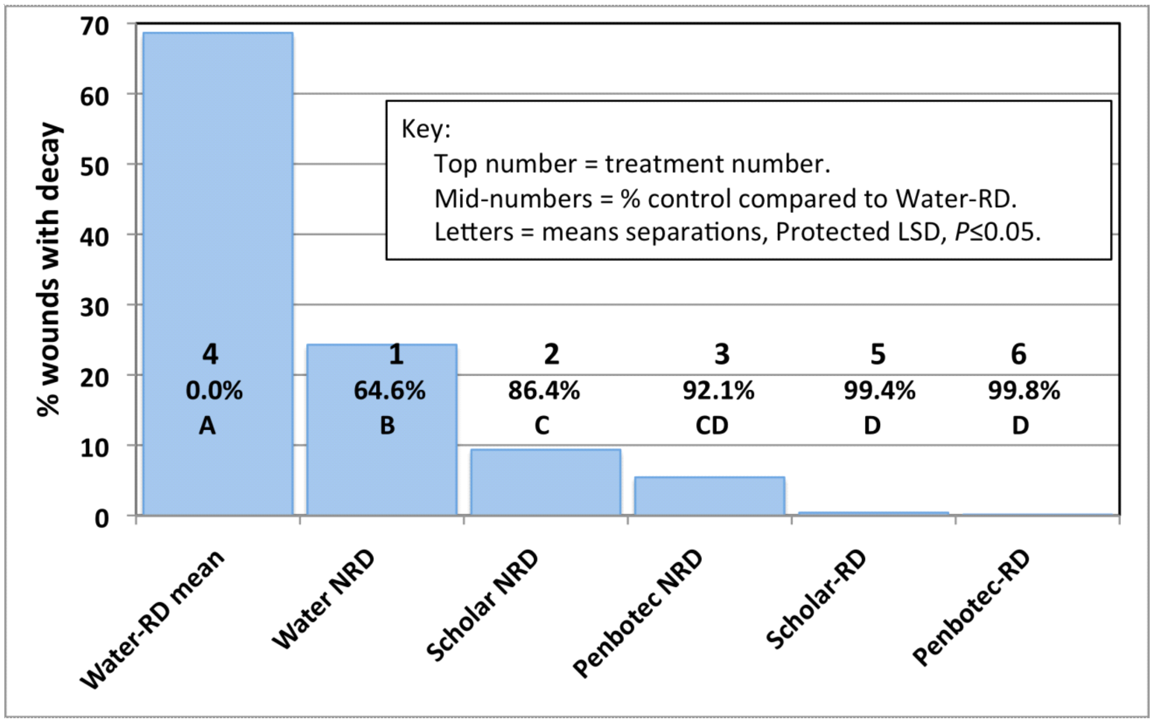

Figure 1. Effects of fungicide treatments on disease incidence in Cortland fruit that were wounded, mist-inoculated with spores of *Penicillium expansum*, then treated with water, Scholar, or Penbotec using either recycling drenches (RD) or non-recycling drenches (NRD).

had only 52% of wounds with decay whereas subsequent bins had 68, 78, and 76%, respectively. This sequence is logical if one considers that spore concentrations in the recycling drench water would have increased as each bin was treated in turn, but the effect of increasing inoculum concentration leveled off after several bins had been treated.

If results for other treatments are converted to percent control using trt 4 as the basis for the maximum infection rate, then just switching away from the RD to the NRD treatment system in the absence of any fungicide provided a 65% reduction in disease incidence (Figure 1). When Scholar and Penbotec were applied as RD treatments, they provided greater than 99% control of blue mold, but they only provided 86% and 92% control, respectively, when applied as NRD treatments.

Where water alone was applied as an NRD treatment, disease incidence for fruit at the top, middle, and bottom of the bins was virtually identical, indicating that inoculum was evenly distributed among fruit in the top, middle, and bottoms of the minibins (Figure 2). However, where Scholar was applied as an NRD treatment, decay incidence was nearly 5 times greater in the bottoms of the bins than in the tops of the bins (15.2 % vs. 3.3%). For Penbotec NRD treatments, disease incidence averaged 7.6% for fruit at the bottoms of bins compared to 2.3% for fruit at the tops of bins. Thus, it appears that fruit in the bottoms of bins received less complete fungicide coverage than those in the tops of bins.

For the NRD treatments, the orientation of the wound on apple surfaces within bins appeared to have relatively little impact on the probability that wounds would become infected. Looking at the total numbers of wounds across all of the NRD treatments, we found that 2,792 wounds faced upward, 5,660 wounds faced toward the sides of the bin, and 2,349 wounds faced downward. Infection percentages for those same categories were 14.2, 14.2, and 11.5%, respectively. Thus, there was a slightly lower incidence of infection in wounds facing downward in the bins where NRD treatments were applied, but the effect of wound position was relatively small.

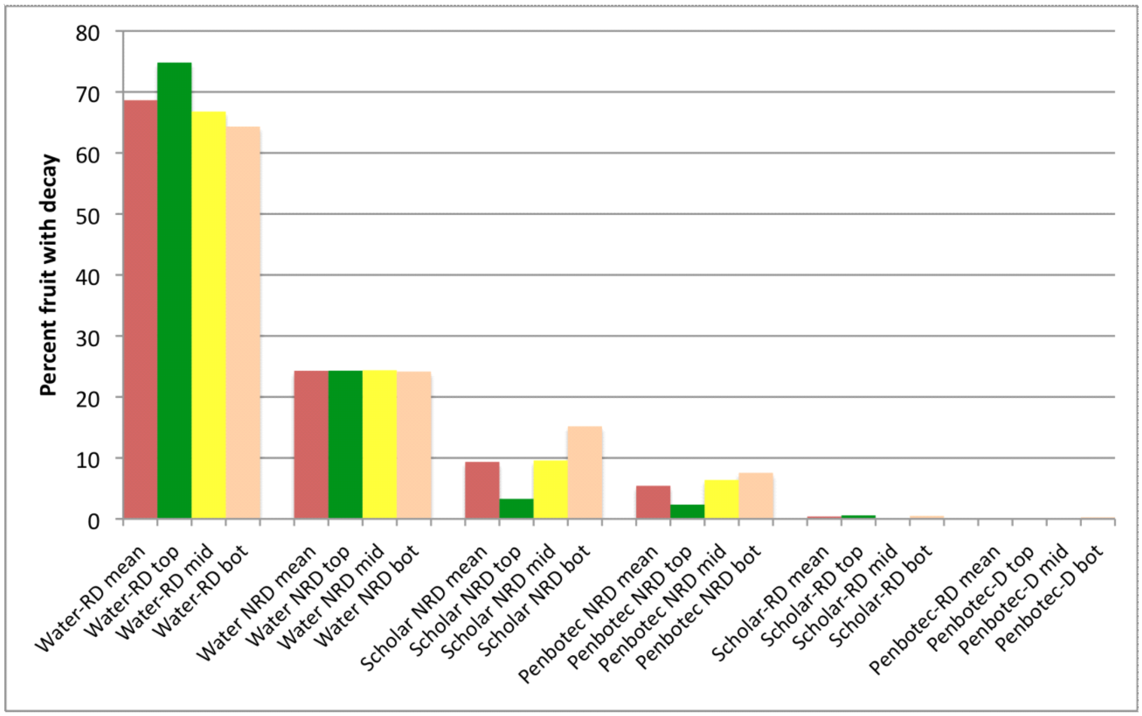

Figure 2. Effects of fungicide treatments on disease incidence in Cortland fruit that were wounded, mist-inoculated with spores of *Penicillium expansum*, then treated with water, Scholar, or Penbotec using either recycling drenches (RD) or non-recycling drenches (NRD). For each treatment, the first bar on the left shows the mean decay incidence throughout the minibin and the other three bars show the incidence for fruit in the top, center, and bottom of the minibins.

Trial 2: Fruit were removed from cold air storage and evaluated for superficial scald on February 1, 2010. Fruit with scald, decay, or senescent breakdown were discarded during the first evaluation. The remaining fruit were held for an additional seven days at 70° F and were then evaluated again to determine how many additional fruit developed superficial scald during the shelf-life test. When results were tabulated, we found that 61% of fruit treated with water only (applied as a non-recycling drench) developed scald by the end of the trial whereas fruit treated with diphenylamine in either a recycling drench or in a non-recycling drench had only 2% of fruit with scald (Figure 3). Furthermore, there was slightly more scald in the tops of bins treated with water only via NRD, but there was no difference between scald incidence in the tops and bottoms of bins treated with DPA regardless of which treatment method was used. The fruit and the storage conditions in this trial were very conducive for development of superficial scald, thereby providing a harsh test for effectiveness of DPA. Nevertheless, DPA applied as a non-recycling drench was just as effective as when applied using the traditional recycling drenching method.

Trial 3: Evaluation of fruit treated with DPA solution containing a fluorescent dye showed that roughly 40% of the total fruit surface was contacted by the solution applied as an NRD. As expected, coverage was better in the tops of bins (55% coverage) than in the bottoms of bins (27% coverage). However, the dye fluoresced strongly only in locations where pooled solution dried on the fruit surfaces, so our analysis of fruit surface coverage may have under-estimated the actual proportion of fruit surface that was contacted. An alternative approach will be used next year to assess the proportion of the fruit skin that contacts the drench solutions.

Discussion

Results from Trial 1 showed the advantages and disadvantages of RD and NRD postharvest treatment

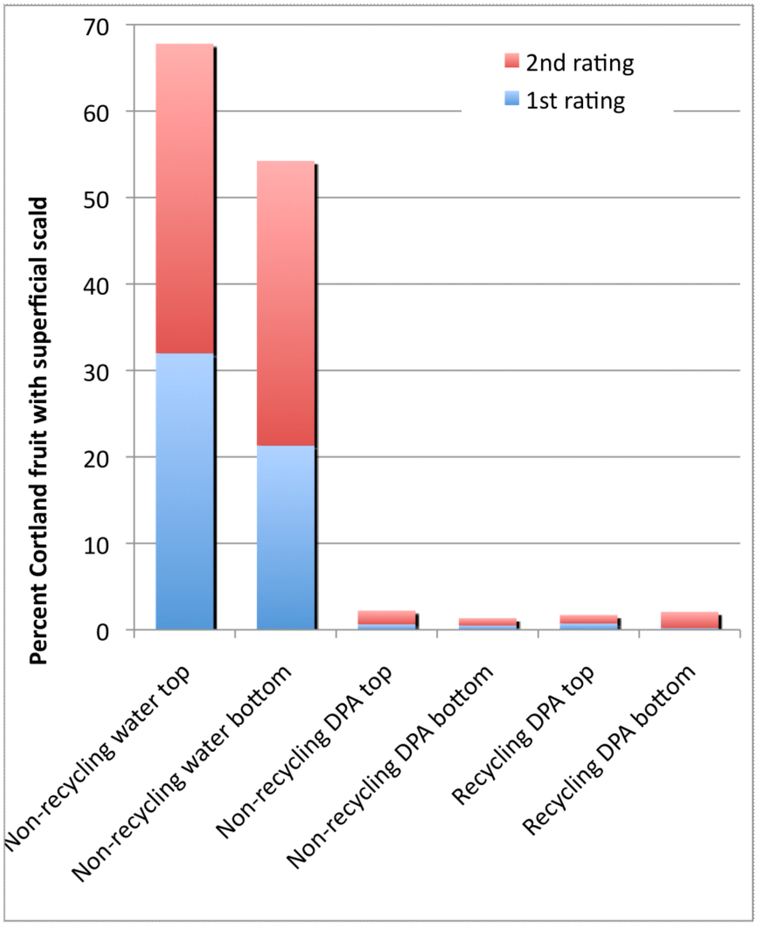

Figure 3. Effects of DPA treatments on the incidence of superficial scald noted on Cortland fruit that had been held in air storage from 23 September through 1 February and that were then evaluated a second time after a 7-day shelf-life test at 70° F. Data is presented separately for fruit from the tops of the bins and fruit from the bottom half of the bins.

systems. In the RD water treatment, the recycling solution rapidly picked up spores from the fruit surface and redistributed them to a high proportion of wounds on the fruit surfaces in the same way that spores in commercial DPA applications are redistributed to fruit wounds in the absence of an effective fungicide. By switching to the NRD treatment system (i.e., applying water without recycling it), we reduced decay incidence by nearly 65% in the absence of any fungicide. This reduction in decay with NRD treatment alone might have been greater if we had applied less inoculum to the fruit as we were filling the bins. Previous work has shown that fruit coming from the field rarely carry more than 30,000 *P. expansum* spores per commercial-size bin (Rosenberger et al. 2006). However, we misted fruit with the equivalent of 3.7 billion spores per full-size bin. Badly contaminated bins can carry more than 2 billion spores on bin surfaces (Rosenberger et al. 2006), so spores can accumulate in very high numbers in recycling drenches. In this trial we purposely used high levels of inoculum so as to ensure that we would be able to detect effects of different treatments.

Applying Scholar or Penbotec in NRD treatments further reduced disease incidence below that observed in the water NRD. However, fungicides applied via NRD were less effective than comparable RD treatments. (Although we included DPA and Captan in all of the Scholar and Penbotec treatments, Scholar and Penbotec provided most of the disease control and we therefore refer to the treatments using those fungicide names.) Disease control with Scholar was especially compromised for fruit in the bottoms of bins, presumably because coverage was less complete in the bottom than in the tops of bins. Further work is required to determine if activity of Scholar in NRD treatments can be improved by adding a surfactant, but any surfactant used in postharvest treatments must be approved as a "food-grade" product.

Packinghouse operators who pioneered the NRD concept reported that they used only about 2.5 qt of postharvest solution per bin or the equivalent of 283 ml per minibin. We increased the amount of solution applied in our NRD treatments to 500 ml per minibin (equivalent to 4.4 qt per commercial bin) because we were concerned that 2.5 qt per full-sized bin might be less than optimal. However, when we recaptured and measured the solution that ran through our minibins following the application of a total of 2000 ml to four bins, we found that we recaptured 1000 ml following Scholar NRD treatments and 910 ml following Penbotec NRD treatments. The fact that we recovered almost half of the 500 ml that we applied to each minibin indicates that previous observations on how much solution can be retained by each bin were pretty accurate. In future tests, NRD treatments should be applied at the equivalent of 2.5 qt per commercial bin or 283 ml per minibin because higher rates of application will result in excessive run-off where large numbers of bins are treated in the same location.

The reduced disease control that we noticed with fungicides applied via NRD as compared to RD applications may be insignificant if inoculum levels are kept low by using clean bins and sanitizing storage rooms at the end of each packing season. Factors in our methodology that favored disease development included having nine wounds/fruit, introduction of artificially high inoculum levels, and maintenance of 100% relative humidity following treatment by bagging the minibins while fruit inside the bins were still wet. Another factor that may have artificially raised disease levels in the Penbotec and Scholar NRD treatments is the fact that, whereas we used clean water for the water NRD treatment, we reused the Penbotec and Scholar solutions that we had used earlier for the RD treatments. Thus, in addition to the spore load introduced by misting fruit with a spore suspension, the Scholar and Penbotec NRD treatments were also exposed to the spore load in that accumulated in the solutions as RD treatments were applied.

The NRD method for applying DPA was more effective than the NRD approach for applying fungicides. Despite conditions that favored a high incidence of superficial scald in our controls, both the NRD and the RD treatments provide equivalent levels of scald control, and there was no difference in scald incidence for fruit in the upper half of each bin and fruit in the lower half of each bin. It seems likely that the volatility of DPA allows DPA vapors to suppress scald on the portions of fruit that may escape direct contact with the DPA solution when DPA is applied as a non-recycling drench. However, this method may fail to provide adequate scald control if small quantities of treated fruit are placed into large storage rooms because the DPA vapors may become too diluted to be effective. This is not a problem when large storage rooms are filled rapidly and all in-coming fruit has been treated, and we avoided this problem by bagging the fruit in our trials. However, more work is needed to determine the limits of this method when only a small proportion of the fruit in a room are treated via NRD.

Conclusions

- Simply switching from RD to NRD applications of water reduced decay by 65% (from 68% of wounds infected for RD application to 24% following NRD application). The fact that NRD applications do not accumulate and recirculate spores gives it a distinct advantage over RD applications.
- Both Scholar and Penbotec were more effective when applied in RD as compared to NRD treatments, although for Penbotec the effect of application method was not significant.
- Penbotec and Scholar applied as NRD treatments reduced decay levels significantly compared to the NRD water control. Benefits of these fungicides might have been even greater if we had used lower levels of inoculum. Alternatively, it is also possible that fungicide treatments could be completely eliminated if DPA can be applied as an NRD treatment under low-inoculum conditions that usually persist in commercial storages.
- Results from the DPA trial showed that, unlike the case with the fungicides, both the RD and NRD treatments provided nearly complete control of superficial scald and control was uniform throughout the minibins.
- These experiments should be repeated using several different levels of inoculum to determine if NRD fungicide treatments are more effective with reduced inoculum levels or if fungicides can be eliminated completely at low inoculum levels and also to determine if DPA applied via NRD provides scald control when bins are not bagged and only a small portion of the fruit in the storage room are treated.

Literature Cited

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Brown Marmorated Stink Bug A New Threat to New Jersey and New England's Agriculture

George Hamilton
Pest Management Specialist, Rutgers Cooperative Extension

The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål), is an exotic insect belonging to the order Hemiptera or true bugs. BMSB, sometimes also called the yellow-brown stink bug or East Asian stink bug, is native to China, Korea and Japan and is considered an important agricultural pest in soybeans and tree crops in Japan.

This non-native stink bug was first collected in the United States in Allentown, PA, during the fall of 1996. In New Jersey, BMSB was recovered in 1999 from a Rutgers Cooperative Extension Vegetable IPM program black light trap in Milford, NJ. Since 2000, BMSB has spread throughout Pennsylvania and New Jersey.

BMSB has also spread to other parts of the United States. Early on it was only found in Delaware, Maryland, New Jersey and Pennsylvania. Today, in addition to these states, it is present in California, George, Illinois, Indiana,

Kentucky, Mississippi, New Hampshire, New York, North Carolina, Ohio, Oregon, Rhode Island, South Carolina, Tennessee, Virginia and West Virginia.

BMSB eggs are elliptical, light green in color and are deposited in a cluster of 20 to 30 eggs on the under-side of leaves. Immatures go through five nymphal stages (instars) and range in size from 2.4 mm in the first instar to 12 mm in length during the final instar. Immatures are characterized by dark red eyes and a yellowish-red abdomen as first instars. In later instars, the abdomen gradually turns to off-white with reddish spots.

Adults are approximately 17 mm long, generally brown in color with characteristic white (or off-white) antennal segments and darker bands on the membranous, overlapping part, at the rear of the wings. They also have patches of coppery or bluish

has been observed feeding on many ornamental plants, fruit trees, legumes, and vegetables and was shown to cause significant damage in pears and apples on two farms. Based on this, it was predicted that BMSB could become a significant agricultural pest.

In 2009, this prediction began to come true. That year, in the fruit growing regions of Virginia and West Virginia, BMSB caused severe late season injury to peaches and apples with some orchards exhibiting 40-50% damage. This year, the same thing happened in Virginia and West Virginia not only in tree fruit but also in vegetables. It was also seen feeding in soybeans. In addition, many growers in New Jersey, Pennsylvania, Maryland and Delaware also saw significant damage in tree fruit and peppers. It was also seen feeding in field and sweet corn and several other vegetables.

As you might imagine, researchers in the mid-Atlantic and northeastern states are very concerned. Chemicals controls for this insect in tree fruit and vegetables are available; however, their use may disrupt current IPM programs that rely on natural enemies to keep certain pests in check. Because of this, research is currently underway to develop chemical and non-chemical alternatives to properly manage this new pest.

metallic-colored punctures on the head and pronotum. Scent glands are located on the dorsal surface of the abdomen and the underside of the thorax. These glands are responsible for producing the pungent odor that characterizes "stink bugs."

The brown marmorated stink bug is a sucking insect that uses its mouthparts to pierce the host plant to feed. Feeding results, in part, in the formation of small, necrotic areas just under the skin and sometimes on the outer surface of fruits and leaves of its hosts. In tree fruit, it can cause characteristic cat-facing injury due to early season feeding. In its native range, BMSB feeds on a variety of fruits and other host plants including apples, cherry, citrus, figs, mulberry, peach, pear, peppers, persimmon, soybeans and tomatoes. In Pennsylvania and New Jersey, BMSB

A Summary of Brown Marmorated Stink Bug Damage in New Jersey Fruit Crops – 2010

Dean Polk, A. Rucker, G. Hamilton, D. Schmitt, W. Cowgill, A. Atanassov, and N. Muehlbauer
Rutgers Cooperative Extension

The brown marmorated stink bug (BMSB), *Halyomorpha halys*, mushroomed into a serious insect pest throughout much of eastern Pennsylvania, New Jersey, western Maryland and the Cumberland-Shenandoah area during 2010. The insect was introduced from Asia, and first found near Allentown, PA in the mid 1990's. It has an extremely wide host range, which includes tree fruits, small fruits, vegetables, ornamentals, and seeded crops such as corn and soybeans. The insect feeds by puncturing the fruit with piercing/sucking mouthparts, and injecting saliva which allows the insect to suck up the plant material through its mouthparts. Fruit tissue at the point of entry and just below into the flesh, then dies and the rest of the fruit grows around it. This leaves a sunken area on the skin at the point of entry, and browning, dead tissue in the flesh. Early injury on stone fruit can go all the way to the pit. The tissue dies, and as the fruit grows, can form cavities in the flesh. Photos of adults and nymphs feeding on peaches, apples and pears can be seen in Figure 1. Internal feeding damage is illustrated in Figure 2.

Figure 1. Stink bugs on fruit – **A.** adults on peach, **B.** nymphs on peach, **C.** nymph on apple, **D.** nymph on pear. Note

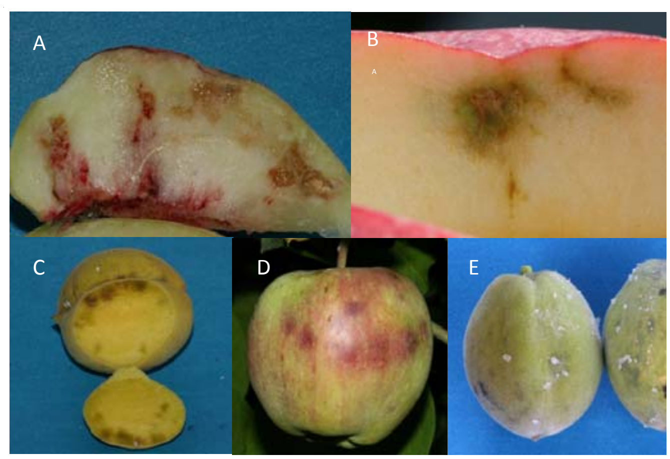

Figure 2. Internal and external damage from brown marmorated stink bug – **A.** internal necrosis in peach, **B.** internal necrosis in apple, note depth of feeding where mouthparts extended into apple , **C.** water-soaked areas in peach, **D.** external damage on apple, **E.** recent bleeding spots on peach.

The insect had 2 generations in 2010. Overwintered adults disperse from overwintering sites in houses and other structures, or protected areas near farms. They enter the orchard, mate and lay eggs. Nymphs hatch from the eggs and undergo 5 nymphal instars before maturing into adults. First instar nymphs feed on what's left from the chorion or egg shells. They then move out through the canopy in search of fruit for food as they mature through 4 additional instars. Adults mature, mate, and the cycle repeats. Unlike other fruit pests, after it arrives in the orchard, BMSB spends its entire life feeding on the fruit, and

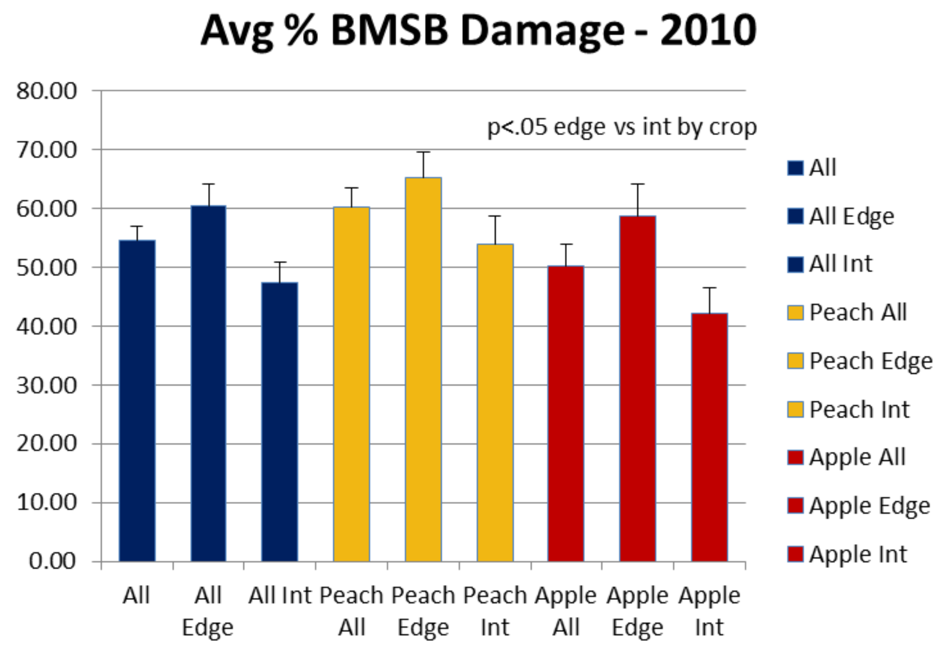

Figure 3. Average overall damage, from samples on edge, and from samples in internal rows.

every life stage, other than the egg, causes damage. As the stink bugs become established in managed fields, they are heavily biased towards edge and border rows. In tree fruit this has resulted in higher populations near wooded borders and soybean fields.

Initial damage surveys were completed in 2010. Workers in several Mid-Atlantic States initiated a survey program using the same methodology in each state. We sampled 10 fruit from each of 10 trees on an outside row, and 10 fruit from 10 trees on several inside rows that were at least 5-6 trees in from the edge of the block. We assessed both samples for the number of fruit injured with 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or >10 injuries per fruit. We took a total of 68 samples across 18 farms for a total of 6,800 sampled fruit.

Mean damage levels were significant. We found just over 54% damage across all sampled fruit. Damage was significantly higher towards edge rows. Interiors of peach blocks averaged almost 54% damage, while edge rows averaged 65% damage. The pattern was similar in apples where an average of 42% damage was seen on interior rows compared to 59% damage on edge rows (Figure 3). One peach planting was seen with 97% damage. Other blocks were only slightly damaged, but damage was present throughout NJ at some level. In some cases, damage seemed to increase over time (Figure 4).

This insect cannot be controlled with many common tree fruit insecticides, including Imidan and Sevin. While we do not yet know what insecticides will be the most satisfactory, various pyrethroids gave some control in 2010. Unfortunately these materials have short residual properties, can disrupt orchard

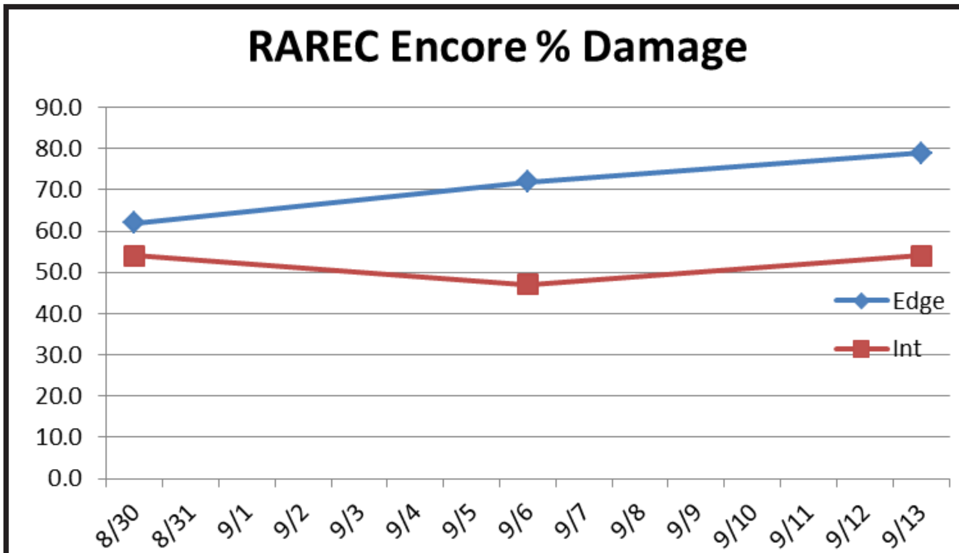

Figure 4. Damage levels seen on Encore peach at the Rutgers Agricultural Research and Extension Center (RAREC) taken over a 3 week period at the end of the season. Note the trend of increased damage over time.

ecosystems, and insects can become resistant to them with repeated applications. Carbamates (methomyl), and several neonicotinoids have shown some activity in ongoing research tests. It is important to note that during 2010, the high damage levels seen were present even though most growers were using intensive insecticide programs. Since little is known about this insect, research programs need to be developed throughout the states that have become infested with BMSB. Over the next several years, researchers will attempt to address questions concerning its life history, environmental and temperature effects, monitoring and control tactics, and other management practices that can be used to control this insect.

Table 1. Brown marmorated stink bug sample summary – 2010.

Date	Crop	Variety	Date	Crop	Variety
8/10	Peach	Harrow beauty	8/27	Asian Pear	Mix
8/12	Peach	Jerseyqueen	9/14	Peach	Encore
8/12	Peach	Blushing Star	9/2	Apple	Gala
8/13	Peach	Sweetenup	9/13	Apple	Cameo
8/13	Peach	Glowing star	9/15	Apple	Red Del
8/16	Peach	Mix	9/15	Apple	Gold Del
8/23	Peach	Mix	9/15	Apple	Mutsu
8/30	Peach	Cresthaven	9/15	Apple	Red Del
8/17	Peach	Encore	9/16	Apple	Empire
8/16	Peach	Jerseyqueen	9/16	Apple	Red Del
8/16	Peach	Cresthaven	9/20	Apple	Red Del
8/23	Peach	Cresthaven	9/13	Apple	Fuji
8/24	Peach	Encore	9/17	Apple	Macoun
8/27	Peach	PF 17	9/21	Apple	Red Del
8/30	Peach	Parade	9/29	Apple	Mix
8/31	Peach	Encore	10/6	Apple	Granny Smith
9/7	Peach	Encore	10/6	Apple	Rome
8/27	Apple	Mix	10/14	Apple	Fuji

N=68 samples, 32 peach, 34 apple, 2 Asian pear, 18 farm sites.

Upcoming Viticulture Symposium

Rutgers University/NJAES will hold a viticulture symposium next spring in cooperation with the Outer Coastal Plain Vineyard Association, on April 9, 2011 at Rutgers Snyder Research and Extension Farm, Pittstown, NJ. The symposium is presented as part of Specialty Crops Block Grant Award from the NJ Department of Agriculture to improve competitiveness and enhance sustainability of viticulture in NJ.

Rutgers Snyder Farm:
shttp://snyderfarm.rutgers.edu

Outer Costal Plains Vineyard Association:
http://www.outercoastalplain.com

From Left to Right: Dr. Dan Ward, Pomologist, Rutgers/ NJAES and Dr. Larry Coia of Coia Vineyards, in Vineland, NJ. Dr. Coia is president of the Outer Coastal Plain Vineyard Association, Justen and Mike Benaduce, of Benecuce Vineyards, Pittstown NJ view and discuss the NE-1020 Multi-state Wine Grape Variety Trial located at the Rutgers Sndyer Farm, Pittstown, NJ. *Photo credit: Win Cowgill.*

2002 Massachusetts/New Jersey Cameo Dwarf Rootstock Trial

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New Jersey Agricultural Experiment Station, Rutgers University

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In 2002 semi-formal NC-140 plantings were established at the University of Massachusetts Cold Spring Orchard Research and Education Center in Belchertown, MA and at the Rutgers Snyder Research and Extension Farm in Pittstown, NJ. Cameo apple trees (Willow Drive Nursery) on three dwarfing rootstocks – Geneva (G.) 16, M.9-NAKBT337 (M.9-337), and B.9 – were planted in a randomized complete block design (10 replications) spaced at 1.2 X 3.6 m. (Massachusetts) and 2.5 X 4.5 m. (New Jersey). All trees are trickle irrigated and have been trained to a vertical axis.

Annual measurements of trunk circumference, tree height and spread (2006 only, reported in 2006), suckering, fruit yield (beginning in 2003), and fruit size (NJ only 2004, 05, 08) have been made.

It is anticipated similar data collection will continue for another four growing seasons. An article on the up-to-date performance (2002-2009) of these three commercial dwarf rootstocks has been published in the Volume 74, Combined Issue of ‘Fruit Notes.’

Results

This report presents data from the 2009 (8th leaf) growing season, and results are presented on page 2. in Tables 1-3.

Figure 1. Trunk crack on G.16 (10/29/2009).

Over both states, G.16 had the largest trunk area, followed by M.9 and B.9. (Table 1.) In Massachusetts, G.16 was larger than both M.9 and B.9. (Table 2.) In New Jersey, G.16 and M.9 are both larger than B.9.

Massachusetts rootstocks exhibited more suckering than New Jersey.y There was no difference in suckering between the rootstocks within State. (Table 2.) Longitudinal trunk cracks were observed on two (20%) G.16 rootstocks in Massachusetts, pictured above.

In 2009, there

Table 1. Overall trunk size, suckers, yield, and fruit size in 2009 of ‘Cameo’ apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

Rootstock	Trunk cross-sectional area (cm2)	No. root suckers	Yield per tree (kg)	Cum. yield (2003-09) per tree (kg)	Yield efficiency (kg/cm2 TCA)	Cum. yield efficiency (2003-09) (kg/cm2 TCA)	Fruit weight (g)
G.16	47.5 a	1.3	25.0	106.2	0.49 b	3.7 b	221 b
M.9-337	37.3 b	2.6	30.0	106.8	0.9 a	4.2 b	254 a
B.9	22.8 c	1.3	19.1	87.2	0.85 a	5.3 a	241 ab

Levels not connected by same letter are significantly different. (Tukey HSD P=0.05)

Table 2. Trunk size and suckers by state in 2009 of 'Cameo' apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

Rootstock	Trunk cross-sectional area (cm2)		No. root suckers	
	Mass.	*New Jersey*	*Mass.*	*New Jersey*
G. 16	34.4 a	60.7 a	2.3	0.3
M.9-337	18.9 b	55.7 a	4.6	0.5
B.9	15.8 b	29.7 b	1.8	0.8

Levels not connected by same letter are significantly different (Tukey HSD P=0.05)

was no difference in yield per tree between the rootstocks across both states. (Table 1.). Cumulative yield (2003-2009) did not differ either. Yield efficiency, however, was greater for both B.9 and M.9 compared to G.16. B.9 had the highest cumulative yield efficiency compared to both M.9 and G.16.

There is no difference in yield and cumulative yield per tree by rootstocks in both states. (Table 3.) Yield efficiency, however, was highest in Massachusetts for M.9, followed by B.9, and then G.16 with the lowest efficiency. (Table 3.) B.9, however, was more yield-efficient in New Jersey than the other two rootstocks. Similarly, cumulative yield efficiency (2003-2009) was highest for B.9 in New Jersey, but in Massachusetts there was no difference between the rootstocks.

Across both states, M.9 fruit were larger than G.16 fruit, but did not differ in size from B.9 fruit. (Table 1) In New Jersey, G.16 fruit were smaller than both M.9 and B.9 fruit. And overall in 2009, New Jersey fruit were smaller (230 g) than Massachusetts fruit (248 g).

Table 3. Yield and fruit size by state in 2009 of 'Cameo' apple trees on three rootstocks in the 2002 MA/NJ NC-140 Cameo Dwarf Rootstock trial.

Rootstock	Yield per tree (kg)		Cum. yield (2003-09) per tree (kg)		Yield efficiency (kg/cm2 TCA)		Cum. yield efficiency (2003-09) (kg/cm2 TCA)		Fruit weight (g)	
	Mass.	New Jersey	Mass.	New Jersey	Mass.	New Jersey	Mass.	New Jersey	Mass.	New Jersey
G. 16	9.6	40.4	68.6	143.9	0.32 c	0.66 b	4.10	3.27 b	243	199 b
M.9-337	20.0	40.1	60.1	153.5	1.07 a	0.73 b	4.62	3.88 b	252	257 a
B.9	11.9	26.3	49.0	125.4	0.79 b	0.90 a	5.01	5.63 a	248	234 a

2010 Massachusetts IPM Report

Dan Cooley, Arthur Tuttle, and Jon Clements

Department of Plant, Soil, & Insect Sciences, University of Massachusetts

This material was presented at the 72nd Annual Meeting of the New England - New York - Candian Fruit Pest Management Workshop (Northeast Tree-fruit IPM Working Group), October 19-20, 2010, Burlington, VT. Most observations were made at the UMass Cold Spring Orchard Research & Education Center in Belchertown, MA.

Winter was generally mild, low temperature of -3 degrees F. recorded on January 30.

Spring was early — peaches started bloom on April 7, sweet cherries on April 12, and McIntosh full bloom on April 26 (10-14 days ahead of average); scattered/isolated frost damage to mostly apples on 10,11-May with below-freezing temperatures (apples well past bloom but still susceptible to frost/freeze).

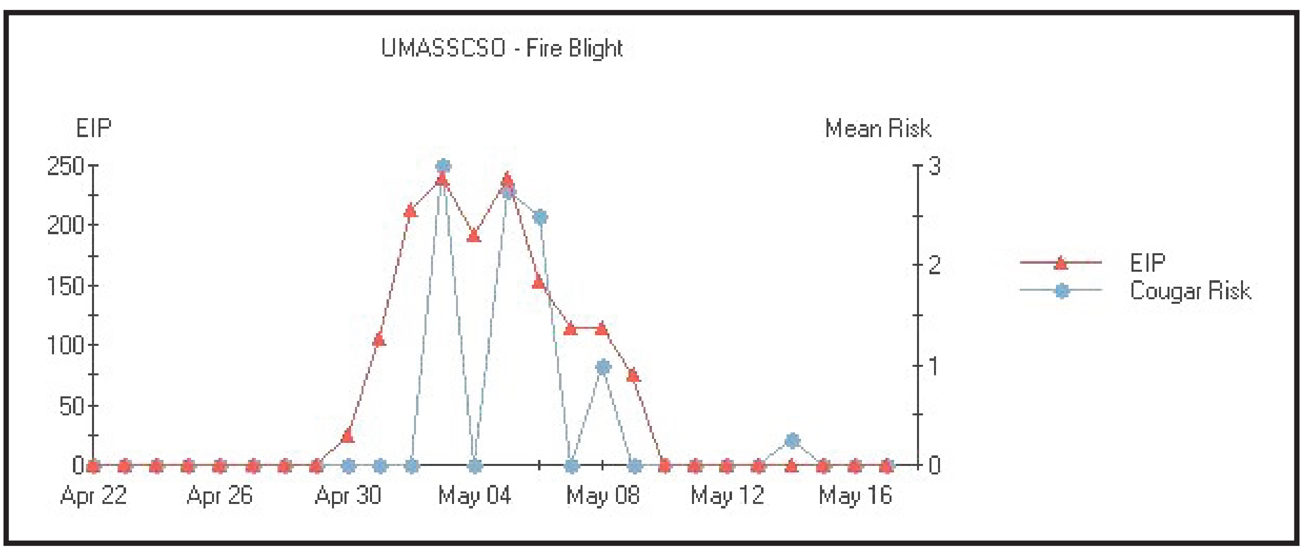
Summer was hot and dry (at end, depending on location) — high temperature 97.1 on July 6; sunburn was common but did not seem to manifest itself (badly) through harvest.

The **stone fruit** (cherry and peach) crop was generally exceptional, high sugars in peaches on account of all the sun and heat.

The **apple** harvest started up to two weeks early, McIntosh harvest averaged one week early, late apples were still early but not so much; pre-harvest drop of McIntosh was worse than in recent memory, particularly on stressed trees, however, ReTain worked very well on all but the most stressed trees. Overall a good, moderate apple crop with generally high quality, and great fall weather (little rain). Still a somewhat trying year on account of the weather (early bloom, frost, heat, lack of rain in some locations).

Five primary **apple scab** infection periods were recorded. Scab was generally very manageable this year.

A major, high risk period during late bloom (beginning approximately May 1, lasting for almost a week) for **fireblight** infection occurred; many growers applied streptomycin; those that did not experienced some fireblight strikes throughout the growing season, while some did not; overall, fireblight seemed to take



a break after a few years of relatively high infection rate(s) in some orchards.

Five on-site weather stations and 23 airport locations were added to Cornell's **NEWA** (Network for Environment and Weather Applications) in Massachusetts, providing fruit and vegetable growers with daily developmental models (including forecasts) to aid in decision-making for management of various insect and disease pests; in addition extension IPM funding will allow us to expand this network in 2011 and 2012 while providing a more team-based approach to IPM recommendations on diversified fruit & vegetable farms.

Insects were generally unremarkable and easily controlled; notable exceptions included a pretty good influx of plum curculio during late May when fruits were relatively large — unprotected fruit had considerable PC damage near borders; and, several reports of more San Jose scale damage than seen in a while, including sprayed orchards (although one that had not been oiled for several years) — could mild(er) winters and softer pesticide application programs result in more SJS problems in the future?

We completed the 1st year of a Northeast IPM regional study, "**Development of Advanced Integrated Pest Management for Northeastern Apples**" with 6 commercial orchards in New England and 5 in NY. Collaborating scientists are Art Agnello, Harvey Reissig, and Kerik Cox from Cornell/Geneva; Peter Jentsch from Cornell/Hudson Valley; and Tracy Leskey and Starker Wright from USDA/Kearneysville. Advanced IPM strategies for scab, plum curculio, summer diseases, leafrollers, internal lepidoptera, and apple maggot were tested successfully against conventional methods.

We participated in the 1st year of a PMAP study, "**National Effort to Implement Sustainable Management of Sooty Blotch and Flyspeck on Apples**" with two commercial orchards in MA and the UMass Cold Spring Orchard. This project is developing regional SBFS warning systems based on weather data collected at orchard sites and data collected remotely. Mark Gleason, Iowa State University, is the project director.

We participated in the 1st year of an SCRI (Specialty Crops Research Initiative) study, "**Manipulating Host- and Mate-finding Behavior of Plum Curculio: Development of a Multi-Life Stage Management Strategy for a Key Fruit Pest**." We performed "trap-tree" experiments for PC management at 5 orchards in New England. Tracy Leskey, USDA-ARS Kearneysville is the project director.

There were **32 research/data-collection/demonstration trials/plots** conducted at the UMass Cold Spring Orchard in 2010, including: using NAA with ReTain to improve drop control; NE-1020 Multi-state Evaluation of Winegrape Cultivars and Clones; NC-140 rootstock planting with Honeycrisp; assessing Alion/Rely (Bayer) herbicide performance; and fungicide efficacy including Luna (Bayer) and Inspire (Syngenta). Leads include Autio, Greene, Cooley, Clements, Schloemann.

A **Lipco over-the-row curtain/recycling (tunnel) sprayer** was purchased with Massachusetts state specialty crop block grant funding for use at the UMass Cold Spring Orchard to research its viability and potential to reduce pesticide-application rates.

Effective Use of Models in the Management of Sooty Blotch and Flyspeck

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Introduction

During the 2010 growing season, in the process of developing sooty blotch/flyspeck recommendations for apple growers, Extension advisors in Massachusetts found they were getting very different disease forecasts for the disease depending on which model they used. In an attempt to determine what was behind these discrepancies, we compared five different methods for recommending the first SBFS fungicide spray at CSOREC in 2010. The five methods were the 270 ALW threshold from the New England Tree Fruit Guide with data from a Hobo Data Logger (Onset Computer Corp., Pocassett, MA); a Spectrum Watchdog weather station with the SpecWare SBFS model; Orchard Radar; Skybit; and NEWA with data from the on-site Hobo station. The results are shown in Figure 1.

This graph shows the large differences between the various models in terms of when the first fungicide application for SBFS was recommended. The earliest recommendation was June 2 (NEWA, Hobo) and the latest July 17 (SpecWare, Watchdog), a total difference of five weeks. The SpecWare recommendation was much later than any other. If it was excluded, the range between the other four models was two weeks, with the SkyBit model being the latest on June 16.

Unfortunately, we did not have trees that were sprayed according to each model, so we do not know whether these differences would have translated to control failures or over-application of fungicide. Under normal conditions, the differences in time would result in one to three applications of fungicide over the range of dates. What lies behind these differences? More importantly, what differences in performance would be expected between them?

Fundamentally, all SBFS forecast models measure periods when environmental moisture is high. They almost always use leaf wetness although relative humidity has been determined to be most effective in the Midwest. SBFS models add-up the number of hours of leaf wetness from a point called the biofix, usually at or near petal fall (PF). When a critical number of leaf wetting hours is reached, a fungicide spray is recommended. This point is the treatment threshold. Most SBFS models stop at this point, though some continue to evaluate SBFS risk based on estimates of fungicide residue on apples governed by the amount of time or the amount of rain since the last spray. Underlying these models are four key ideas:

1. SBFS risk is very low until bloom;
2. Fungicides targeting apple scab will control SBFS through PF;
3. After primary scab it will take some time, depending on how much wet weather occurs, for SBFS inoculum to move into an orchard, colonize fruit, and develop the smudges and specks that are the signs of the disease;
4. Some fungicides can either eradicate SBFS fungi or stop their growth before signs develop.

Based on points 3 and 4, SBFS forecast models primarily try to take advantage of the period following the last apple scab fungicide to eliminate one or more cover fungicides, allowing SBFS to start to grow on apple fruit but stopping it before SBFS develops.

Because development of SBFS fungi cannot be observed directly, researchers have built SBFS models by keeping track of wetness data and observing when the first signs of SBFS appear. Data usually are taken over several years and at several sites, and then statistics are applied to determine which weather factor best

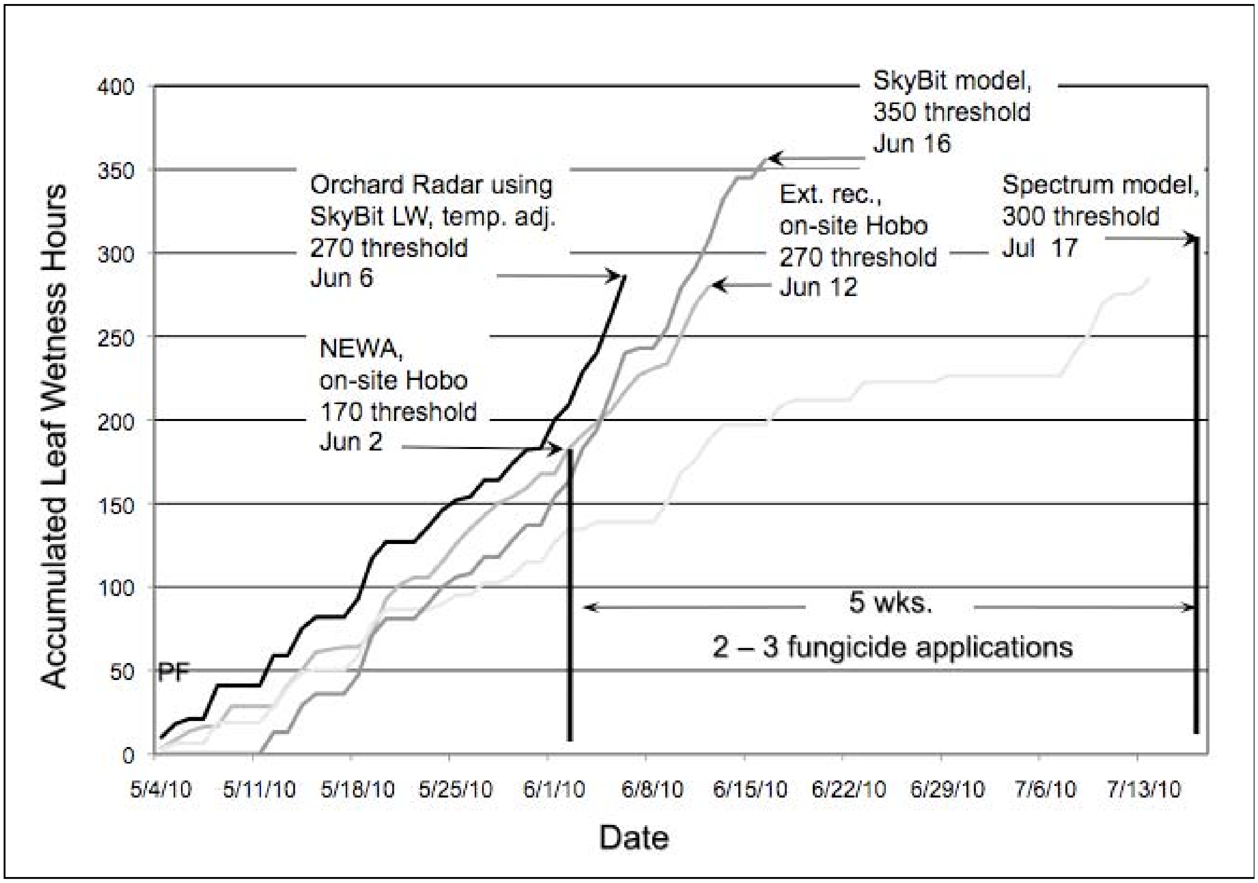

Figure 1. Graph of accumulated leaf wetness hours measured using different methods at the University of Massachusetts Cold Spring Orchard, Belchertown, MA vs. date, indicating the time recommended for the first fungicide application to manage sooty blotch and flyspeck for each method.

predicts first appearance of SBFS and when, on average, SBFS is first seen. Presumably, application of an appropriate fungicide before SBFS shows will prevent further disease development, so a treatment threshold is established shortly before first symptoms are predicted. In subsequent trials, fungicides are applied at the treatment threshold to make sure that the model works.

This type of model development does not depend on detailed knowledge of the microbiology of the disease, but on a statistical relationship between key environmental factors and the visible development of disease. Forecasting models developed this way are called empirical, and it's important that the type of data used to develop them is the same as the data used to run them in the field. Even then, trying to use an empirical model in a region that differs climatically or geographically from the place in which it was developed can result in poor disease management. In this article, we will look at the various SBFS models in use in terms of where and how they were developed, and attempt to clarify how they should be used in order to make SBFS management most effective. Key aspects of SBFS models are summarized and compared in Table 1.

Multiple Ways to Forecast SBFS

The first SBFS forecast model. Brown and Sutton developed the first SBFS model in North Carolina by taking weather data from 1987 to 1994 and comparing it to the first appearance of SBFS on fruit (4). The best predictor of when SBFS would show was leaf wetness duration (LWD) measured from 10 days after PF. They found that the best prediction came when they only counted those wetting periods that were 4 hours or longer. They added the number of leaf wetness hours for each day to give a single number, accumulated leaf wetness hours (ALWH). Over the 7 years of their tests, starting at a biofix of 10 days after PF, SBFS first appeared between 209 and 310 ALWH. The average threshold for first appearance was 273 ALWH. Based on this they recommended applying a benzimidazole fungicide, such as Benlate or Topsin M, at a treatment threshold of 200 to 225 ALWH to eradicate SBFS.

To get accurate results with this empirical model, it is important that ALWH be measured just as the model developers measured them. The NC researchers placed the device that measured leaf wetness inside the dripline of an apple tree, 1.5 meters (4½ ft.) above the ground. They used an instrument called a deWit monitor to measure leaf wetness. The deWit uses a string to move a pen on chart paper. A dry string is relatively taught holding the pen at one edge of the chart while a thoroughly soaked string is loose allowing the pen to move to the other edge of the chart. There is considerable distance between the edges of the chart, and it is not always clear whether the string is dry or wet, so deciding whether a leaf is wet or dry based on a deWit monitor is a judgment call. Brown and Sutton said movement across 50% of the chart or more indicated leaf wetness, but also said "… the threshold that we have established with the deWit sensor may have to be modified if other sensors are used" and noted

Table 1. List of major sooty blotch and flyspeck models describing the type of action being recommended, the biofix, the weather parameter used in calculating the threshold, the point at which first symptoms appear, and the treatment threshold.

Model	Biofix	ALWH accumulation	First symptoms	Treatment threshold	Recommended action
Brown/Sutton	10 days after PF[z]	LW[y] = 4 hrs.	273 hrs.	200 – 225 hrs.	1st benzimidazole fungicide
Brown/Sutton/ Hartman	10 days after PF[z]	All LW hrs.	218 hrs.[x]	175 hrs.	1st fungicide
Gleason/ Duttweiler	Date of last scab fungicide	RH[w] periods = 97% hrs. and = 4hrs.	192 hrs.	192 hrs.	1st fungicide
Rosenberger	PF	All LW hrs.[v]	540 hrs.	270 hrs.[v]	1st fungicide & follow-up[v]
Orchard Radar	PF	All LW hrs., temp. adj.	270 hrs.[u]	270 hrs.[u]	1st fungicide & follow-up
NEWA	PF	All LW hrs.	200 hrs.	175 hrs.[t]	1st fungicide & follow-up
Skybit	PF	All LW hrs.[s]	?	350 hrs.	1st fungicide
SpecWare	PF	LW = 3 hrs.	?	250 hrs. / 300 hrs.[r]	1st fungicide

[z]Petal fall.
[y]Leaf wetness.
[x]An average of the reported range, 185 to 251 hrs.
[w]Relative humidity
[v]As measured with a deWit monitor. Assumes application of at least one post-petal fall fungicide targeting scab.
[u]Temperature adjusted hrs.
[t]Measured electronically – interpolated from original deWit measurements.
[s]Leaf wetness is estimated from relative humidity, wind speed and other data.
[r]250 hrs. for "southern" orchards and 300 hrs. for "northern" orchards.

that a test of the model in Kentucky using an electronic sensor found a lower threshold. The type of wetness sensor and its location makes a great deal of difference in leaf wetness measurements, and using an electronic sensor to run a forecast model with thresholds based on a mechanical sensor like the deWit can be problematic. In other words, the researchers cautioned that if ALWH were measured with something other than a deWit monitor, the treatment threshold probably would change.

Revising the NC model. John Hartman in Kentucky tested the Brown/Sutton model, taking data with an electronic wetness sensor rather than a deWit. Realizing that the treatment threshold should be checked, he developed a method to protect fruit from SBFS fungi without using fungicides, using small paper bags. At regular time intervals of approximately one week, he bagged randomly selected fruit on trees in orchards. He found that fruit bagged during the weeks soon after petal fall did not develop SBFS, but fruit bagged later did. Specifically, SBFS first appeared from 185 to 251 ALWH depending on the site and year. Fruit bagged before 175 hrs. ALWH did not develop SBFS. Based on this, Hartman recommended a 175 ALWH treatment threshold. He also counted all wetting periods, not just those that exceeded 4 hours.

While the basic idea was the same as that developed in NC, Hartman used different equipment to measure wetting and a different method to determine when infections occurred and when symptoms would first appear from those infections - the paper bags. It is not surprising that this resulted in a large difference between the two treatment thresholds. Using the revised model, Hartman effectively controlled SBFS in the Kentucky trials, saving from two to four fungicide applications relative to calendar-based cover sprays (11, 20, 21).

This Hartman adaptation of the Brown/Sutton model was tested in three states in the upper Midwest in 2001-02 in both university trials and in commercial blocks (1, 9). In addition to testing the relative efficacy and application efficiency of the forecast model vs. conventional cover sprays, the study compared on-site weather measurement to off-site web-based measurements using SkyBit (ZedX, Inc., Bellefonte, PA). While the study generally reduced the number of fungicide applications by about 2, the model-managed plots often had significantly higher levels of SBFS. The study also indicated that the SkyBit measurements overestimated leaf wetness relative to electronic sensors placed in apple canopies.

As pointed out above, a forecast model developed in one region may perform poorly in another region, particularly if there are significant climatic differences. This may be what lies behind the inconsistent performance of the Hartman/Brown/Sutton model developed in the Southeast when it was applied to the upper Midwest. Duttweiler and colleagues (2, 7) suggested that during the growing season, the Midwest is significantly drier than the Southeast. While rain events provide the bulk of the leaf wetting periods measured in the Southeast, high humidity and dew provide most of the ALWH recorded in the Midwest. After examining other possible weather variables, the Iowa researchers found that accumulated periods of relative humidity greater than 97% provided better forecasts than LWD in the Midwest, though LWD performed better than humidity in the Southeast.

Adaptation of the NC model to the Northeast. In the Northeast, Rosenberger has developed an SBFS forecast model that is based on the fundamentals of the NC model and incorporates his extensive research on timing SBFS fungicide applications (19). His model is based on the idea that flyspeck is more difficult to control than sooty blotch and if flyspeck is controlled, sooty blotch is also controlled. The fungus that causes flyspeck in the Northeast, *Schizothyrium pomi*, produces primary inoculum starting around pink and continuing through to 3 or 4 weeks after petal fall when fruit are between 2 and 4 cm diam. (5). SBFS inoculum develops on reservoir hosts adjacent to orchards and is blown into apple trees. During the time that primary flyspeck inoculum is produced, apples are protected by fungicides applied to manage apple scab, so the primary infections pose no risk of SBFS to fruit. However the fungus can infect the waxy cuticles of the trees and shrubs adjacent to orchards, eventually growing to produce secondary inoculum, conidia. Based on the NC model, Rosenberger estimates that it takes approximately 270 ALWH from PF for inoculum in orchard borders to develop to the point that it is able to infect fruit. (The PF biofix and 270 ALWH are simplifications of the ALWH and biofix used in the NC model.)

After the intial 270 ALWH, Rosenberger estimates it takes an additional 270 ALWH for inoculum that lands on fruit to develop into ‘specks’. So, in his model, if fruit is unprotected by fungicide after scab applications have stopped, it will take a total of 540 ALWH for SBFS signs to develop. At any time after the first 270 ALWH, the process can be stopped by a fungicide application, but after the fungicide from an application is depleted (by tissue growth, oxidative and photochemical breakdown, and/or rainfall), SBFS fungi will start to develop again. Once fruit have been unprotected for a total of 540 ALWH, SBFS appears. This means a grower needs to know how long each fungicide is effective. Different fungicides have different effective periods, which Rosenberger has categorized in three groups based on time or rainfall from the last application: 1) 21 days or 2.5 in. rainfall; 2) 21 days or 2.0 in. rainfall; 3) 14 days or 1.5 in. rainfall.

Rosenberger’s model recommends the timings for both a first fungicide and for later fungicides. His specific recommendation is to apply the first fungicide at 270 ALWH from PF and to then allow no more than an additional 270 ALWH when fruit are unprotected by fungicide after that. Recently, Rosenberger has suggested that if electronic sensors are used, it may be more appropriate to use shorter thresholds of 175 ALWH before the first fungicide application followed by a 175 ALWH of unprotected fruit. The incorporation of efficacy periods into an SBFS model is unique among the SBFS models.

Based on these research studies, two Extension recommendations have been developed, and a third will probably be introduced next year. In the Midwest and Southeast, the Hartman/Brown/Sutton model is recommended, and in the Midwest this will probably change to the Gleason/Duttweiller adaptation based on relative humidity. In New York and New England, the Rosenberger model is generally recommended.

Adaptation of SBFS models in computerized delivery systems. Versions of the models described above have been adapted to computerized forecasting systems, merging automated weather data collection with model forecasts and recommendations. In the Northeast, Orchard Radar (http://pronewengland.org/allmodels/RadarIntro.htm) and the Network for Environment and Weather Applications (NEWA; http://newa.cornell.edu/) are web-based IPM advisory systems developed by the University of Maine and Cornell, respectively that incorporate SBFS advisory models. SkyBit is a web-based agricultural weather and advisory system developed by ZwdX, Inc. (Bellefonte, PA) that has an SBFS component. Commercial weather stations are often bundled with pest forecasting software. One example is the Watchdog (Spectrum Technologies, Plainfield, IL) which can be used with their SpecWare software, which includes a SBFS model.

Orchard Radar. Glen Koehler has developed Orchard Radar as a web-based pest management system for New England. For the most part it follows the Rosenberger model, except that LW data is adjusted for temperature based on *in vitro* growth data for the flyspeck fungus *Zygophiala jamaicensis* (17). Weather data is supplied by SkyBit and, for predictions, 30 year averages of historical weather data are used. Given application of a particular SBFS fungicide on a given date, Orchard Radar gives growers information on when the protection from that application ends (Protection End Date) and an estimate of when SBFS signs will first appear if no further applications are made. These estimates include a worse-case prediction for large, unpruned trees for a relatively wet year, and average prediction, and a prediction for low-risk sites (small, well-pruned trees, good air movement, significant distance from SBFS reservoir plants in orchard borders, etc.). Sample output for Orchard Radar is shown in Figure 2.

NEWA. The NEWA Sooty Blotch & Flyspeck Risk Prediction module also relies primarily on a simplified Rosenberger model, except that it uses threshold values of 170 ALWH rather than 270, to account for the fact that the data used by NEWA is largely from privately-owned weather stations on grower sites with electronic LW sensors. NEWA partners with the Northeast Regional Climate Center (Cornell Univ.) and through them uses data from airports and other public weather stations. However, LW is not available from these sites, so in the present version of the site SBFS risks are not given for those sites. For sites with LW monitoring, NEWA tracks LW from PF and asks growers to input the date of the most recent fungicide application. It then uses time and rainfall to estimate fungicide depletion (at present NEWA does not distinguish between fungicides in terms of depletion rates) and assigns three levels of risk (low, moderate, high) based on AWH from PF and fungicide depletion. The rules used in 2010 and sample output from the NEWA SBFS

Flyspeck prevention, Group A fungicides (strobilurins and Topsin M): August-September spray dates

Background Information for this page
Return to radar list for Belchertown MA

Weather data for Belchertown MA. Forecast values begin August 3, 2010

Continuous protection from June 6 until 30 days before harvest is recommended. Risk of new flyspeck infections increases around July 11, and increases again around August 10.

Flyspeck infections that begin before August 19 are likely to become visible around September 20. Infections that begin before September 2 are likely to become visible around October 20. But warm wet weather in September can accelerate flyspeck development resulting in earlier dates of flyspeck appearance before harvest.

Postinfection control of flyspeck may occur with application a strobilurin or Topsin M fungicide within 50 wet hours after the 'Protection end date' of the previous fungicide application.

Weather data for Belchertown MA. Forecast values begin August 3, 2010

Inches Rain	Spray Date - assumes that fungicide was applied before any rain fell on spray date	Protection End Date for full-dose Pristine, Flint, Sovran, or Topsin M (deadline for postinfection strobilurin or Topsin M)	Date flyspeck infections that started after end of protection could appear (Left side = rough estimate of flyspeck show date for dense canopy trees if weather beyond forecast range is in top 20% of years for both temperature and wet hours. x = show date is within forecast range. Right side = rough estimate of flyspeck show date for small, open canopy, low-risk trees.)		
0	Sun, August 1	Aug 22 (August 27)	(Sep 13)	September 25	(> Oct. 31)
0	Mon, August 2	Aug 23 (August 28)	(Sep 14)	September 27	
0	Tue, August 3	Aug 24 (August 29)	(Sep 15)	September 29	
0	Wed, August 4	Aug 24 (August 29)	(Sep 15)	September 29	
0	Thu, August 5	Aug 24 (August 29)	(Sep 15)	September 29	
0.10	Fri, August 6	Aug 24 (August 29)	(Sep 15)	September 29	

Figure 2. Computer screen output of information from the Orchard Radar Flyspeck module, taken on Aug. 2, 2010, showing the end of protection and subsequent first appearance of SBFS signs for six dates, based on SkyBit weather data for the Univ. of Mass. Cold Spring Orchard, Belchertown, MA. (More dates could be accessed on the actual screen.)

model shown in Figure 3.

SkyBit. SkyBit estimates weather variables for a specific site within a 1 km. square based on publically available weather data from many sites, and using proprietary algorithms. Growers supply SkyBit with the precise latitude, longitude and elevation of their site, and for a subscription fee receive estimates of what has happened, predictions of what will happen, and risk evaluations for various pests based on models. The SkyBit model uses the Brown/Sutton/Hartman model. However, based on extensive comparisons, SkyBit has determined that their estimated leaf wetness hours are generally higher than those that would be obtained from field measurements by a constant proportion, and therefore 350 AWH, rather than 270 AWH, is an appropriate threshold for the SBFS using SkyBit data. A sample of information received via email from SkyBit is shown in Figure 4.

Spectrum Watchdog and SpecWare. The WatchDog weather station is offered with a bundle of pest forecasting software, SpecWare. The documentation for the SBFS model in the SpecWare package infers that there are two models, one for sooty blotch and one for flyspeck, and says that “both models require air temperature and leaf wetness data” though none of the published models uses air temperature. The Spectrum model starts accumulating leaf wetness at PF, and has two infection thresholds, one for “Southern States” at 250 AWH and one for “Northern States” at 300 AWH. After that, any 3 hr. wetting period is enough for an infection. Apparently the Spectrum model is based on 1996 recommendations made by Jones and Sutton (13), though they start accumulation at 10 days after PF, and stress that the model is only meant to recommend timing for the first SBFS fungicide. Further, the 300 AWH is probably based on Jones’ interpretations of work done by Rosenberger at the time that suggested an effective interval of 300 hrs could be used with benzimidazole fungicides (18). The leaf wetness sensor for the Spectrum WatchDog has a range

2					
3		Accumulated Leaf Wetness Hours			
4	Days/Rain Since Petal Fall or Fungicide App	<100	100-129	130-170	>170
5	< 10 days, <= 1.5" rain	No Risk	Low	Low	Low
6	< 10 days, 1.51" - 2.0" rain	No Risk	low	Moderate	Moderate
7	< 10 days, >= 2.01" rain	No Risk	Low	Moderate	High
8					
9	10-13 days, <= 1.5" rain	Low	Low	Low	Low
10	10-13 days, 1.51" - 2.0" rain	Low	Low	Moderate	Moderate
11	10-13 days, >= 2.01" rain	Low	Low	Moderate	High
12					
13	14-20 days, <= 1.5" rain	Low	Low	Moderate	Moderate
14	14-20 days, 1.51" - 2.0" rain	Low	Low	Moderate	Moderate
15	14-20 days, >= 2.01" rain	Low	Low	Moderate	High
16					
17	>=21 days, <= 1.5" rain	Low	Moderate	Moderate	High
18	>=21 days, 1.51" - 2.0" rain	Low	Moderate	Moderate	High
19	>=21 days, >= 2.01" rain	Low	Moderate	Moderate	High
20					

Sooty Blotch and Flyspeck Risk Predictions for Deerfield

Petal fall date for McIntosh: 5/3/2010

Petal fall date above is estimated based on degree day accumulations or user input.
Enter the actual date for blocks of interest and the model will calculate the accumulated leaf wetness hours since petal fall more accurately.

Most recent fungicide application date: 7/20/2010

If petal fall has passed, enter the date of your most recent fungicide application.
If no fungicide applications have been made, do not enter a date.

In the Risk Summary table, note the accumulated leaf wetness hours since petal fall (Leaf Wetness Hours) and the Risk Level. Leaf wetness hours, rain events, and the last fungicide application date are taken into consideration in assessing risk level. To estimate risk in the near future, look at the probability of rain.

Consult the Risk Level IPM Guidelines below the **Risk Summary** table.

Sooty Blotch and Flyspeck Risk Summary - Northeastern US Model

	Past	Past	Current	5-Day Forecast		Forecast Details		
Date	Aug 1	Aug 2	Aug 3	Aug 4	Aug 5	Aug 6	Aug 7	Aug 8
Days since petal fall	90	91	92	-	-	-	-	-
Accumulated Leaf Wetness Hours - ALWH	784	786	790	-	-	-	-	-
Risk Level	Low	Low	Moderate	-	-	-	-	-
Rain Events and Fungicide Depletion Estimate								
Days since last fungicide application	12	13	14	-	-	-	-	-
Rain since last fungicide application	0.99	0.99	0.99	NA	NA	NA	NA	NA
Daily rain amount (inches)	0.00	0.00	0.00	-	-	-	-	-
Rain probability (%)			-|-	-|-	-|-	-|-	-|-	-|-

Back to Deerfield, MA Weather Station Page

Figure 3. Rules for evaluating sooty blotch and flyspeck risk in the NEWA system (2010) with sample output from Deerfield, MA for Aug. 3, 2010 based on a weather station at Clarkdale Orchards.

of 0 to 15, and the threshold for determining wet vs. dry can be set by the user; Spectrum recommends using 3 (20% of the range), though at the UMass CSOREC we have used 6 (40% of the range) which is similar to settings that we use with other electronic leaf wetness equipment. Output for the SBFS model and Spectrum weather station at the UMass CSOREC are shown in Figure 5.

E-WEATHER SERVICE — AGWEATHER IPM APPLE DISEASE PRODUCT

For: MA-BELCHERTOWN-HORTRESCENTER — Date: SUN Jun 20, 2010

	WEATHER					APPLE SCAB 100329				FIRE BLIGHT 100422				SOOTY BLOTCH 100502	
Date	TMX F	TMN F	PREC in	ARH %	LW hr	ASM %	AW hr	TW F	PW	ADH 65F	AW hr	TW F	PW	ALW hr	PW
BASED ON OBSERVATIONS															
0601	76	61	0.51	85	17	100	12	71	++	225	12	71	++	154	+
0602	81	59	0.00	69	9	100	21	68	++	225	21	68	++	163	+
0603	78	63	0.23	81	20	100	11	73	++	225	11	73	++	183	+
0604	82	63	0.24	72	11	100	21	70	++	225	21	70	++	194	+
0605	82	67	0.42	77	22	100	11	76	++	225	11	76	++	216	+
0606	75	57	0.54	81	24	100	35	70	++	225	35	70	++	240	+
0607	70	52	0.00	55	3	100	38	69	++	225	38	69	++	243	+
0608	68	49	0.00	57	0	100	0	-	+	225	0	-	-	243	+
0609	64	45	0.39	76	12	100	12	58	++	225	3	62	++	255	+
0610	63	54	0.54	90	24	100	36	58	++	225	36	58	+	279	+
0611	69	55	0.00	79	12	100	48	58	++	225	48	58	+	291	+
0612	64	58	1.01	90	17	100	14	63	++	225	14	63	++	308	+
0613	65	60	0.12	91	24	100	38	63	++	225	38	63	++	332	+
0614	74	60	0.00	81	13	100	51	63	++	225	51	63	++	345	+
0615	76	54	0.00	62	0	100	0	-	+	225	0	-	-	345	+
0616	70	51	0.15	72	11	100	11	67	++	225	11	67	++	356	++
0617	69	57	0.06	81	10	100	21	65	++	225	21	65	++	366	++
0618	84	54	0.00	63	5	100	5	58	+	225	5	58	+	371	++
0619	82	57	0.00	66	0	100	0	-	+	225	0	-	-	371	++
BASED ON FORECASTS															
0620	82	65	0.00	75	5	100	5	68	+	225	5	68	++	376	++
0621	83	62	0.00	62	0	100	0	-	+	225	0	-	-	376	++
0622	74	60	----	69	0	100	0	-	+	225	0	-	-	376	++
0623	79	61	----	84	24	100	24	71	++	225	24	71	++	400	++

Figure 4. Sample information from SkyBit for the Univ. of Mass Cold Spring Orchard, Belchertown, MA from the June 20, 2010 email, showing both past and predicted weather on the far right (TMX = maximum temp. ºF; TMN = minimum temp. º F; PREC = precipitation in inches; ARH = avg. relative humidity in percent; LW = leaf wetness hours for each day), and three disease models, one each for apple scab, fire blight and sooty blotch/flyspeck. The SBFS model is shown in the two columns on the far left (ALW = accumulated leaf wetness hours from PF; PW = pest warning), where + indicates the disease is active but infection has not occurred, and ++ indicates infection can occur on unprotected fruit. Note the change from + to ++ on June 16.

Written recommendations. Many fruit growers track weather data, but do not have a computerized models to process it and make recommendations for SBFS treatment. They can, however, use written recommendations such as *The New England Tree Fruit Management Guide*. It states "The real risk of flyspeck infection … occurs after approximately 270 hours of accumulated wetting (rains and dew periods) counting from petal fall" and "After spores land on unprotected fruit, 270 hr of accumulated wetting are required before flyspeck will become evident on fruit." In other words, it outlines the risk of infection according to the Rosenberger model. However, this guide does not include the fungicide depletion tables that Rosenberger developed.

The Special Problem of Measuring Leaf Wetness

In the descriptions above, it is obvious that

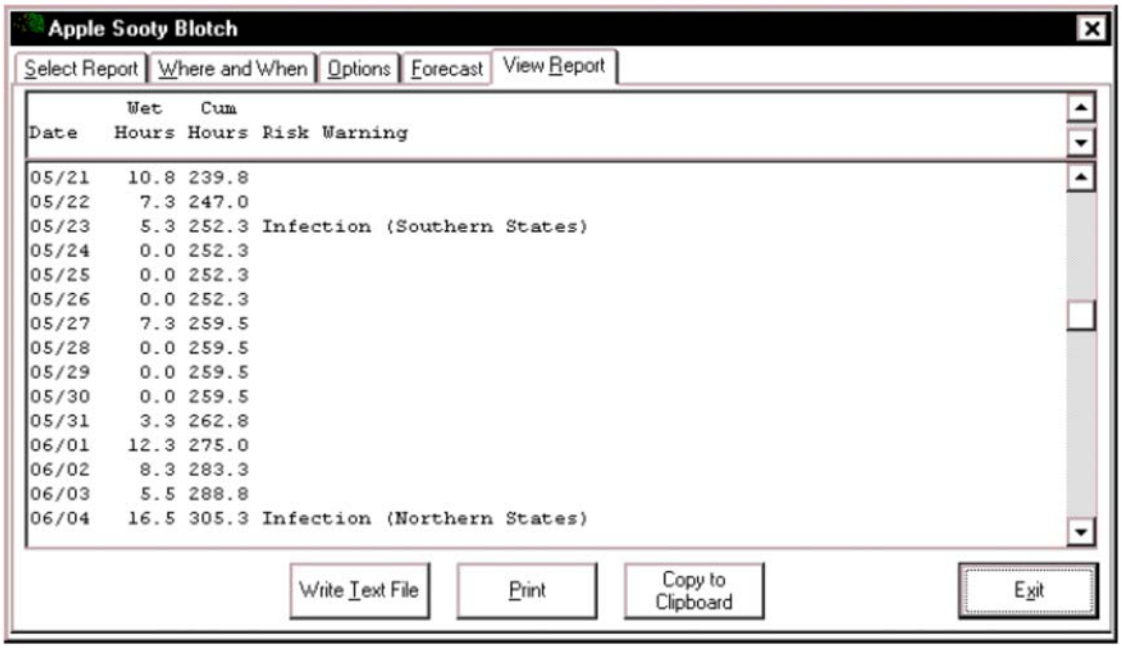

Figure 5. Output from the Spectrum Watchdog weather station at the Univ. of Mass. Cold Spring Orchard, Belchertown, MA in 2010, showing the predictions for potential infection for sooty blotch and flyspeck. Note infections can first occur in MA on June 4.

measurement of leaf wetness can be highly variable, depending on what sort of instrument is used, if any, and how sensors are placed. Again, data from Cold Spring Orchard illustrates the point. Figure 6 shows ALWH at the orchard based on five different sources: an Onset Hobo weather station with the leaf wetness threshold set to 40%; the same weather station with the leaf wetness threshold set at 100%; a Spectrum weather station with the threshold at 40%; Skybit; and an estimate based on airport weather data using a fuzzy logic algorithm (14). By June 12, the largest estimate of ALWH is over two and a half times greater than the smallest estimate.

While the differences are very large, the actual relationship between the different measurements is relatively constant. That means any of the estimates is acceptable **as long as it is used with an appropriate model and threshold.** For example, a user should not use SkyBit weather data to with a threshold developed using a string leaf wetness sensor.

The most common recommendation is to take measurements in the canopy of a typical tree in an orchard. Generally little attention has been paid to standardizing how high a LW sensor is placed above the ground, or which direction it should face, or if it should be placed at a specific angle. Recently, consensus has built around facing sensors north at a 45º angle relative to level (10). However, placing sensors in tree canopies can lead to practical problems because pesticides and other chemicals sprayed in an orchard can corrode the electronics in leaf wetness sensors. To avoid damaging sensors and ease access to the instruments, it would be useful to place sensors near but not in the orchard. To standardize the data, both researchers and growers should consider rules for placing sensors. For example, in addition to the rules for sensor angle and direction, these might include placement over mowed grass, at least 10 meters from any building or other physical features that could inhibit air circulation or effect microclimate.

Little emphasis has been placed on establishing what percent of an electronic sensor's response signifies "wet." If, for example, a company developed an SBFS model using sensors set to use 50% of the maximum to indicate a wet leaf surface, and a grower then uses the equipment and model with a setting of

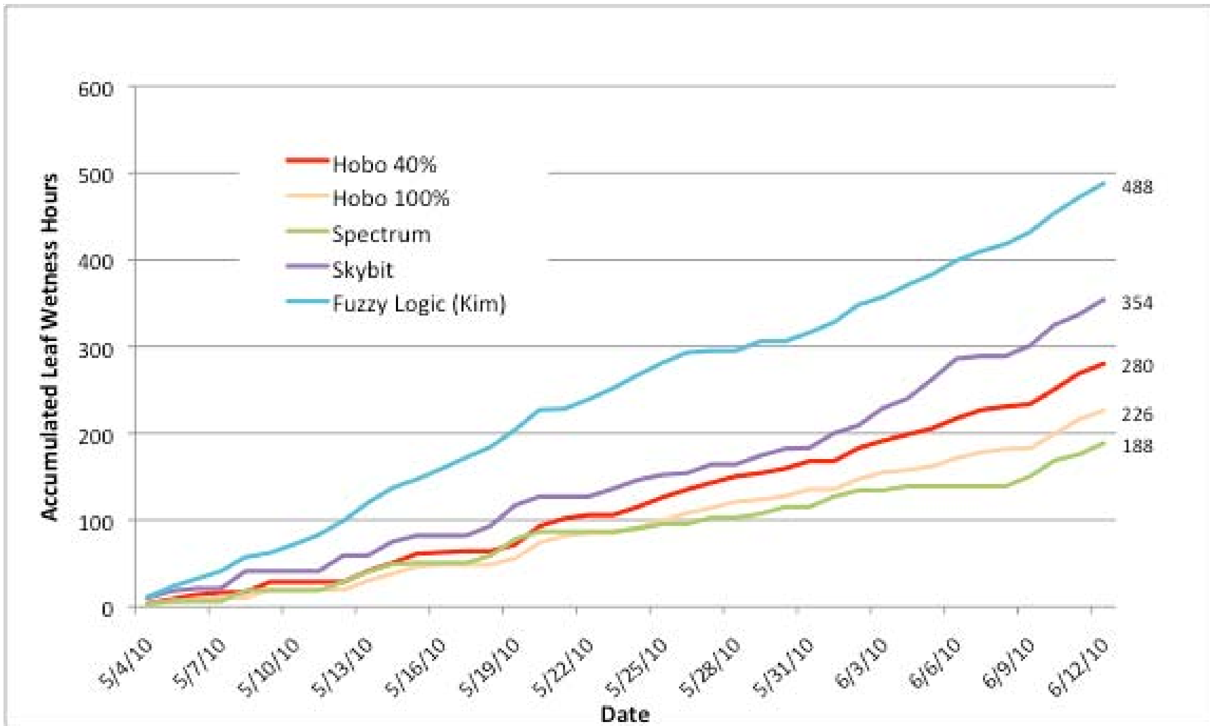

Figure 6. Accumulated leaf wetness hours at the Cold Spring Research and Education Center, Belchertown MA in 2010, measured using five different methods, with values on June 12 shown at the right of the graph.

10%, the grower will apply sprays sooner than necessary.

Even with such standardization in placing and calibrating equipment, there is a great deal of variability from sensor to sensor (16). Leaf wetness measurement is so variable that several researchers have recommended using off-site agricultural meteorological systems, such as SkyBit, rather than depending on on-site measurements (10, 16). One major issue is that publically available weather information of the type that is used in these systems do not supply LW data, so LW must be calculated based on the available data such as temperature, relative humidity and wind speed (14). Ultimately whatever LW measurement method is used needs to be evaluated within disease models. To take one measurement method and apply it to a model developed with a different method will lead to errors. For example, Babadoost et al. (1) applied the Brown/Sutton/Hartman model and compared on-site weather stations to SkyBit data (not the SkyBit model). Because SkyBit accumulates LW faster than on-site equipment, using SkyBit data with the 170 ALWH threshold meant fungicides were applied much sooner on SkyBit blocks compared with blocks timed by on-site equipment. While SkyBit has suggested that their 350 ALWH is equivalent to 270 ALWH measured by a deWit monitor or 175 ALWH measured by an electronic instrument, to our knowledge the 350 ALW threshold has not be tested in field trials to determine its performance within an appropriate model.

It would greatly help the accuracy of SBFS models (and all weather-based disease forecasting models) if LW measurement were better standardized, both at the time of model development and when it is used by growers. Researchers have pointed out that there no single "best" method to acquire weather data for use in disease-warning systems (10), but growers, consultants and researchers should make a concerted attempt to insure that data is being applied appropriately.

Summary and Conclusions

The biology and epidemiology of SBFS is not well understood and existing SBFS forecast models are largely empirical. The values of parameters in the models and recommendations they give users differ significantly. With this level of variability, it is useful to ask the fundamental question, what do users expect from a forecast model?

For SBFS the short answer is specific guidance in timing fungicide applications. Most SBFS models recommend a break in early cover sprays followed by the first SBFS spray. The length of the break is determined by some type of moisture measurement, usually accumulated leaf wetness hours. Most models then stop and growers use calendar-based covers. Other models continue, estimating fungicide depletion after each spray for different types of fungicides based on rainfall and elapsed time.

As shown above, growers in the Northeast can get widely divergent recommendations about timing the first SBFS fungicide application. There are three basic sources for this variability:

- The source of weather data, in particular leaf wetness.
- The biofix chosen to start a model.
- The method and amounts of accumulated wet hours used in determining a treatment threshold.

The variability of ALWH between different measurement techniques can be large, as shown above. This does not mean that any one method of measuring leaf wetness is better than another, but that researchers, consultants and growers must use the appropriate measurement method and threshold for a given model. Thresholds and measurement methods are not interchangeable.

The different biofixes in SBFS models, petal fall, 10 days after PF, and the last primary scab fungicide, are somewhat arbitrary, and not necessarily closely related to the epidemiology of the disease complex. Apple phenology is largely temperature driven, and if the development of SBFS fungi is also temperature driven, then apple phenology may provide a convenient and accurate biofix, but PF may not be the best growth stage to use. Work in MA on the flyspeck fungus *Schizothyrium pomi* showed that inoculum development is highly correlated with temperature starting with a green tip ('McIntosh') biofix. *S. pomi* ascospores start to develop near pink bud or bloom at 540 degree days (base 32ºF) and ends approximately 3 to 4 weeks after PF at 1,625 degree days (5). Hence, primary inoculum for flyspeck is available well before PF and continues to be available well after PF. In estimating the availability of FS inoculum, PF is not particularly relevant, while a biofix of green tip coupled with temperature data is.

To develop better SBFS models, it would be useful to know when inoculum is mature and able to infect fruit, the environmental conditions that lead to fruit infection, e.g. wetting, high humidity and/or temperature, and the amount of time related temperature, wetness and/or humidity that it takes for infections to develop into signs on fruit. This will probably mean developing separate models for inoculum development and for symptom development, just as there are separate models for these process for apple scab (8, 15, 22, 23). While some models, notably Rosenberger's (19), suggest that ALWH at one point are related to inoculum development, and at another related to symptom development, the understanding of SBFS inoculum development and symptom development on fruit has not yet been closely studied. A clearer understanding of these aspects of SBFS epidemiology would undoubtedly improve forecast accuracy

Evidence to date suggests that inoculum is developing on reservoir hosts before fruit form, but that it does not move into orchards and infect until several days to several weeks after fruit set. In MA, while primary FS inoculum develops before bloom, conidia are not detected in orchards until 3 to 4 weeks after primary inoculum has been released (5). In NC, sooty blotch infections were initiated 10 to 21 days after PF (3). In KY fruit left unprotected by bags during the 175 ALWH starting 10 days after PF did not develop SBFS, but after that fruit without bags were infected. This research suggests that there is a period following fruit set when SBFS fungi grow on reservoir hosts but do not spread into orchards. By trapping spores of SBFS fungi at orchard borders, identifying them with appropriate PCR methods, it would be possible to relate inoculum development to temperature and/or moisture measurements.

Movement of SBFS inoculum into orchards does not necessarily mean that spores will successfully establish themselves on fruit. The specific conditions that enable SBFS fungi to colonize apple fruit remain largely unexplored. It is not clear that fruit need to be wet, or if they do, for how long. It may be that high humidity is sufficient to promote spore germination and growth. Again, temperature may also play a role.

No one really knows how long this period of invisible, or cryptic, growth is, because visible signs in the field may not appear until several weeks after SBFS fungi have landed on fruit and started to grow. Rosenberger has seen that newly infected apples harvested and stored at controlled levels of high humidity (essentially 100%) and at normal ambient temperatures (60º to 80º F) take at least 10 days to show SBFS (Rosenberger, unpublished). In the field, where humidity and temperatures fluctuate outside these optimal ranges for SBFS growth, it generally takes much longer for SBFS to show on fruit, though it is undoubtedly present. Some studies have shown the optimal conditions for growth under controlled laboratory conditions (12, 17), but these need to be related to actual infection and growth on apple fruit. In order to get a better estimate of the time it takes for symptoms to develop following infection, it would be useful to do bagging studies in orchards and controlled environment studies in the lab.

Unfortunately, the SBFS complex is very large, and species composition varies from region to region (6). Probably the development of different fungal species varies, meaning that developing a single set of inoculum development, infection and symptom development models for the entire complex may be problematic. However, in terms of practical management, it may be possible to time fungicide applications with a single set of models and achieve efficient SBFS control.

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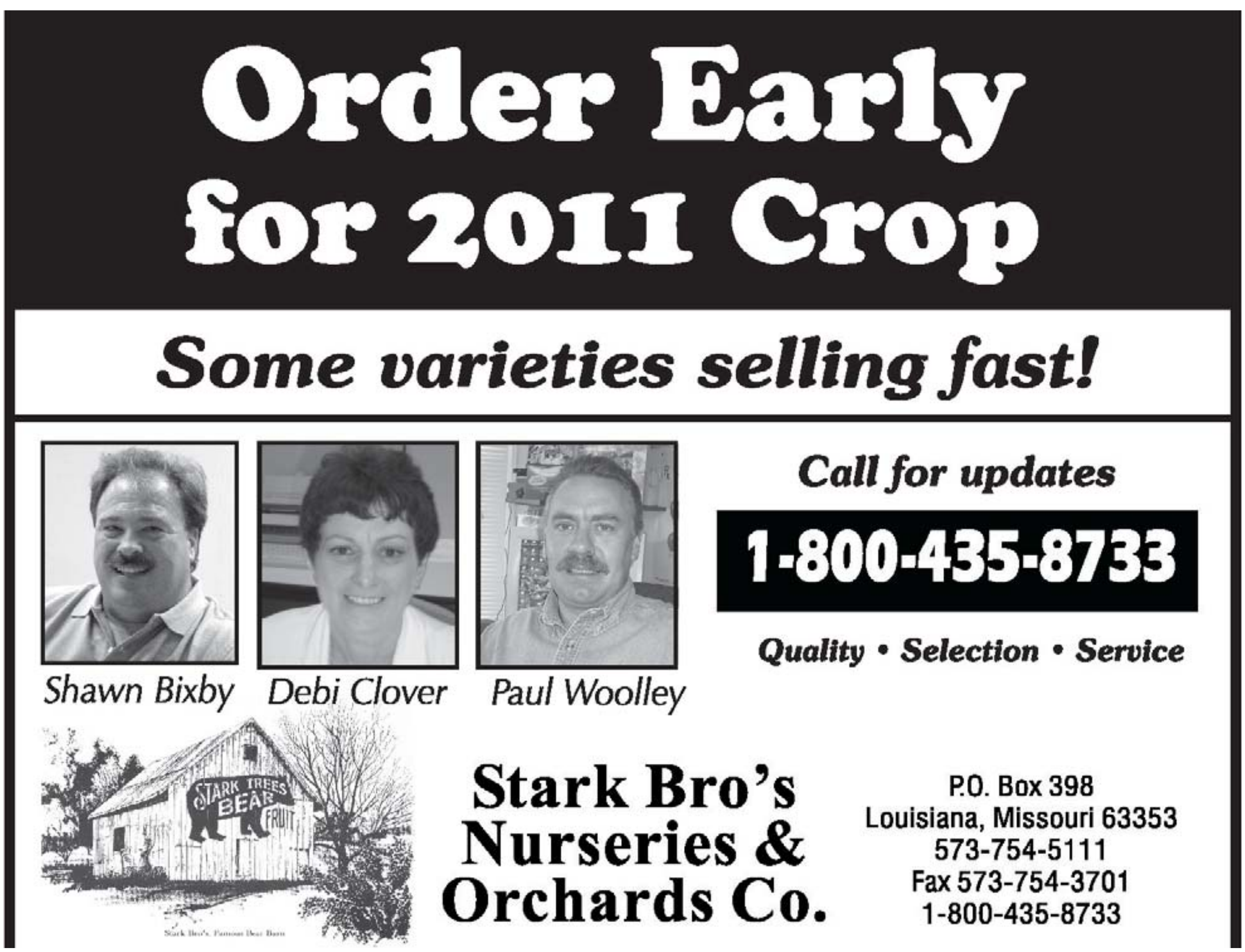


New Jersey News

Ed and Marsha Gaventa of Logan Township, Gloucester County Honored by Gloucester County Board of Agriculture

Ed and Marsha Gaventa of Logan Township were recently presented with the Distinguished Service to Agriculture Award for their leadership and service to their community and agriculture in Gloucester County and New Jersey. The award and special commendations from the Gloucester County Board of Freeholders and the Legislature of the State of New Jersey were presented in late October with friends, fellow agribusiness people, guests, and agricultural officials and leaders in attendance at Botto's Restaurant in Swedesboro.

Mr, and Mrs. Gaventa own and operate Cedarvale Winery in Logan Township, Gloucester County, and Mr Gaventa operates A.L. Gaventa and Sons agricultural business in nearby Repaupo with his cousin Roy Gaventa..

The Gaventas were read a citation of their accomplishments and presented a plaque by Agricultural Agent Jerome L. Frecon with Rutgers NJAES Cooperative Extension, Gloucester County. Mr. Frecon cited many Gaventa Farms production innovations, including integrated pest management, strawberry variety evaluations, plasticulture sweet corn and low water use irrigation on peaches. "The Gaventa's newest development is a 6 acre planting of European wine grapes, and the establishment of a full scale winery and tasting room off Repaupo Road near Rt. 295 in

Left to Right. Mabel Gaventa, A.L. Gaventa Sons, Ed and Marsha Gaventa, Cedarvale Winery, and Jeff Link, President Gloucester County Board of Agriculture.

Logan Township," said Mr Frecon.

Mr. Gaventa was recognized for his leadership as a director and President of the National Peach Council and as an officer and director in the New Jersey State Horticultural Society, New Jersey Small Fruits Council, and the New Jersey Peach Promotion Council. Mr. Gaventa also received the "Outstanding Fruit Grower Award," from the State Horticultural Society in 2009. Mr. Frecon stated, "Ed and Marsha Gaventa have been enthusiastic and energetic leaders in the promotion and marketing of New Jersey peaches as directors and coordinators of the New Jersey Peach Festival and have played active roles in the Jersey Fruit Marketing Cooperative."

The Gaventas were also recognized for their leadership in Logan Township. Marsha Gaventa served on the Logan Township Council from 2004 to 2007 and was also a member of the township beautification committee and Logan Little League secretary for five years. Ed Gaventa has served on the Logan Township Planning Board, the Logan Township Open Space Committee as Chair, and for the past twenty five years been a life member and served as Lieutenant, Captain, Assistant Chief, Treasurer, and Vice President of the Repaupo Volunteer Fire Company. The Gaventas have two children, Chris and Andrew.

The Gloucester County Board of Agriculture, the local unit of the New Jersey Farm Bureau represents agriculture interests and has 1600 agriculture members in Gloucester County.

2010 New Jersey State Horticultural Society Research Grant Awards

Each year the NJSHS awards research grants to support important research topics to the New Jersey Horticultural industry. A large part of these funds comes from our membership gifts made to the society for this purpose. Please consider a donation to help support research (See the Membership invoice in this issue). In times of budget cuts on the Federal, State and County Level our research grants become even more critical as means of support to our researchers.

The NJSHS awarded the following grants and dollars in February of 2010. Reports on these projects will appear in the winter issue of Horticultural News.

- Establishment of a Plant Pathology Research Apple Orchard at the Rutgers Agriculture Research and Extension Center, Bridgeton- Dr. Norman Lalancette- $2000
- Testing and Evaluation of Peach and Nectarine Cultivars- Jerome L. Frecon- $2000
- Support for: 1. Tall Spindle Apple System Trial, 2. Early Fuji Cultivar Trial, 3. Plant Growth Regulator Trials for Return Bloom, 4. Late Thinning with Ethephon on Apples- Winfred P. Cowgill, Jr.- $2000
- Using GIS Technology to Decrease Cost of Mating Disruption in Peaches- Dean Polk- $2000

Obituary: Dr. Richard D. Ilnicki, Ph.D.

Dr. Richard D. Ilnicki, Ph.D., devoted husband, father, and grandfather, died on Friday October 8, 2010 at his home, after a long illness, with his family at his side. He was 82.

Dr. Ilnicki was born in Proctor, Vermont and has lived in South Brunswick since 1932. He graduated with a BS in Plant Science from Rutgers University in 1949, and received his MS in Agronomy and Plant Physiology in 1951 from Rutgers. He completed his doctorate in Agronomy and Weed Science in 1955 from Ohio State University. He then began his career as an agronomist with the US Army. He was hired by Rutgers University in 1958 and, after a 33 year career, retired as Research Professor of Weed Science. He was a former chairman of the Weed Science Society of America as well as former chairman and past president of the Northeastern Weed Science Society. He was a professor at Rutgers University and taught many Agronomy courses at Cook College up to and following his retirement in 1997. He served on many Cook College Committees. He loved teaching and was most proud of having graduated 23 successful PhD students, 15 MS students, and 3 Post-Doctoral students who have gone on to have successful careers. Two who were most outstanding were Dr. Prasert Chitipong of Thailand, who became President of Songkhla University and later served the Senate, and Dr. Ratemo Michieka, who became Vice-Chancellor of Jomo Kenyatta University later working for the government and traveling to the UN on Kenya's behalf. He was honored with many awards including distinguished member of the NEWSS in 1986, Outstanding teacher award for the WSSA in 1987, Fellow for the WSSA in 1976, distinguished service award for the pesticide association of NJ in 1990, New York Farmers Award for distinguished contributions to Agriculture and Weed Science in 1966, and outstanding 4-H alumnus given by the State of NJ in 1968. He was a member of a team of scientists visiting the USSR in 1983 and China in 1990. Never refusing when asked to serve on a committee, he always gave 100%. Appointed by Gov. W. Cahill to serve on the NJ Turnpike Authority 1973-1977. He was a charter trustee and former treasurer of the NJ Museum of Agriculture, a 12 year member of the Dayton Cemetery Association, a 25 year member of Pioneer Grange No. 1, and a 23 year member of Mercer County Pomona Grange No. 5. He was a charter member, and past president of the South Brunswick Library, which he helped to build. He served on the South Brunswick Township Committee from 1966-1975 and was elected three terms as the Mayor of South Brunswick Twp. in 1969, 1970, and 1972. He held the title of Director of Public Safety and was a former member of the Industrial Commission, the Planning Board, and the Board of Trustees of the League of Municipalities of NJ from 1970-1973. He was passionate about studying the Bible, especially the Old Testament, which he read for hours at a time and could quote much of it from memory. Another interest was the Civil War and he could recite details about all the generals and battles. Upon retiring, hybridizing daylilies became his outdoor hobby; he had over 100 varieties and several crosses which he named after his daughters.

He was pre-deceased his parents, Demetry J. Ilnicki and Mary (Choma) Ilnicki, two daughters, Deanna J. Berardi in 1999, and Janet R. Adamko in 2009, and his brother-in-law, John Franek in 2010. He is survived by his wife of 55 years, Helen (Franek) Ilnicki of Dayton; his daughter, Dr. Carolyn B. Ilnicki of Long Valley; two sons-in-law, Cesare J. Berardi of Chester, NJ, and Christian L. Gebbie of Barrington, Ill.; his sister, Ruth Cilo and her husband John of Belle Mead; three grandchildren, Arianna A. Berardi, David C. Gebbie, and Danielle D. Gebbie; a close family friend, Tom Cherrington of Robbinsville, and 9 nieces and nephews and 17 great neices and great nephews.

The family will receive friends and relatives at the M. David DeMarco Funeral Home 205 Rhode Hall Rd. Monroe Twp., NJ 08831, 732-521-0555, on Monday, October 11 from 7-9pm and on Tuesday October 12 from 2-4pm and 7-9pm. The funeral and interment will be private. In lieu of flowers, memorial contributions may be made to the South Brunswick Public Library 110 Kingston Lane Monmouth Junction, NJ 08852. For directions please visit www.demarcofuneralhome.com.

Obituary: J. Wilson Hughes

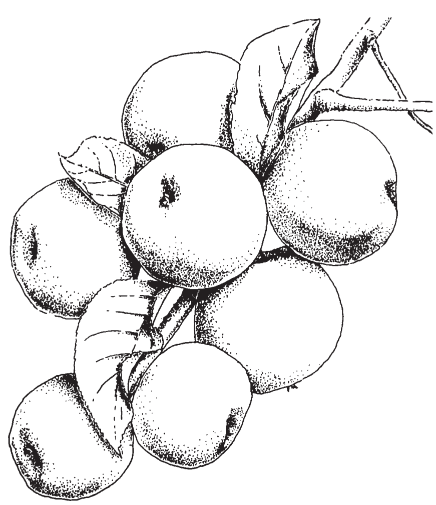
J. Wilson Hughes, of Aura, on Friday, July 30, 2010. He was 90, blessed with a long, robust life, and left this world after a short illness, surrounded by his loving family.

A 1937 graduate of Glassboro High School, Wilson was a very involved lifelong servant of family, industry and community.. He was a lifelong farmer, always recognized for producing the finest quality in every product he grew, especially peaches. Wilson was also a tireless advocate for improving his industry, in order to better provide for his family. He served agriculture in many varied capacities, including: The Gloucester County Board of Agriculture, Glassboro Service Association, NJ Farm Bureau, NJ Asparagus, Peach and Apple Councils, NJ Horticultural Society, Farm Credit System, NJ Governor's Rural Advisory Council and Governor's Task Force on Agricultural Funding. Wilson served Elk Township and beyond for 65 straight years, starting with joining the Aura Fire Company at age 14! He served on three Boards of Education; Elk Township, Gloucester County Vo-Tech, and was a proud founder of Delsea Regional High School. He also served Elk Township as a councilman, deputy mayor, public safety director, finance and roads committees, on the planning and zoning boards and Municipal Utilities Authority, from which he retired at the age of 79. He also served on the Elmer Community Hospital board of directors.

He was predeceased by his devoted wife of nearly 61 years, Mildred Shaw Hughes and his daughter, Charlotte Ann. He is survived by his three children: J. (Jay) Wilson, Jr. (Jonny), Richard B. (Betty), both of Aura, and Susan (Scott) Hansen, of Glassboro. He is also survived by his siblings: Grace (Edward) Redmond, of Pitman and Ralph Jr., (Fran), of Elmer. He was predeceased by his sisters, Doris Sahms and Beatrice Nicholson, and brother, Earl F., all of Aura. He was also predeceased by two separate companions, Dorothy Morlachetta, of Woodbury, and Irene Irvin, of Pitman.

He is also survived by his seven grandchildren: Kathryn Titus, J. Wilson, III, Matthew, Caitlin, Brian and Kelly Hughes, Jason Hansen, and five great grandchildren: Alexander Titus, Caleigh and Megan Hughes, Isabella and William Hansen. He is also survived by nine nieces andnephews.

The family suggests memorial contributions may be made to the J. Wilson Hughes Memorial Fund, Aura Volunteer Fire Company, 909 Aura Road, Glassboro, NJ 08028 or the J. Wilson Hughes Memorial Fund, South Jersey Healthcare Foundation, 2950 College Drive, Suite 1F, Vineland, NJ, 08360, to be used for the needs of the Emergency Department at SJH Elmer Hospital.



Mid-Atlantic Fruit and Vegetable Convention and Trade Show

Hershey Lodge and Convention Center, Hershey, Pennsylvania

Sponsored by the New Jersey State Horticultural Society, Maryland Horticultural Society, State Horticultural Association of Pennsylvania, and the Pennsylvania Vegetable Growers Association in cooperation with the Rutgers New Jersey Agricultural Experiment Station, Cooperative Extension, University of Maryland, and Penn State University

Register for lodging at www.mafvc.org/html or call 1-800-HERSHEY.

Educational Program

Tuesday Morning, February 1, 2011

Tree Fruit – Nigerian Room
9:00 **Invocation** –James Clarke
9:05 **SHAP President's Address** –. Ed Weaver, Pres. SHAP
9:15 ****Getting a Handle on Worker Protection Inspections** - James Harvey, Penn State Univ.
9:45 **George Goodling Lecture - Flower Bud Formation and Control in Apples -** Dr. Steve McArtney, North Carolina State Univ.
10:30 **Adjourn to Plenary Session**
(New Jersey Pesticide Applicator Units)

Wholesale Marketing – Aztec Room
9:00 **Food Alliance Certification** – Ben Wenk, Wenk's Orchards
9:30 **Industry Show and Tell**
9:45 **Buyer Grower Panel –** to be announced
10:30 **Adjourn to Plenary Session**

Snap Beans - Magnolia Room A
9:00 ***Ways to Have Poor Weed Control in Snap Beans –** Dwight Lingenfelter, Penn State Univ.
9:30 **Industry Show and Tell**
9:45 ***Update on Virus Epidemics in Snap Beans by Aphid Vectors -** Dr. Brain Nault, Cornell Univ.
10:30 **Adjourn to Plenary Session**

Sweet Corn – Magnolia Room BCD
9:00 **Reduced Tillage Sweet Corn -** Lenny Burger, Burgers Farm
9:30 **Industry Show and Tell**
9:45 ***Tackling the Top 10 Weed Problems in Sweet Corn –** Dwight Lingenfelter, Penn State Univ.
10:30 **Adjourn to Plenary Session**

High Tunnels – Crystal Room
9:00 **Considerations for High Tunnel Nutrient Management-** Dr. Matthew Kleinhenz, Ohio State Univ.
9:30 **Industry Show and Tell**
9:45 **Advantages of Movable High Tunnels: From Structural Considerations to Plant Production Potential-**Michael Bollinger, Four Season Tools
10:30 **Adjourn to Plenary Session**

Organic Vegetables – Empire Room AB
9:00 **The Role of Crop Rotation in Weed Management** - Charles Mohler, Cornell Univ.
9:30 **Industry Show and Tell**
9:45 **A Crop Rotation Planning Procedure/Crop Rotation During the Transition from Conventional to Organic Vegetable Production** - Charles Mohler, Cornell Univ.
10:30 **Adjourn to Plenary Session**

Pesticide Safety – Empire Room CD
9:00 ****Record Keeping for Pesticide Applicators -** William Riden, Penn State Univ.
9:30 **Industry Show and Tell**
9:45 ****Pesticide Regulation Update and Pesticide Safety: Focus on PPE–** William Riden, Penn State Univ.
10:30 **Adjourn to Plenary Session**
(New Jersey Pesticide Applicator Units)

Labor – Wild Rose Room
9:00 **Grower Panel –** To be announced
9:30 **Industry Show and Tell**
10:30 **Adjourn to Plenary Session**

Plenary - Nigerian and Aztec Rooms
10:45 **Mid-Atlantic Legislative Affairs Update –** Gary Swan, Pennsylvania Farm Bureau
11:00 **KEYNOTE PRESENTATION – EATING – IS THERE A SOLUTION TO THE CONFUSION? –** DR. JOSEPH SCHWARCZ, MCGILL UNIV.

Tuesday Afternoon, February 1, 2011

Tree Fruit - Nigerian Room
Taking the LEAP (Labor Efficient Apple and Peach Production) to Labor Efficient Technologies

1:30 **Preparing Our Enterprises for Labor Efficient Technologies** - Dr. James Schupp, Penn State Univ.
2:00 **Engineering Solutions Under Development by Univ./ Commercialization** - Drs. Sanjiv Singh, Carnegie Mellon and Paul Heinemann, Penn State Univ.
2:40 **Industry Show and Tell**
2:55 **Apple Rootstock and Cultivar Extension Project** – Dr. Rob Crassweller and Dr. Rich Marini, Penn State University
3:05 **Labor Efficient IPM Tools** - Dr. Larry Hull, Penn State Univ.
3:25 **Encouraging Results from CASC Harvest Assist Trials with a Commercial Partner** - Phillip Brown and Dr. James Schupp, Penn State Univ.
3:45 **Developing a Mind-Set for Automation –** Karen Lewis, Washington State Univ.
4:15 **Adjourn**
(New Jersey Pesticide Applicators Units)

Direct Marketing - CSAs – Aztec Room
To Be Announced

Onions – Magnolia Room A
1:30 **Onion Production 101-** Arthur King, Harvest Valley Farms
2:00 ***Iris Yellow Spot Virus: The New York Story** - Christy Hoepting, Cornell Coop. Ext.
2:30 ***Maximizing the Level of Onion Thrips Control Using Insecticides –** Dr. Brian Nault, Cornell Univ.
3:00 **Industry Show and Tell**
3:15 ***Managing Bacterial Diseases of Onion** - Dr. Beth Gugino, Penn State Univ.
4:00 **Considerations for Marketing Onions** - William Saussaman, Seminole Produce Distributing Co. Inc
4:30 **Adjourn**

Sweet Corn – Magnolia Room BCD
1:30 **Techniques for Producing Early Sweet Corn: Clear Plastic and Covered Using a Hoop Layer** - Brenton Barnhart, Country Creek Produce; **Row Cover** - Keith Eckel, Fred W. Eckel Sons; **Clear Plastic or Row Cover Depending on Planting Date** - John Mason, Mason Farms
2:30 **How We Harvest Fresh Market Sweet Corn: Hand Harvesting and De-Tasseling** - Keith Eckel Fred W. Eckel Sons; **One Row Mechanical Harvester** - William Geise, Geise's Sweet Corn; **Four Row Mechanical Harvester** - Brian Campbell, Brian Campbell Farms
3:15 **Industry Show and Tell**
3:30 ****Sprayers for Sweet Corn – Coverage and Calibration –** Dr. Andrew Landers, Cornell
4:30 **Adjourn**

High Tunnels – Crystal Room
1:30 **What to Consider When Purchasing a High Tunnel Frame** - Ed Person, Ledgewood Farm and Greenhouses
2:00 **Putting the Economic Pencil to High Tunnel Production-** Adam Montri, Michigan State Univ.
2:30 **The Use of Compost, Grafting and Irrigation in Organic High Tunnel Management-** Dr. Matthew Kleinhenz, Ohio State Univ.
3:00 **Industry Show and Tell**
3:15 **Using High Tunnels for the Production of Tomatoes and Other Crops-** Fred Forsburg, Honeyhill Farm
4:00 **How I Use High Tunnels in My Farming Operation-** Ed Person, Ledgewood Farm and Greenhouses
4:30 **Adjourn**

Organic Vegetables – Empire Room AB
1:30 **Grant Programs Available that Allow Farmers to Try New and Innovative Practices on their Farms** - Carol Delaney, SARE farmer grant specialist
2:00 ***Managing Late Blight on Organically Produced Tomato** – Dr. Beth Gugino, Penn State Univ.
2:30 **Growing Potatoes Organically** – Dr. Melvin Henninger, Rutgers NJ Agricultural Experiment Station, Cooperative Extension
3:00 **Industry Show and Tell**
3:15 **Tools for Integrated Crop Management of Peppers** - Dr. Mark Bennett, Ohio State Univ.
4:00 **Organic Cucurbit Production** - Ermita Hernandez, Penn State Univ.
4:30 **Adjourn**

Cole Crops – Empire Room CD
1:30 ***Managing Diseases of Cole Crops During a Cool, Wet Season** - Dr. Chris Smart, Cornell Univ.
2:00 **Variety Selection** - Jan Van Heide, Bejo Seeds
2:30 **Colorful Cauliflower Production –** Michelle Casella, Rutgers, NJAES, Cooperative Extension
3:00 **Industry Show and Tell**
3:15 **Nutrition of Cole Crops** - Dr. Carl Rosen, Univ. of Minnesota
4:00 **To Be Announced**
4:30 **Adjourn**

General Vegetables – Wild Rose Room
1:30 **Soil pH, CEC and Organic Matter: How are They Related?** - Dr. Carl Rosen, Univ. of Minnesota
2:00 **Improving Caretenoid Phytochemical Concentrations in Vegetable Crops** - Dr. Dean Kopsell, Univ. of Tennessee

2:30 ***Fumigants: Current Materials and Uses - Victor Lilley, Reddick Fumigants
3:00 **Industry Show and Tell**
3:15 ***Management Strategies for Phytophora** - Dr. Chris Smart, Cornell Univ.
4:00 **Asparagus Production** - Dr. Robert Precheur, Ohio State Univ.
4:30 **Adjourn**

Tuesday Evening, February 1, 2011

Social
6:00 **Fruit and Vegetable Grower Reception** – Chocolate Lobby
7:00 **Fruit and Vegetable Growers Banquet** - Aztec and Nigerian Rooms (ticket required) – buffet dinner, recognitions and awards

Wednesday Morning, February 2, 2011

Tree Fruit - Nigerian Room
9:00 ***Managing Apple Powdery Mildew on Susceptible Varieties in SI Resistant Orchards** - Dr. Kerik Cox, Cornell Univ.
9:45 ****Matching the Sprayer to the Canopy** - Dr. Andrew Landers, Cornell Univ.
10:30 **Industry Show & Tell**
10:45 **Competitive Orchard Systems: One Destination, Several Ways to Get There** - Karen Lewis Washington State Univ.
11:15 **The Wonderful World of PGR's:Harvest Management and Thinning in Apple** - Dr. Steve McArtney, N Carolina State Univ.
(New Jersey Pesticide Applicator Units)

Spiking Your Farm Market – Aztec Room
9:00 **Why We Do What We Do at Our Market** - Jay Milburn, Milburn Orchards
10:00 **Industry Show and Tell**
10:15 **The Significance of Educating Consumers - Your Customers** – MeeCee Baker, Versant Strategies
11:00 **Visually Communicating with Your Customers Through Print and Virtual Media** – Deanna Fox, The Fox Groupe
11:45 **Using EBT Machines at Your Market** – Sandy Hopple, Penna. Dept. of Agriculture
12:15 **Luncheon Buffet** - Great Lobby and Confection Hall Lobby (cash)

Spanish - Magnolia Room A
9:30 Principios de la seguridad alimentaria con buenas prácticas agrícolas (GAPs) (Food Safety Principles Using Good Agricultural Practices) - Maria Gorgo-Gourovitch, Yardley
10:00 Control de plagas y enfermedades del suelo por uso de cobertura vegetal (Control of Soil-Borne Pests and Diseases with Cover Crops) - Tianna DuPont, Penn State Coop. Ext.
10:30 Manejo y control del escarabajo japonés en arándanos (Japanese Beetle Control on Blueberries) - Dr. Carlos Garcia-Salazar, Michigan State Univ.
11:00 Noticia del chinche apestoso (vaquiña) marrón mármol (Brown Marmorated Stink Bug Status Update) - Dr. Katie Ellis, Penn State Univ.
11:10 Cómo igualar la aspersora de alta presión a la copa (Matching the Sprayer to the Canopy) - Dr. Andrew Landers, Cornell Univ. - English/ Spanish Interpretation Session; Interpretation by Bruce Hollabaugh, Hollabaugh Bros., Inc.
11:30 Identificación y control de enfermedades del tomate (Selected Tomato Diseases and Their Control) - Dr. Beth Gugino, Penn State Univ. - English/ Spanish Interpretation Session; Interpretation by Bruce Hollabaugh, Hollabaugh Bros., Inc.
(New Jersey Pesticide Applicators Units)

Tomatoes - Magnolia Room BCD
9:00 **New Fresh Market Varieties** – Peter Nitzsche, Rutgers NJAES, Cooperative Extension
9:30 **To Be Announced**
10:00 **Industry Show and Tell**
10:15 ***Bacterial Canker-and Other Tomato Diseases**- Dr.Beth Gugino- Penn State Univ.
11:00 **Fighting Disease/Grafting**- Dr. Matthew Kleinheinz- Ohio State Univ.
11:30 **PVGA Annual Meeting** – Wild Rose Room
12:30 **Luncheon Buffet** - Great Lobby and Confection Hall Lobby (cash)

Food Safety – Crystal Room
9:00 **Penn State GAPs Program**- Dr. Luke LaBorde, Penn State Univ.
10:00 **Industry Show and Tell**
10:15 **Problems Observed in Audits in New Jersey** – Dr. Wesley Kline, Rutgers NJ Agricultural Experiment Station, Coop. Ext.
11:00 **New York GAP Update** – Elizabeth Bihn, Food Science, Cornell Univ.
11:45 **Panel Discussion** – Donald Wellbrock, Penna. Dept. of Agriculture; Glenda Christy, Giant Eagle; and other session speakers
12:30 **Luncheon Buffet** - Great Lobby and Confection Hall Lobby (cash)

General Vegetables – Empire Room AB
9:00 ****Surfactants 101** – Kerry Hoffman-Richards, Penn State Univ.
9:30 **Brassica Cover Crops and Seed Meals as Soil Biofumigants in Vegetable Crop Production** - Dr. Dean Kopsell, Univ. of Tennessee
10:00 **Industry Show and Tell**
10:15 **Basic Plant Nutrition** - Dr. Ernest Bergman, Emeritus Penn State Univ.
11:00 **Burning Plastic for Energy: An Update** - James Garthe, Penn State Univ.

11:30 **PVGA Annual Meeting –** Wild Rose Room
12:30 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)

Potatoes – Empire Room CD
9:00 ****Preventing Catastrophic Failures of Poly Tanks-** Robert Leiby, Penn State Univ.
9:30 **Drip Irrigation of Potatoes on a Large Scale-** Nolan Masser, Red Hill Farms
10:00 **Industry Show and Tell**
10:15 **Plant the Crop Right –** Dr. William Bohl, Univ. of Idaho
11:00 **Basics of Potato Storage Management–** Dr. Steven Johnson, Univ. of Maine
11:30 **PVGA Annual Meeting –** Wild Rose Room
12:30 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)

Wine Grapes – Wild Rose Room
9:00 ***Weed Control in Wine Grapes** - Scott Guiser, Penn State Coop. Ext.
9:45 **Winter Hardiness in Grapes** - Dr. Robert Crassweller, Penn State Univ.
10:15 **Industry Show & Tell**
10:30 ***Brown Marmorated Stink Bug Control -** Dr. Mike Saunders, Penn State Univ.
11:15 **Temperature and Light Impact on Fruit Color** - Dr. Sara Spayd, North Carolina State Univ.
12:30 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)
(New Jersey Pesticide Applicator Units)

Greenhouse – Cocoa Suite 1
9:00 **Container Grown Vegetables: New Business Opportunities** - Steven Bogash
9:30 ***Pests of Vegetables and Herb Transplants** - Stanton Gill, Univ. of Maryland Ext.
10:00 **Industry Show and Tell**
10:15 ***IPM for Root and Stem Diseases** - Rick Yates, Griffin Greenhouse Supplies
11:00 **Supplemental Lighting Guidelines for Greenhouse Crop Production** – Dr. Erik Runkle, Michigan State Univ.
11:30 **The Best Tried and True Varieties That You Should Be Growing** - Alan Michael, Penn State Coop. Ext.
12:00 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)

Wednesday Afternoon, February 2, 2011

National Peach Council – Aztec Room
1:30 **Ernie Christ Memorial Lecture - Peach Breeding Program of the Univ. of Arkansas**
Dr. John Clark, Univ. of Arkansas
2:15 **Industry Show & Tell**
2:30 **Automated String Thinner Positioning** - Reuben Dise/ Dr. Paul Heinemann, Penn State Univ.
3:00 **Industry Show & Tell**
3:15 **Peach Training Systems for the Mid-Atlantic** - Dr. James Schupp, Penn State Univ.
4:00 **Adjourn**
(New Jersey Pesticide Applicator Units)
4:30 **ANNUAL MEETING OF NEW JERSEY STATE HORTICULTURAL SOCIETY** (TOWER SUITE)

Tree Fruit - Nigerian Room
1:30 ****Core Presentation** – Dr. Kerry Hoffman Richards – Penn State Univ
2:00 **Cost of Fruit Production Part A** - Lynn Kime, Penn State Univ.
2:30 **Generating Buzz for Your Business – PR Roundtable** - Karin Rodriguez, Penna Apple Marketing Board, and
Teri Hurst, PPO & S
3:15 **Industry Show & Tell**
3:30 **U.S. Apple Update -** Nancy Foster, U.S. Apple Association
3:50 **Pennsylvania Apple Marketing Board Update** - Karin Rodriguez, PA Apple Marketing Board
4:15 **Adjourn**
(New Jersey Pesticide Applicator Units)
4:30 **ANNUAL MEETING OF NEW JERSEY STATE HORTICULTURAL SOCIETY** (TOWER SUITE)

Spanish - Magnolia Room A
1:30 ¿Cómo leer la etiqueta del pesticida?/Calibración de equipos de aplicación de pesticidas (How Do You Read a Pesticide Label?/Pesticide Application Equipment Calibration) - Miguel Saviroff, Penn State Coop. Ext.
2:00 Introducción al manejo de los gusanos del fruto del arándano (CBFW)/Uso de técnicas de pronóstico para control de plagas (Managing Cranberry Fruitworm Larvae in Blueberries/ Using Weather Models for Pest Control) - Dr. Carlos Garcia-Salazar, Michigan State University
2:30 Visualizando el futuro mediante un plan de negocios (Viewing Your Future Through a Business Plan) - Miguel Saviroff, Penn State Coop. Ext.
3:00 El arte y la ciencia de podar árboles de manzana y Durazno (The Art and Science of Pruning Apple and Peach Trees) - Dr. Chris Walsh, Univ. of Maryland
(New Jersey Pesticide Applicators Units)
4:30 **ANNUAL MEETING OF NEW JERSEY STATE HORTICULTURAL SOCIETY** (TOWER SUITE)

Tomatoes – Magnolia Room BCD
1:30 **The A-B-C's I Mean N-P-K's of Tomato Production -** Dr. Dean Kopsell, Univ. of Tennessee
2:00 **To Be Announced**

2:30 **Starting Out Right:How to Protect Your Tomato Transplants from Disease –** Dr. Kelly Ivors, North Carolina State Univ.
3:00 **Industry Show and Tell**
3:15 **Keeping Your Tomatoes Healthy –** Dr. Michael Orzolek, Penn State Univ.; Dr. Albert Liptay, Stoller USA; Terry Hughes, Grower
4:00 ****Sprayer Safety –** to be announced
4:30 **Adjourn**

Postharvest Handling – Crystal Room
1:30 **ABCs of Postharvest Handling -** Lee Young, Penn State Coop. Ext.
2:15 **Evaluation of Yield and Postharvest Quality of Winter Squash Cultivars in West Virginia-** Dr. Lewis Jett, West Virginia Univ.
2:45 **Industry Show and Tell**
3:00 **PA Market Maker -** Sarah Cornlisse, Penn State Coop. Ext.
3:15 **Postharvest Tips and Tools for Small Scale Producers** – Thomas Ford, Penn State Cooperative Extension
3:45 **Maintaining Quality at the Wholesale/Retail Level –** Dr. Wesley Kline, Rutgers NJ Agricultural Experiment Station. Coop Ext.
4:15 **Adjourn**

Small Fruit – Empire Room AB
1:30 ***Spotted Wing Drosophila Update in Small Fruit -** Kathy Demchak, Penn State Univ.
2:00 ***Understanding the Role of Root Diseases in Strawberry and Raspberry Decline -** Kerik Cox, Cornell Univ.
2:30 ***Weed Management in Strawberries: What's New –** Dr. Richard Bonanno, Univ. of Massachusetts
3:00 **Industry Show and Tell**
3:15 **Berries in High Tunnels: Discussion Forum -** Kathy Demchak, Penn State Univ.
4:30 **Adjourn**
(New Jersey Pesticide Applicators Units)
4:30 **ANNUAL MEETING OF NEW JERSEY STATE HORTICULTURAL SOCIETY** (TOWER SUITE)

Potatoes – Empire Room CD
1:30 ***Insect Management Update-** Dr.Gerald Ghidu, Rutgers NJ Agricultural Experiment Station, Cooperative Extension
2:00 ***Disease Management Update-** Dr. Beth Gugino, Penn State Univ.
2:30 ***Potato Seed Treatments and Handling for Optimum Results-** Dr. Steven Johnson, Univ. of Maine
3:00 **Industry Show and Tell**
3:15 *****Fumigating Potato Ground in Pennsylvania-** Chad Hutchison, Hendrix and Dail, Inc.
4:00 **Minimizing Bruise Damage-** Dr. William Bohl, Univ. of Idaho
4:30 **Adjourn**

Wine Grapes – Wild Rose Room
1:30 **Impact of Vineyard Fertility on Wine Grape Quality** - Dr. Sara Spayd, North Carolina State Univ.
2:15 ***Progress in Bunch Rot Control*** - Mr. Bryan Hed, Penn State Univ.
2:30 **Industry Show & Tell**
3:00 ***Wine Grape Disease Management in 2010** - Dr. Noemi Halbrendt, Penn State Univ.
3:30 **Vineyard Floor Management for Successful Establishment -** Dr. Daniel Ward, Rutgers NJ Agricultural Experiment St
4:15 **Adjourn**
(New Jersey Pesticide Applicators Units)
4:30 **ANNUAL MEETING OF NEW JERSEY STATE HORTICULTURAL SOCIETY** (TOWER SUITE)

Greenhouse – Cocoa Suite 1
1:30 **The Best New Varieties That You Should Be Growing** - Alan Michael
2:00 **Energy-Efficient Strategies To Provide Long Days To Photoperiodic Crops –** Dr. Erik Runkle, Michigan State Univ.
2:30 **Nightmare Crops** - Rick Yates, Griffin Greenhouse Supplies
3:00 **Industry Show and Tell**
3:15 **Thrips and Whitefly Management: What's New and What Works** - Stanton Gill, U. Maryland Ext.
4:00 **My Crystal Ball: Anticipating the Market for 2011** - Steve Bogash, Penn State Coop. Ext.
4:30 **Adjourn**

Wednesday Evening, February 2, 2011 Social/Educational

4:30 **ANNUAL MEETING OF NEW JERSEY STATE HORTICULTURAL SOCIETY** (TOWER SUITE)
5:00 **Reception for Pennsylvania Apple Growers** - Cocoa Suites – hosted by the Pennsylvania Apple Marketing Board and Temple-Inland
7:00 **Ice Cream Social for All Convention Attendees –** Great Lobby – hosted by the Pennsylvania Vegetable Growers Association – ice cream served until 8:00 p.m.
7:00 **Cut Flower Arrangement Workshop –** Wild Rose Room
7:00 **Business Management Software –** Empire Room CD
7:00 **Strawberry Plasticulture Roundtable Discussion** - Empire Room AB

Thursday Morning, February 3, 2011

National Peach Council - Aztec Room
9:00 **Early Season Insecticide Programs to Maximize Biological Control of OFM -** Dr. David Biddinger, Penn State Univ
9:30 **PPV: Let's Not Give it Another Chance -** Dr. Ruth Welliver, PA Dept. of Ag

10:00 **Industry Show & Tell**
10:15 **California's Stone Fruit Industry ,** Dr. Roger Duncan, U of California, Cooperative Extension
11:00 **Peach Marketing Panel** - Kay Rentzel (moderator)
(NJ Pesticide Applicator Units)

<u>Tree Fruit</u> - Nigerian Room
9:00 **Video Series for Pruning and Training Dwarf Cherry Trees** Win Cowgill, Rutgers NJAES, Cooperative Extension; Jon Clements, UMass; Greg Lang, Michigan State Univ.; Lynn Long, Oregon State Univ.
9:45 **Cost of Fruit Production Part B** - Mr. Lynn Kime, Penn State Univ.
10;15 **Industry Show and Tell**
10:30 ***What Do We Know About Brown Marmorated Stink Bug** - Dr. Greg Krawczyk, Penn State Univ.
11:00 ****How Pesticide Label Language is Developed** - Dr. Clayton Myers, US EPA
11:30 ***New Chemistries and Alternate Row Middle Spraying** - Dr. Larry Hull, Penn State Univ.
(NJ Pesticide Applicator Units)

<u>Agritainment</u> – Magnolia Room ABCD
9:00 **What is Agri-tanment and How Do We Enhance Customer Safety** – John Berry, Penn State Cooperative Extension
9:30 **Agri-tainment Perspective –PDA, Rides and Amusements Regulations and Guidelines –** John Filoromo, Pennsylvania Department of Agriculture.
10:00 **Industry Show and Tell**
10:15 **Growing our Agri-tainment Experience –** Greg and Tina Forry, Risser-Marvel Farm Market
11:00 **Adjourn**

<u>Vine Crops</u> – Crystal Room
9:00 ***Fungicide Resistance Management for Cucurbit Crops**- Dr. Andrew Wyenandt, Rutgers NJAES, Cooperative Extension.
9:30 **Winter Squash Variety Trial Update –** Dr. Elsa Sanchez, Penn State Univ. and Dr. Timothy Elkner, Penn State Coop. Ext.
10:00 **Industry Show and Tell**
10:15 ***Early Season Virus Transmission by Striped Cucumber Beetles in Cucurbits –** Dr. Gerald Brust, Univ. of Maryland
11:00 ***Recommendations Based on Science: How to Effectively Manage Common Cucurbit Diseases.** - Dr. Kelly Ivors, North Carolina State Univ.
11:30 ***Weed Issues in Cucurbit Crops –** Dr. Bradley Majek, Rutgers NJAES, Cooperative Extension.
12:00 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)

<u>Small Fruit</u> – Empire Room AB
9:00 ***Experiences with Brown Marmorated Stink Bug in Raspberries** - Bryan Butler, Univ. of Maryland
9:30 **Topic TBA –** John Clark, Univ. of Arkansas
10:00 **Industry Show and Tell**
10:15 ***Assessing and Avoiding Viruses in Blueberries and Raspberries** – Dr. Kerik Cox, Cornell Univ.
11:00 ****Core Pesticide Credit –** Dr. Timothy Elkner, Penn State Coop. Ext.
11:30 **Primocane-Fruiting Blackberry Breeding –** Dr. John Clark, Univ. of Arkansas
12:00 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)
(NJ Pesticide Applicator Units)

<u>Leafy Greens</u> – Empire Room CD
9:00 **Consumer Preferences for Specialty Greens and Herbs –** William Sciarappa, Rutgers Coop. Ext.
9:30 **Growing Leafy Greens in a High Tunnel –** Eli Cook, Grower, West Virginia
10:00 **Industry Show and Tell**
10:15 **Growing and Harvesting Leafy Greens –** Thomas Sheppard, Sheppard Farms,
11:00 **Activities of the Leafy Green Council**- Ray Clark, Leafy Greens Council
11:30 ***Weed Control in Leafy Green Crops –** Dr. Richard Bonanno , Univ. of Mass. and Bonnano Farms
12:00 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)

<u>Cut Flowers</u> –Wild Rose Room
9:00 **Starting and Growing Lisianthus from Seed** - Robert Ambrose, Ridgeview Acres
9:30 **How I Market Lisianthus and Other Interesting Flowers** - Dave Dowling, Farmhouse Flowers
10:00 **Industry Show and Tell**
10:15 **Managing Insect Pests in Cut Flowers** - Stanton Gill, Univ. of Maryland Coop. Ext.
11:00 **New Varieties: Lisianthus and More from American Takii** - Mark Huggett, American Takii
11:30 **Trends in Cut Flowers: Growing your Market** - Steve Bogash, Penn State Coop. Ext.
12:00 **Luncheon Buffet -** Great Lobby and Confection Hall Lobby (cash)

<u>Thursday Afternoon, February 3, 2011</u>

<u>National Peach Council</u>- Aztec Room
1:30 ****Core Presentation**
2:00 ***Critical Steps in Weed Control** - Dr. Thomas Tworkoski
2:30 ***Approaches for Bacterial Spot Management in Stone Fruits** - Dr. Norman Lalancette, Rutgers Univ.
3:15 **National Peach Council Update** - Kay Rentzel, National Peach Council
3:30 **Annual Business Meeting of National Peach Council**

4:00 **Adjourn**
(NJ Pesticide Applicator Units)

Tree Fruit - Nigerian Room
1:30 **Real Energy Savings for Horticulture** - Dr. Daniel Ciolkosz, Penn State Univ.
2:00 **Market Trends in Apples** - Karin Rodriguez, PA Apple Marketing Board
2:30 ***Practical Implications of Molecular Aspects of Fungicide Resistance in Apple Scab and Brown Rot Pathogens**. - Dr. Kerik Cox, Cornell Univ.
3:00 ***Status of DMI Fungicide Resistance in PA Orchards** - Dr. Henry Ngugi, Penn State Univ.
3:45 **Adjourn**
(NJ Pesticide Applicator Units)

Web Presence Marketing – Magnolia Room ABCD
1:30 **Making Your Website Everything It Can Be –** David King Harvest Valley Farm
2:00 **Maximizing Visits to Your Web Site** – Chris Moore, Penn State University
2:30 **Selling Through Your Website** – David Brown, Brown's Orchard and farm market
3:00 **Adjourn**

Pumpkins - Crystal Room
1:30 **Growing Giant Pumpkins –** James Beauchemin, New Hampshire Giant Pumpkin Growers Association
2:00 ***Controlling the Mildews –** TBD
2:30 **To Be Announced**
3:15 **Pennsylvania Pumpkin Varietry Trial Overview –** Dr. Timothy Elkner and Thomas Butzler, Penn State Coop. Ext.
3:45 ***Weed Control Update in Pumpkins –** Dr. Bradley Majek, Rutgers Univ.
4:15 **Adjourn**

Small Fruit – Empire Room AB
1:20 **Welcome and Growers' Survey –** Kathy Demchak, Penn State Univ. and Cesar Rodriguez-Saona, Rutgers NJAES, Cooperative Extension
1:30 ***Japanese Beetle Management in Blueberries –** Carlos Garcia-Salazar, Michigan State Univ.
2:00 ***Best Weed Control Program Choices for 2011** – Dr. Bradley Majek, Rutgers NJAES, Cooperative Extension
2:30 ***Rational Fungicide Use for Blueberry Disease Management –** Dr. Peter Oudemans, Rutgers NJAES,.
3:00 ***Effect of Nitrogen Regime on Blueberry Overwinter, Stem Blight, and Phomopsis Susceptibility and Aphid Population Density - Year Two Results –** Dr. Gary Pavlis, Rutgers NJAES, Cooperative Extension
3:30 ***What We Have Learned for More Efficient Blueberry Scouting –** Dean Polk, Rutgers NJAES, Cooperaitve Extension
4:00 ***Plum Curculio Management in Blueberries: New Solutions for an Old Problem –** Dean Polk, Rutgers NJ Agricultural Experiment Station, Cooperative Extension
4:30 **Adjourn**
(NJ Pesticide Applicator Units)

Equipment for Reduced Tillage – Empire Room CD
1:30 Approaches to Reduce Tillage on Small to Large Farms – Dr. Anu Rangarajan, Cornell University
2:15 **Tillage Equipment – Panel Discussion** - Furman Farms, Donn Branton, Branton Farms
3:30 **Adjourn**
Herbs – Wild Rose Room
1:30 **Growing Medicinal Herbs** - Rusty and Claire Orner, Quiet Creek Herb Farm
2:00 **Medicinal Qualities of Herbs** - Leslie Alexander, Restoration Herbs
2:30 **Is this Plant a Hoax?** - Dr. Arthur Tucker, Delaware State Univ.
3:00 **Eat Your Weedies** - Leslie Alexander, Restoration Herbs
3:45 **Adjourn**

ADVANCED REGISTRATION AND MEMBERSHIP INVOICE
For the Mid-Atlantic Fruit & Vegetable Convention
and Membership to the New Jersey State Horticultural Society
Hershey Lodge and Convention Center – Hershey, PA

February 1-3, 2011

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