UNIVERSITY OF ILLINOIS EXTENSION
College of Agricultural, Consumer, and Environmental Sciences

Illinois Fruit and Vegetable News

Vol. 15, No. 16, January 20, 2010
A newsletter for commercial growers of fruit and vegetable crops

"We are what we repeatedly do. Excellence, then, is not an act, but a habit." Aristotle

Address any questions or comments regarding this newsletter to the individual authors listed after each article or to its editor, Rick Weinzierl, 217-244-2126, weinzier@illinois.edu. The ***Illinois Fruit and Vegetable News*** is available on the web at: http://www.ipm.illinois.edu/ifvn/index.html . To receive email notification of new postings of this newsletter, call or write Rick Weinzierl at the number or email address above.

In this issue ...

Upcoming Programs

- **Energy-Efficiency in Greenhouse Crop Production, January 26, 2010. (Webinar)** Erik Runkle, Michigan State University, 10:00-11:15 a.m. CST. Link to registration: http://www.uwex.edu/ics/wlwreg/wlw_dept_list.cfm?class=B&cat=IOL.
- **Horseradish Growers School. January 28, 2010.** Gateway Convention Center, Collinsville, IL. For details contact Elizabeth Wahle, wahle@illinois.edu, 618-692-9434.
- **Southern Illinois Commercial Tree Fruit School. February 2, 2010.** Mt Vernon Holiday Inn, Mt. Vernon, IL. For details contact Elizabeth Wahle, wahle@illinois.edu, 618-692-9434.
- **Southwestern Illinois Commercial Tree Fruit School. February 3, 2010.** First Presbyterian Church, Hardin, IL. For details contact Elizabeth Wahle, wahle@illinois.edu, 618-692-9434.
- **Southern Illinois Commercial Vegetable School. February 10, 2010.** Mt Vernon Holiday Inn, Mt. Vernon, IL. For details contact Elizabeth Wahle, wahle@illinois.edu, 618-692-9434.
- **Illinois/Wisconsin (Stateline) Fruit and Vegetable Conference. February 15, 2010**. Donley's, Union, IL. For more information, contact Larry Wilson at lwwilson@illinois.edu or 708.352.0109.
- **Western Illinois Fruit and Vegetable School**. February 16, 2010. Adams County Farm Bureau Office, Quincy, IL. For more information, contact Mike Roegge at roeggem@illinois.edu or 217-223-8380.
- **Kankakee Vegetable Growers School, February 24, 2010.** Kankakee County Extension Office, Bourbonnais, IL. For details contact James Theuri, jtheu50@illinois.edu, 815-987-7379
- **Illinois Grape Growers and Vintners Association Annual Conference, February 25-27, 2010.** Springfield, IL. See http://www.illinoiswine.org/.
- **Organic Farming Conference, February 25-27, 2010.** La Crosse, WI. See http://www.mosesorganic.org/conference.html.
- **Illinois Small Fruit and Strawberry Schools. March 2-3, 2010.** Mt Vernon Holiday Inn, Mt Vernon, IL. For details contact Jeff Kindhart, jkindhar@illinois.edu 618-695-2444.

- **20th Annual Greenhouse Tomato Short Course. March 9-10, 2010.** Eagle Ridge Conference Center, Raymond, Mississippi. For more information, see http://greenhousetomatosc.com or contact Rick Snyder of Mississippi State University at 601-892-3731 or RickS@ra.msstate.edu.
- **International Herb Association Annual Meeting. July 11-15, 2010.** Collinsville, IL. (More details in future issues of this newsletter.)
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Regional Updates

From southern and southwestern IL … The results are in for the Illinois State Horticulture Society-sponsored cider contests that were held at the 2010 Illinois Specialty Crops, Agritourism and Organic Conference held in Springfield. Congratulations go to Edwards Apple Orchard, located at Poplar Grove, IL. They produced the No.1 overall rated cider at this year's contest, thus repeating their 2006 win of the First Place National and Illinois Cider. Ken and Barb Hall pressed their winning cider for this year's contest on November 4th, using Jonagold, Honeycrisp, Golden Delicious, and GoldRush as the main apple varieties in their blend.

Second Place National went to our out-of-state neighbor Jim Hill, with Hill Bros. of Grand Rapids, Michigan. Pat Curran, of Curran Orchard in Rockford, IL, won Third Place National and 2nd Place Illinois Cider. Third Place Illinois Cider was awarded to Craig Tanner of Tanner's Orchard, located in Speer, IL. Midwest Cider of Merit, 1st Runner-up was awarded to Tom Schwartz of Schwartz Orchards in Centralia, IL. Steve Bock of Honey-Hill Orchard in Waterman, IL was awarded the Midwest Cider of Merit, 2nd Runner-up and the Midwest Cider of Merit, 3rd Runner-up went to Keith, Denise and Justina Boggio of Boggio's Orchard and Produce in Granville, IL.

Jon and Robert Karr from The Orchard in Emporia, KS, were awarded the Champion Hard Cider Award, using a blend of Jonathan, Ozark Gold, and Gala. Congratulations to all our winners.

Some sad news to report. Gary Laird, at age 53, died at his home on December 15, 2009. Many of you knew Gary, and for those of you who didn't, he was the farm manager at Eckerts' Orchard in Grafton for thirty years. One behalf of University of Illinois Extension, our sympathies go to Gary's family and friends for such an unexpected loss.

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EQIP Funding for High Tunnels

Illinois is one of the pilot states for the new NRCS High Tunnels conservation practice pilot project. During the pilot period, high tunnel systems may be eligible for financial assistance through the Environmental Quality Incentives Program (EQIP). Financial assistance will be limited to tunnels covering up to 5% of one acre (2,178 square feet) per farming operation – equivalent to a structure size of approximately 30 ft x 72 ft. There will be annual reporting requirements for the producer - things like crop yield, fertilizer and pesticide application, and growing season dates. There are still some details that have to be worked out but you should contact your local USDA Natural Resources Conservation Service (NRCS) office now and start the application if you are interested in high tunnel production. Further information is available at http://www.nrcs.usda.gov/ .

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Fruit Production and Pest Management

Insecticide Mixtures and Rotations for Resistance Management in Tree Fruits

Earlier this month at the Illinois Specialty Crops, Agritourism, and Organic Conference in Springfield I provided a summary on insecticide mixtures and rotations for resistance management in tree fruits. The article that follows is an attempt to get the same ideas down in writing.

Let's start with a reminder of the meaning of the term insecticide resistance. Insecticide resistance is a population trait that develops over time as a result of insecticide use that "selects" individuals with the greatest ability to survive

insecticide exposure. Those insects are the ones that reproduce, and the ability to survive the particular insecticide becomes more widespread in subsequent generations. In resistant populations, a higher dose or concentration of an insecticide is required to kill a given portion (50 percent or 95 percent). Pre-existing mechanisms for survival are selected by insecticide use … this means that individuals are born "resistant;" immunity does not develop in an individual after exposure to a spray.

Delaying the evolution of resistance almost always depends upon minimizing selection pressure (so reducing pesticide use). In crops such as apples and peaches where tolerances for cosmetic damage and insect contamination are extremely low, minimizing insecticide use can be difficult or impractical. Instead, repeated cover sprays are applied, selection pressure is high, and resistance to one or more insecticides has developed in codling moth, oriental fruit moth, white apple leafhopper, San Jose scale, European red mite, and other species.

Resistance management – a term we often hear in discussions of fruit insect control – tries to (1) delay resistance development and maintain the usefulness of an insecticide or (2) attempts to manage target pests after resistance has led to control failures. The importance of this second aspect of resistance management – coping with pests already resistant to one or more insecticides – is an unfortunate reality in tree fruit insect management.

Managing resistance by minimizing insecticide use should always be part of tree fruit insect management efforts. In general this means spraying only when necessary, treating only blocks or areas that need to be treated, etc. Where repeated and widespread use of insecticides is needed, resistance management recommendations may call for high doses, mixtures, or rotations. Let's look at each of these approaches.

High-dose management tactics are based on the ideas that resistance genes are rare in the target pest population and that resistance is usually a recessive trait (or incompletely recessive). Insects with two genes for resistance (homozygous *rr*) should be VERY rare, and a particularly high dose or rate would kill heterozygotes (*Sr*), preventing them from mating with each other and producing offspring that are homozygous for resistance (*rr*). High doses (with refuges for susceptible insects to survive) are used in BT corn, and models of resistance development predict they can be successful. However, true high-dose management has no place in insect resistance management involving conventional insecticides in tree fruit crops. Unlike concentrations of BT toxins in transgenic corn, applying high doses of insecticides (specifically intended to kill *Sr* heterozygotes) to fruits and foliage (1) costs much more than standard doses; (2) causes more nontarget mortality of beneficial insects; and (3) leaves greater residues on fruit at harvest. In addition (and perhaps more importantly), even if specifically prescribed high doses that would kill heterozygotes were applied on a given day, residues decline rapidly to levels that likely kill all the homozygotes for susceptibility (*SS*) but not heterozygotes. This idea probably warrants far more explanation than I can present in this newsletter, but suffice it to say that high doses are not practical for insecticide resistance management in tree fruits. This does NOT mean that growers should use rates too low to provide adequate control for the desired treatment interval … it just means that using rates greater than those listed on a product label is not an effective technique for delaying insecticide resistance.

Using mixtures to manage insecticide resistance involves applying a combination of insecticides (A + B) in each treatment. To be effective in delaying resistance, this approach assumes resistance to either component is very rare and that insects resistant to both components are so rare that they do not mate with each other and pass on that combined resistance. Where resistance to one ingredient already exists, these assumptions are not met. A key question centers on how much of each ingredient to put in a mixture. Using full rates of each ingredient means paying the full price for both products. Could you use a portion of the rates of each and expect additive results? Probably not. Let's start with the idea that a full rate of product A or product B would provide near total control of a target pest for a certain time period until we make our next cover spray (which is what we expect of effective products for codling moth control, for example). Then …

- Assume (1) a half-rate of product A provides 70 percent control of the target pest over the planned time period before the next cover spray and (2) a half-rate of B also provides 70 percent control. How much control will the mixture provide?
    - If the action of the two ingredients is truly independent (two completely different modes of action and detoxification routes) …
    - A controls 70 of 100 insects … 30 remain alive.

    - B controls 70 percent of those 30 … 21 dead and 9 remain alive. (B also would have killed some of the 70 that A killed, but hey, you cannot kill them more than once.)
- Oops … a half-rate plus a half-rate did not provide equal results to a full rate of either component.
- If the target pest population already contained a portion that is resistant to A or B, control provided by that ingredient will be less than the 70 percent expected.

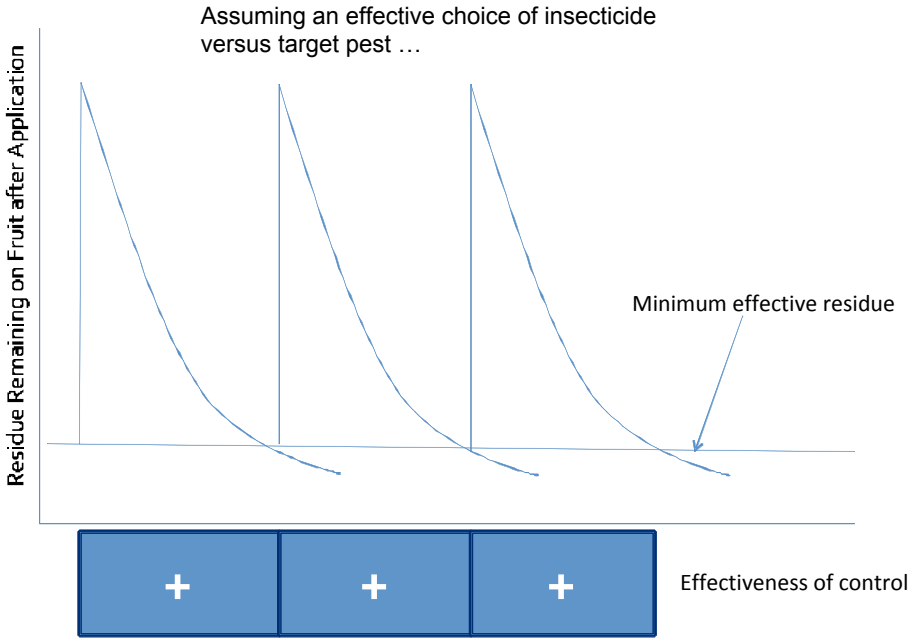
So … in apples and peaches, where resistance is already an issue for several pests, mixtures may be valuable to control multiple pests (one ingredient against some, the second against others), but mixtures are not well suited for preventing resistance development. Rates of each ingredient have to be high enough to provide control for the necessary treatment interval. Appropriate mixtures in apples or peaches might include:

- Apples: Altacor or Delegate or Rimon to control OP-resistant codling moths plus Imidan for apple maggot control or plum curculio control
- Peaches: Altacor or Delegate or Assail (or mating disruption) to control pyrethroid-resistant oriental fruit moths plus Permethrin to control stink bugs and plant bugs

These mixtures are not really intended to delay resistance development but to manage a pest complex in which resistance is already an issue for one or more species.

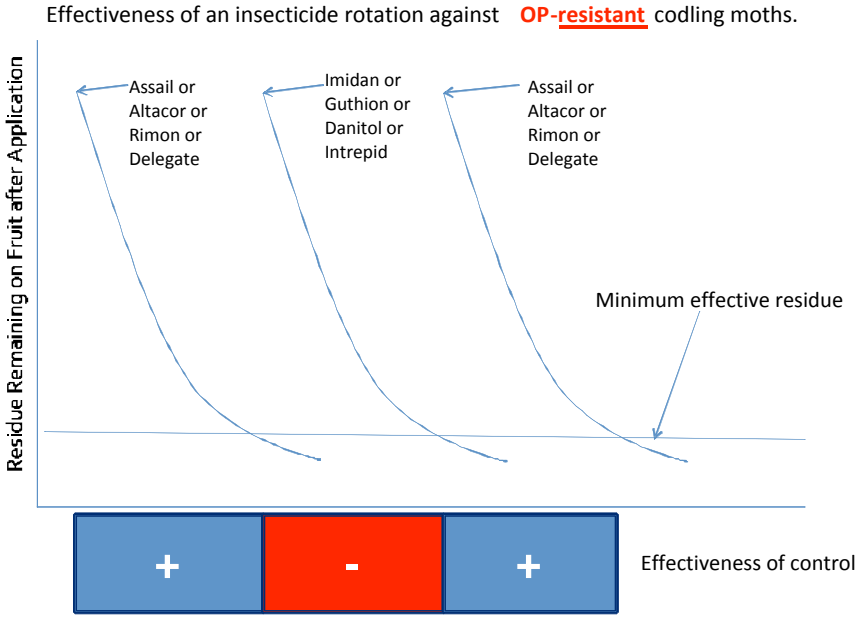
Rotations: The approach here is fairly straightforward … use insecticide A for a period, then insecticide B, (then insecticide C …), then eventually back to insecticide A. Usually the goal is to not use the same insecticide against successive generations of the same pest, with the hypothesis that any increase in resistance gene frequency (and prevalence of resistant insects) may decline again in the absence of treatment (selection). (This decline may or may not happen, but there is no negative cost to effective rotations.)

Let's look at what we expect of cover sprays for the control of internal pests of apples and peaches (focusing on codling moth and oriental fruit moth). In general, we apply an insecticide and expect that the residue will decline steadily over a period of time, and based on research and experience, we make another application when the residue is insufficient to control newly hatching larvae on fruit (IF traps and phenology models indicate control is still necessary). The idea looks something like this …



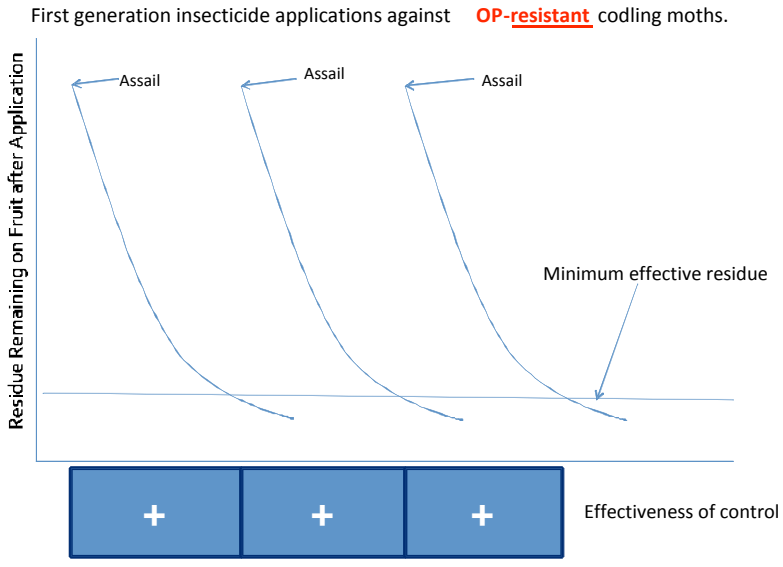
Although rotations of different insecticides within a generation of codling moth or oriental fruit moth sprays is not usually recommended, some apple growers may use Imidan for apple maggot or Japanese beetle control and "rotate"

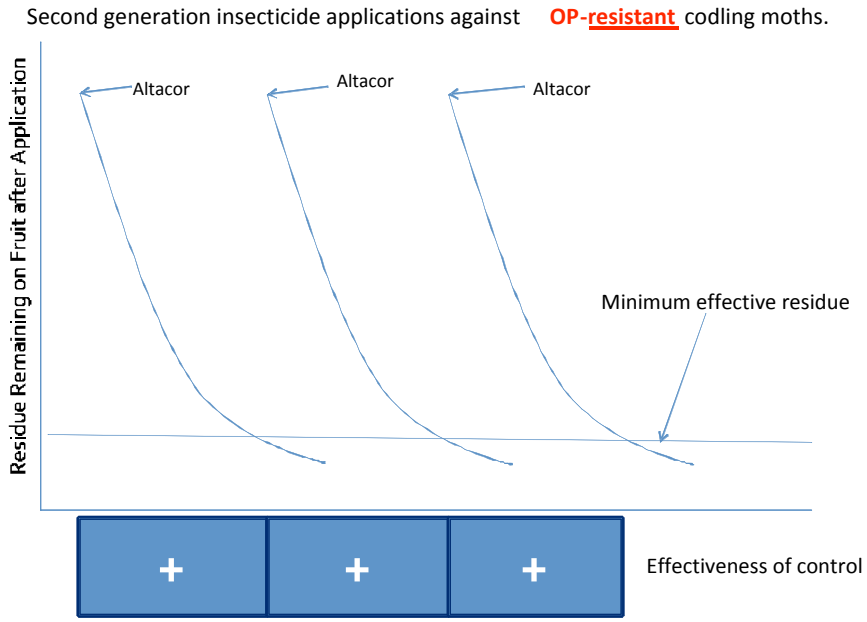
it into the cover spray program. Where organophosphate-resistant populations already exist, as is true in many areas, this is a very BAD decision. The application of Imidan (or Guthion or even a pyrethroid or Intrepid if the population shows cross-resistance to these as well) leaves a "hole" in the spray program – a period in which fruit is not protected from the resistant population. Graphically, the problem looks like so …

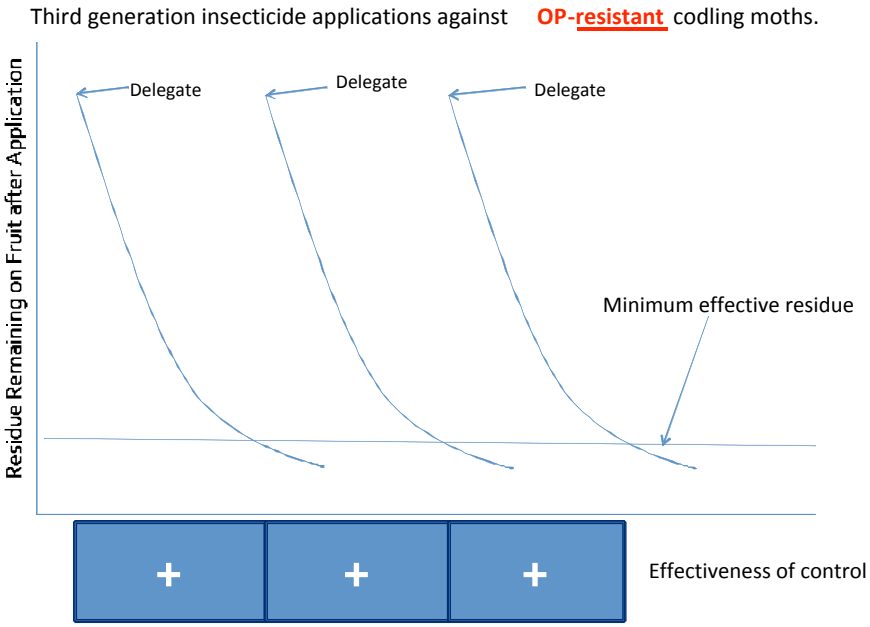


The point here is that if resistance to a given insecticide or group of insecticides already exists, it cannot be part of a rotation scheme against that pest (especially for internal pests, because they cannot be controlled after they enter fruit). The example above centers on codling moth in apples, but a similar "hole" in protection would occur in peaches if a grower chose to use permethrin (or another pyrethroid) to control stink bugs, plant bugs, or Japanese beetles at a time when pyrethroid-resistant oriental fruit moth larvae were hatching and entering fruit.

In general, the best approach to using rotations against key resistant pests in apples and peaches (codling moth and oriental fruit moth) is to rotate products from generation to generation. In apples this might look like so …







The sequence illustrated above is not meant to be a specific recommendation, either in terms of the insecticides included or the sequence in which they are presented. Assail (and related neonicotinoids), Altacor, Delegate, and Rimon are all effective alternatives for codling moth control, but Altacor, Delegate, and Rimon do not prevent egg-laying scars from plum curculio and are not effective against apple maggot (or leafhoppers or plant bugs or stink bugs). In peaches, Assail, Altacor, and Delegate are effective against oriental fruit moth, but Altacor and Delegate do not control plum curculio; none are adequately effective against plant bugs and stink bugs. As a result, mixtures with additional insecticides may be necessary at certain times, whatever the rotation scheme is over generations.

Finally, all insecticide labels now bear an "IRAC" mode of action grouping number. IRAC is the abbreviation for the Insecticide Resistance Action Committee, and the committee's classification system includes 29 mode of action groups. The groups and individual compounds are listed at: http://www.irac-online.org/documents/IRAC%20MoA%20Classification%20v5_3.pdf . Rotations intended to delay resistance development should always use ingredients from different mode of action groups.

Rick Weinzierl (217-244-2126; weinzier@iilinois.edu)

Vegetable Production and Pest Management

Effects of winter temperature and host resistance on the probability of exceeding critical thresholds of Stewart's wilt that warrant the use of seed treatment insecticides

Contributed by Snook Pataky (j-pataky@illinois.edu, Mike Meyer, Darin Joos, Ralph Esgar, and Brian Henry

For nearly 75 years, the Stevens-Boewe forecast has been used as a rule of thumb to predict the prevalence of Stewart's wilt based on the effects of winter temperatures on overwintering populations of corn flea beetle, the vector of *Pantoea stewartii*. According to this forecast, the seedling wilt phase of Stewart's disease is likely to be destructive if the average temperature for December, January, and February is above 33°F. If the average winter temperature is below 27°F, Stewart's wilt is unlikely to occur. If the average winter temperature is between 27°F and 33°F, Stewart's wilt occurs at intermediate levels. These associations were based on Stevens' observations of the occurrence of Stewart's wilt on open-pollinated sweet corn cultivars grown in the early-1930s. Many of the sweet corn hybrids commercially available today have much better levels of Stewart's wilt resistance than the cultivars from which Stevens' developed his forecast.

For the past 12 years, the University of Illinois sweet corn pathology and variety testing programs have cooperated to survey the incidence of Stewart's wilt at locations throughout Illinois. One objective of the survey was to develop a data set from which to assess the probability of exceeding critical levels of Stewart's wilt on sweet corn hybrids with different levels of host resistance in relation to ranges of winter temperatures from the Stevens-Boewe forecast. The survey data includes observations of 741 sweet corn hybrids in 79 trials at 16 different locations from 1998 to 2009. Based on these data, levels of host resistance and winter temperature appear to affect the probability of exceeding critical thresholds of Stewart's wilt. This information can be used to make more informed decisions with regard to using seed treatment insecticides to control this disease.

The economic value of neonicotinoid insecticides (e.g., Cruiser, Gaucho, Pancho) relative to their control of Stewart's wilt has been shown previously to be equivalent to yield reductions resulting from about 1% incidence of systemic Stewart's wilt on sweet corn grown for fresh market and about 5% incidence of systemic Stewart's wilt on sweet corn grown for processing. Based on 12 years of survey data, the probability of exceeding 1% or 5% incidence of systemic infection depends on the Stewart's wilt reaction of the hybrids being grown and on winter temperature.

For fresh market growers, the decision to treat or not to treat seed with these insecticides is clear cut in two cases. When the average winter temperature is above 27°F and the hybrid being grown has a moderately susceptible (MS) to susceptible (S) reaction to Stewart's wilt, the probability of exceeding 1% incidence of seedling wilt is about 60%. Thus, seed treatment insecticides are economical more than half of the time (Table 1, Fig. 1). When the average winter temperature is below 27°F and the hybrid has a moderate (M) to resistant (R) reaction to Stewart's wilt, the probability of exceeding 1% incidence of seedling wilt is about 4%, and the seed treatments are not economical.

In two other cases, the use of neonicotinoid seed treatments on fresh market sweet corn are not economical in the long run, but for risk averse growers, seed treatments may have utility as an insurance against variation in levels of production resulting from occasionally severe epidemics. When average winter temperatures are below 27°F but above 24°F and MS to S hybrids are grown, the probability of exceeding 1% incidence is about 22%. When average winter temperatures are above 27°F and M to R hybrids are being grown, the probability of exceeding 1% incidence is about 28%. Therefore, while the seed treatments are not economical in the long run (the probability of exceeding

the 1% threshold is less than 50%), they may prevent economically significant yield losses about a quarter of the time.

For processing sweet corn crops where the economic value of these seed treatments is equivalent to 5% Stewart's wilt, the only situation in which seed treatments may be warranted is when MS to S hybrids are being grown when the average winter temperature exceeds 27°F (Table 2, Fig. 2). In this case, the probability of exceeding 5% Stewart's wilt is about 34%, and the seed treatment insecticides again may have utility for risk averse growers as an insurance against more severe occurrence of the disease. In other cases, the probability of exceeding 5% Stewart's wilt is too low to warrant the use of seed treatment insecticides.

Based on a recent summary of data on the occurrence of Stewart's wilt from seed production fields in Iowa, Stewart's wilt does not occur when the average winter temperature is below 24°F. Obviously, neonicotinoid insecticide seed treatments are unwarranted when winters are this cold.

Table 1. Probability of exceeding 1% incidence of systemic Stewart's wilt

Mean winter temperature[a]	Hybrid reaction to Stewart's wilt	
	MS to S	M to R
> 27°F	0.59	0.28
< 27°F	0.22	0.04

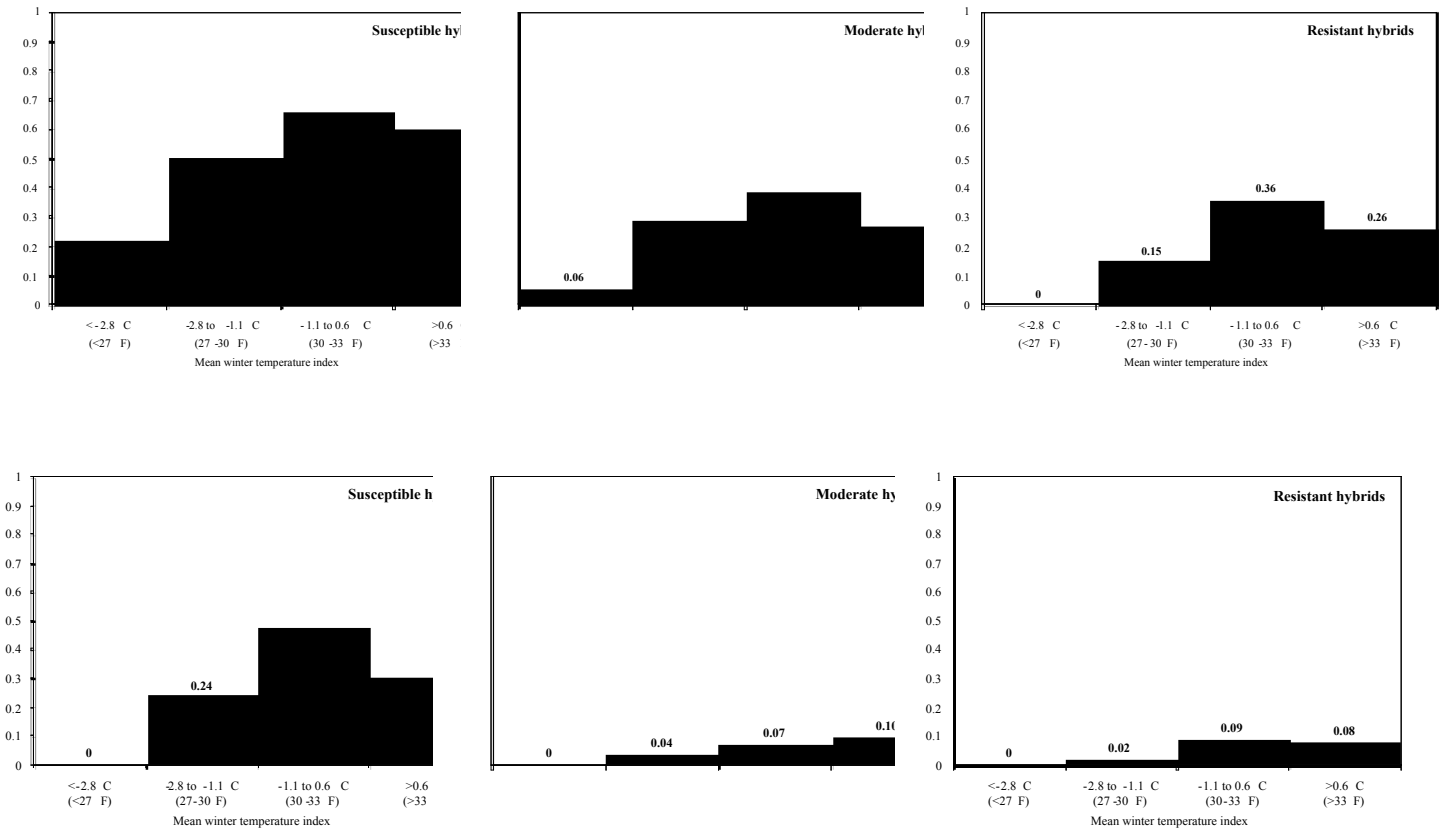
[a] mean temperature in Dec., Jan. and Feb.

Table 2. Probability of exceeding 5% incidence of systemic Stewart's wilt

Mean winter temperature[a]	Hybrid reaction to Stewart's wilt	
	MS to S	M to R
> 27°F	0.34	0.07
< 27°F	0	0

[a] mean temperature in Dec., Jan. and Feb.

Fig. 1. Probability of exceeding 1% systemic Stewart's wilt based on surveys, 1998 to 2009



Less seriously …

How bad is the economy? The economy is sooooo bad that …

- I got a pre-declined credit card in the mail.
- I ordered a burger at McDonald's and the kid behind the counter asked, "Can you afford fries with that?"
- CEO's are now playing miniature golf.
- If the bank returns your check marked "Insufficient Funds," you call them and ask if they meant you or them.
- Hot Wheels and Matchbox stocks are trading higher than GM.
- McDonald's is selling the 1/4 ouncer.
- Parents in Beverly Hills fired their nannies and learned their children's names.
- A truckload of Americans was caught sneaking into Mexico.
- Dick Cheney took his stockbroker hunting.
- Motel Six won't leave the light on anymore.
- The Mafia is laying off judges.
- Exxon-Mobil laid off 25 Congressmen.
- Congress says they are looking into this Bernard Madoff scandal. Oh Great!! The guy who made $50 Billion disappear is being investigated by the people who made $1.5 Trillion disappear!

- And, finally ... I was so depressed last night thinking about the economy, wars, jobs, my savings, Social Security, retirement funds, etc., I called the Suicide Lifeline. I got a call center in Pakistan, and when I told them I was suicidal, they got all excited, and asked if I could drive a truck.

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