PENNSTATE
The Pennsylvania INTEGRATED PEST MANAGEMENT PROGRAM
Pennsylvania Department of AGRICULTURE

Reduced Risk Insect/Mite Management in Tree Fruit 5/11/09

For over 45 years, organophosphate (OP) and carbamate (CB) insecticides have been the cornerstone of apple and peach Integrated Pest Management (IPM) programs in the eastern US. A RAMP research project in seven states, involving 65 apple growers over four years, found OPs and CBs made up 91% of the average total insecticides/miticide usage (6.60 lb ai/A) in northeastern apple production. The same study, in four states involving 19 peach growers, found OPs and CBs constituted almost 97% of the average 4.36 lb ai/A of insecticides/miticides used in northeastern peach production. The broad-spectrum activity of these neurotoxic compounds gives excellent control of most pests that feed directly on the fruit and of some of the indirect pests. From a grower viewpoint, OPs and CB simplify a complex orchard ecosystem by economically and reliably killing the majority of 40+ insect/mite pests, while from an IPM point of view, they also kill most non-target and beneficial arthropods. From the environmental perspective, broadspectrum OP and CB insecticides have affected wildlife and water quality through spray drift, volatilization, and leaching. Over the decades, only a few beneficial insects (i.e. predatory mites & *Stethorus punctum* LeConte) developed resistance to OPs and were incorporated as key components in apple IPM programs. The heavy use of synthetic pyrethroids (SPs) in peaches, have made the incorporation of even these few biological control agents into peach IPM programs unreliable. Many beneficial insects/mites important in the early days of fruit production have not been seen in significant numbers in eastern orchards since the introduction of DDT in the mid-1940s. These include parasitic wasps and flies, some predatory mites, and many generalist predators (See biological control section).

OP and CB insecticides are currently in danger of being lost in tree fruits due to resistance, concern over food safety from residues, acute human exposure in orchards, ground water contamination, and negative impacts on the environment. Passage of the Food Quality and Protection Act (FQPA) required the U.S. Environmental Protection Agency (EPA) to review all pesticide tolerances under new guidelines that place greater emphasis on safety of infants and children. Since apples and peaches are disproportionately consumed by infants and children, they are of special concern. Several OPs have already been lost or have had uses severely curtailed in tree fruits during this process and it is likely that more OPs, CBs and eventually some SPs will be eliminated or restricted in tree fruit production.

FQPA has created incentives for the pesticide industry to develop and register selective insecticides/miticides known as “reduced risk” (RR) that are safer to the consumer and environment, and more IPM compatible. The following are key characteristics of RR insecticides/miticides:

- **Lower risks to human health (generally not neurotoxic) – result in shorter re-entry intervals by orchard workers, less stringent personal protection equipment requirements, and generally shorter pre-harvest intervals after applications.**
- **Lower toxicity to non-target organisms (e.g. birds, fish, plants, & honey bees).**

- **Lower potential for contamination of water & other environmental resources (i.e. don't leach).**
- **Lower use rates, low pest resistance potential.**
- **Broaden the adoption and effectiveness of IPM strategies.**

RR pesticides hold much promise in reducing environmental contamination and non-target effects both inside and outside fruit orchards. The 4 year RAMP research program demonstrated and average pesticide reduction in lb ai/A of mostly OP & CBs of 81% in peach and 82% in apple. While the potency of many newer products which translates into much lower use rates accounts for much of this reduction, the safer characteristics of RR products outlined above makes a pound of a RR product much safer to the environment than a pound of OP, CB or SP.

RR products come in two categories: **a) Chemical pesticides** - (IGRs, neonicitinoids, oxydiazines, etc.) and **b) Biopesticides** - (BT products, spinosad, pheromone disruption, NPV viruses, Kaolin clay etc.). Most RR biopesticides are also acceptable for organic fruit production. See Tables 1 & 2 for some conventional and RR insecticide/miticide options in peach production and Tables 3 & 4 for some conventional and RR options in apple and peach production. For a complete list of options refer to the recommendation from the current issue of the PSU Tree Fruit Production Guide; available on the web at: http://tfpg.cas.psu.edu/).

While these reduced risk (RR) pesticide alternatives have promise in tree fruit production for reducing pesticide risk to the environment and human health, they also pose significant challenges for growers who wish to use them. In the past, the use of broadspectrum insecticides reduced the need to know what pests were causing damage in grower orchards. The decision to treat an orchard was often prevention based and several target pests and many non-target pests were killed in the same treatment by contact activity. Timing of sprays was often not as critical as these non-selective compounds were toxic to all stages of a pest from egg to adult. RR pesticides are often have specific activity to only a particular life stage of a pest and often have little contact activity and therefore must be ingested to give effective control. Timing and spray coverage are often more critical with RR products and many give selective of only give control of a limited spectrum of the pest species present in the orchards. The selectivity of RR pesticides, however, also allows the buildup of many biological control species that have not been reliable control agents or even present in orchards since the introduction of some broadspectrum insecticides/miticides. Biological control was documented to increase from 3- to 8-fold in Pennsylvania RR apple and peach orchards in the 4 year RAMP research project and two new phytoseiid predatory mite biological control agents were documented for the first time in RR apple orchards. For a complete list of insecticide/miticide compatibility/selectivity toward key biological control agents refer to the current issue of the PSU Tree Fruit Production Guide; available on the web at: http://resources.cas.psu.edu/TFPG/Table4_5.pdf.

RR IPM control strategies are more management and information intensive than the conventional programs currently in use. They require a level of sophistication and training in IPM that some growers do not presently have and growers that wish to try Reduced Risk IPM are required to sign up for the Basic IPM Scouting option as well or demonstrate that they have already done this level of monitoring in the past. Growers should be cautioned that Reduced Risk IPM is less forgiving of mistakes or delays in application timing and will be more costly

than conventional IPM programs they are familiar with. Growers are allowed to use the carbamate insecticide, carbaryl (Sevin) for thinning in apple and for Japanese beetle control in peach if necessary as no reduced risk alternatives exist. Because of resistance in predatory mites and its short residual, the use of this pesticide probably has minimal impact on biological control. Pyrethroid applications in both apple and peach are prohibited in RR IPM programs because of their strong negative impact on biological control, especially mite predators. Because relatively few RR products are currently registered in peach, peach growers must also be enrolled in pheromone mating disruption for Oriental fruit moth and for peach tree borers. *A single pyrethroid or OP application is allowed in peach only for emergency situations until more reduced risk pesticides are registered for this crop, but such use will need to be justified.*

RR pesticides are also significantly more expensive than existing conventional options with the RAMP research program's four year average cost in apple being $70/A above the conventional pest management programs and $20/A more for RR peach programs. The cost of the RR IPM programs was highest in the first season of management but consistently declined through time as familiarity with the orchards and pest populations increased, as some pest populations were reduced by more effective control, and as biological control agents (i.e. predatory mites) became effective. Protection of the harvested fruit in RR IPM programs was at least equivalent to that obtained with grower IPM programs using conventional pesticides, and in the case of peaches, fruit protection at harvest was slightly superior. The overall difference in net return to the grower was $100/A less than the conventional program in apple and $50/A less in peach.

<u>Checklist</u>

Which crops were managed with RR IPM programs? apple and/or peach

Are they signed up and have followed the criteria for Basic Insect Monitoring and Trapping? (if no, disqualify).

Are they signed up and have followed the criteria for OFM disruption in peach if the crop is peach?

Did they use OPs, CBs (other than Sevin) for thinning, or SPs post-bloom in apple? (if yes, disqualify)

Did they use more than a single application of an OP **or** SP in peach? (if yes, disqualify)

Did they use a carbamate other than Sevin (i.e. Lannate) in peach? (if yes, disqualify)

Do they have a copy of the Pennsylvania Tree Fruit Monitoring Guide and are familiar with it? (if no, disqualify).

Do they have a weather monitoring station, access to remote weather information (i.e. Skybit), or regularly access the PSU Fruit Research & Extension Center at Biglerville website for pest development information? (if no, disqualify).

Do they use establish pest biofixes from pheromone trap catches and use phenology models to time spray applications for key pests? (if no, disqualify).

Are they familiar with various RR pesticide chemistries, modes of action, and their effectiveness on key pests? Do they rotate pesticides for resistance management (if no, disqualify).

Did they keep records from monitoring, pheromone trap catches, and fruit injury sampling? (if no, disqualify)

What have they done to encourage biological control agents?

Did they conduct the monitoring and sampling themselves or hire a crop consultant?

Reduced Risk Peach IPM & Conventional Control Options

Table 1. Arthropod pests and broad-spectrum materials targeted for pest management in conventional peach orchards.

Arthropod Pests	Organophosphate	Carbamate	Pyrethroid
Oriental fruit moth	Imidan – resistant in some areas	Sevin, Lannate	Asana, Danitol, Warrior, Proaxis,
Leafrollers	Resistant	Lannate	Asana, Danitol, Warrior, Proaxis,
Plum curculio	Imidan	Sevin, Lannate	Asana, Danitol, Warrior, Proaxis,
Tarnished plant bug Stink Bugs	Lorsban, Imidan, Diazinon	Sevin	Asana, Danitol, Warrior, Proaxis,
Green Peach Aphid	Resistant	Resistant	Asana, Warrior
San Jose Scale	Lorsban	Lannate, Vydate	Asana, Warrior
Mites * Most miticides in their own classes. Most important in peach are Nexter, Acramite, Fujimite, Kanemite	Resistant	Resistant	Danitol
Lesser Peachtree Borer Peachtree Borer	Lorsban	Not effective	Not effective
Western flower thrips	None	Lannate	Not effective - PHI restrictions

Table 2. Arthropod pests and materials targeted for pest management in reduced-risk-peach orchards.

Arthropod Pests	Neonicitinoid	Insect Growth Regulators	Pheromone	Oxadiazine, Anthranilamide	Miticide	Antibiotic
Oriental fruit moth	Assail, Beleaf	Intrepid, Rimon	Isomate ties, Hercon clips, Suterra ties 3M sprayable	Avaunt Altacor, Belt, Voliam Flexi	Not effective	Delegate
Leafrollers	Not effective	Intrepid	None	Altacor	Not effective	Spintor, Delegate
Plum curculio	Actara, Assail	Not effective	Not effective	Avaunt, Altacor	Not effective	Not effective
T. plant bug Stinkbug	Actara, Assail, Beleaf, Provado	Not effective	Not effective	Not effective	Not effective	Not effective
Green Peach Aphid	Provado, Actara, Assail, Beleaf, Voliam Flexi	Not effective, promote biological control	Not effective, promote biological control	Not effective, promote biological control	Not effective	Not effective
Leafhoppers	Provado, Actara, Assail, Beleaf, Voliam Flexi	Not effective, promote biological control	Not effective, promote biological control	Not effective, promote biological control	Not effective	Not effective
San Jose Scale White Peach Scale	Provado, Actara, Assail – timing critical.	Esteem	Not effective, promote biological control	Not effective, promote biological control	Not effective	Not effective, promote biological control
Mites *mite growth regulators – Apollo, Savey	Not effective	Zeal, Envidor, IGRs promote biological control	Not effective, promote biological control	Not effective, promote biological control	Envidor, Zeal, Savey, Apollo safe to *T. pyri*	none
L. Peachtree Borer Peachtree Borer	Not effective	Not effective, promote biological control	Isomate LPTB & PTB ties, Isomate PTB Dual	Not effective, promote biological control	Not effective	Not effective, promote biological control
Western flower thrips	Not effective - PHI restrictions	Not effective, promote biological control	Not effective, promote biological control	Not effective	Not effective	Spintor, Delegate

Table 3. Arthropod pests and broad-spectrum materials targeted for pest management in conventional apple orchards.

Arthropod Pests	Organophosphate	Carbamate	Miticides	Pyrethroid
Codling moth	Guthion, Imidan – some resistance	Sevin, Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Oriental fruit moth	Guthion, Imidan, Lorsban through petal fall	Sevin, Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Leafrollers	Resistant	Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Plum curculio	Guthion, Imidan	Sevin, Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Apple maggot	Guthion, Imidan	Sevin, Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Tarnished plant bug	Lorsban, Guthion, Imidan	Sevin, Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
European apple sawfly	Lorsban, Guthion, Imidan, Diazinon	Not used – bee toxicity	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Green/Spirea Aphids	Resistant, diazinon & dimethoate somewhat effective	Lannate	Not effective	Resistant
Wooly Apple Aphid	Supracide, Lorsban	Not used	Not effective	Some areas resistant -Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Leafhoppers	Early season use only not effective	Sevin, Lannate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
San Jose Scale	Lorsban	None	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Leafminers	Resistant	Lannate, Vydate	Not effective	Asana, Danitol, Warrior, Proaxis, Baythroid, Decis
Mites	Resistant	Resistant	Kanemite, Onager, Portal, FujiMite – disruptive to *T. pyri*	Danitol

Table 4. Arthropod pests and materials targeted for pest management in reduced-risk apple orchards.

Arthropod Pests	Neonicitinoid	Insect Growth Regulators, Miticides &Tetramic Acid	Pheromones & Biopesticides	Oxadiazine, Anthranilamide	Antibiotic
Codling moth	Assail, Calypso, Clutch	Intrepid, Rimon	Isomate ties, Suterra clips, Hercon clips (many kinds) CydX, Carpovirusine	Avaunt, Altacor, Belt, Voliam Flexi	Delegate
Oriental fruit moth	Assail, Calypso, Clutch	Intrepid, Rimon	Isomate ties, Hercon clips, 3M sprayable	Avaunt, Altacor, Belt, Voliam Flexi	Delegate
Leafrollers	Not effective	Intrepid, Rimon	Isomate ties 3M sprayable, Bt	Altacor, Belt, Voliam Flexi	Spintor, Proclaim Delegate
Plum curculio	Assail, Calypso, Actara	Not effective	Not effective	Avaunt	Not effective
Apple maggot	Assail, Calypso, Provado	Not effective	Not effective	Avaunt	Spintor
Tarnished plant bug	Assail, Calypso, Actara, Provado, Clutch, Beleaf	Not effective	Not effective	Not effective	Not effective
European apple sawfly	Assail, Calypso, Actara	Not effective	Not effective	Avaunt	Not effective
Rosy, Green/Spirea Aphids	Assail, Calypso, Actara, Provado, Clutch, Beleaf	Not effective, promote biological control	Not effective, promote biological control	Not effective, promote biological control	AgriMek
Wooly Apple Aphid	Assail, Calypso, Actara, Provado, Clutch, Beleaf	Esteeem, Movento	Not effective, promote biological control	Not effective, promote biological control	Not effective
Leafhoppers	Assail, Calypso, Actara, Provado, Clutch, Beleaf, Voliam Flexi	Not effective, promote biological control	Not effective, promote biological control	Not effective, promote biological control	AgriMek, Spintor, Delegate
San Jose Scale	Assail, Calypso	Movento, others promote biological	Not effective, promote biological control	Not effective, promote biological control	Not effective, promote biological

		control			control
Leafminers	Assail, Calypso, Actara, Provado, Clutch, Voliam Flexi	Intrepid, Rimon, Altacor, Belt promote biological control	Not effective, promote biological control	Not effective, promote biological control	AgriMek, Spintor, Delegate
Mites	Not effective, promote predatory mites	Envidor, Zeal, Savey, Apollo safe to *T. pyri*	Not effective, promote biological control	Not effective, promote biocontrol	AgriMek