Reduced-Risk Insecticides For Leafy Vegetables and Melons

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In the past few years, there has been considerable mention of the development and use of “Reduced-risk” pesticides in agricultural crops. This should be of particular interest to local growers and PCA’s because several new insecticides recently registered on vegetable and melons are considered Reduced-risk compounds. These new compounds are becoming increasing important in our pest management programs and I would like to provide a brief overview of what reduced-risk insecticides are and how they fit within our desert cropping system.

Reduced-risk pesticides are newer classes of compounds that pose a lower health risk to humans and the environment. This new classification and registration process resulted when the EPA implemented the Reduced-Risk Pesticides Initiative in 1993 to provide incentives to encourage the development and registration of pesticides that present *lower risks to public health* and the *environment*, and to encourage the *replacement* of higher risk pesticides in the marketplace. Although FQPA was not passed until 1996, the Reduced-risk initiative began the process for the replacement of organophosphate pesticides. EPA technically defines a Reduced-risk pesticide use as one which "may reasonably be expected to accomplish one or more of the following": (1) reduces pesticide risks to human health; (2) reduces pesticide risks to non-target organisms; (3) reduces the potential for contamination of valued, environmental resources, or (4) broadens adoption of IPM or makes it more effective. The agency has established criteria for each category by which a candidate compound must meet before reduced-risk status is granted. Perhaps the most significant advantage of the program to manufactures and growers is that Reduced-risk compounds are given special consideration during registration. FQPA requires the EPA to expedite the review of compounds that meet the Reduced-risk criteria, and EPA considers these low risk compounds a priority in the registration process where pesticide submissions are reviewed based on the following prioritization: (1) methyl bromide alternatives, (2) OP alternatives that pass the Reduced-risk screen, (3) other Reduced-risk candidates, (4) OP alternatives, but denied Reduced-risk status, (5) USDA-EPA identified potentially vulnerable crops, (6) Minor use priorities and (7) non-minor use priorities. This process has in some cases resulted in products gaining federal labels in as little as 14 months. A recent report by IR-4 estimates that 35 reduced-risk compounds are presently registered (10 herbicides, 13 fungicides and 12 insecticides) on a variety of crops and 10 products are currently considered Reduced-risk candidates for registration (2 herbicides, 5 fungicides, and 3 insecticides).

Another significant initiative to encourage the development of lower risk pesticides was the establishment of the Biopesticide and Pollution Prevention Division in 1994 to review and register biopesticides. As defined by EPA, biopesticides are classes of pesticides derived from natural materials found in certain animals, plants, microbial organisms, and minerals. Biopesticides fall into three major classes: (1) *Microbial pesticides* that consist of a microorganism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt. (2) *Plant-Incorporated-Protectants* which are pesticidal substances that plants produce from genetic material that has been added to the plant. Bollguard cotton is an example of a biopesticide which resulted from a gene taken from the Bt pesticidal protein, and introduced into the plant's own genetic material, and (3) *Biochemical pesticides*, which are naturally occurring substances that control pests by non-toxic mechanisms. Biochemical pesticides include substances, such as insect pheromones, plant extracts (mustard oil, limonene), Natural IGR’s (azadirachtin, neem oil), and repellents (garlic, capsaicin). Biopesticides are inherently less toxic than conventional pesticides, both to humans and target pests. Finally, biopesticides can be extremely effective control agents, for example Bt cotton against pink bollworm. However, other biopesticides have shown only limited activity against pests in vegetables and melons. As of January 2002 , there were approximately 195 registered biopesticide active ingredients and 780 products.

Shown in Table 1 below is a list of conventional, Reduced-risk, OP alternative insecticides and biopesticides presently registered or pending approval for use on leafy vegetables and melons. All of the listed compounds have shown activity or are presently used against target insect pests found in the desert. You will note that we presently have 7 insecticide products that EPA has designated as Reduced-risk compounds. Although, several biopesticides are available, only Bt (e.g., Dipel, Xentari, Javelin) and azadirachtin-based products (e.g., AZADirect, Ecozin, Neemix, Trilogy) have shown any measurable activity against some insect species. I also present additional tables and discussions on the use of conventional, Reduced-risk, and OP alternative insecticides for managing target pests individually in specific use windows during the leafy vegetable or melon crop season. These tables and descriptions are meant to be used as general guidelines by growers and PCA’s for integrating these products into their pest management programs

Table 1	Insecticide Alternatives for Leafy Vegetables and Melons			
	Conventional	**Reduced-Risk**	**OP Alternative**	**Biopesticide**
Worms: including beet armyworm, cabbage looper, & budworm	Lannate Larvin Orthene endosulfan	Success Avaunt Confirm *Intrepid*	Proclaim Warrior Mustang *Decis*	Bt, aizawai Bt, kustaki Azadirachtin
Whiteflies	Capture Danitol Endosulfan Orthene	Applaud Assail Fulfill	Admire Platinum Actara *Calypso*	
Aphids	Endosulfan Orthene Capture MSR	Assail Fulfill	Admire Platinum Actara *Pirimor*	Azadirachtin
Leafminers	AgriMek Trigard Vydate	Success		Azadirachtin
Flea Beetles	Lannate Ambush/Pounce Diazinon	Assail	Admire/Provado Mustang Warrior	
Thrips	Lannate Orthene Dimethoate AgriMek	Success Assail	Warrior Mustang	

Italicized compounds are presently pending registration on melons or leafy vegetables

Worm Control in Lettuce: We presently have a great deal of information on the new Reduced-risk and OP alternative chemistries and their fit in lettuce pest management programs. These products have specific use patterns on head lettuce relative to their unique characteristics (Table 2). This would include temporal mortality, residual efficacy, route of activity, efficacy relative to application method and interaction with larval development and feeding behavior. The table below was constructed from data gathered over the past six years and suggests uses for each compound for the protection against beet armyworm, cabbage looper, and budworm/bollworm in lettuce crops. Table 2 is organized by identified stages in plant growth throughout the crop season. The fit within the table for each active ingredient corresponds with its recommended use.

Table 2	Alternatives for Worm Control at Specific Lettuce Crop Stages							
	Stand establishment		***Thinning to Heading***			***Heading to Harvest***		
Success								●
Proclaim							●	●
Avaunt				●	●	●		
Intrepid				●	●	●		
Confirm			●	●				
Lannate	●	●	●	●	●	●	●	●
Larvin			●	●				
Orthene			●	●				
endosulfan			●	●				

● pyrethroid tank mixtures recommended (Warrior, Mustang)

Thinning Stage: Depending on population pressure and temperature, 1-3 applications may be required for larval control during this period. It is assumed that many applications will be by air because of sprinkler irrigation and wet fields during this period. Lannate+pyrethroid is a good option for initial control at stand establishment because of the excellent contact and ovicidal activity, broad-spectrum efficacy against many soil-dwelling pests, and proven efficacy by air. Success and Proclaim have demonstrated good activity against BAW/CL by air, but should be used after emergence because of selective efficacy. If leafminer is also a concern, Success at higher rates (6.0 oz) can be used. *Post-thinning / Pre-heading stage*: All of the compounds are options for control during this period. The opportunity to use ground application equipment is also greater. Confirm use should be directed towards the post-thinning period, and addition of pyrethroid should be used because of its inconsistent performance on budworm/bollworm. Avaunt and Intrepid (registration pending) should be applied at the higher rates with ground equipment whenever possible. Orthene and endosulfan combinations are useful during spring crops because of activity on aphids and thrips. *Heading-Harvest stage*: perhaps the most important period in which plant protection is required. Fewer options, but several effective compounds are available. Addition of pyrethroid with all active ingredients 7-10 days before harvest may enhance control of small larvae and miscellaneous pests such as beetles, plant bugs and thrips.

Whitefly Control in Melons: The number of insecticide products available for whitefly control in melons has increased dramatically in the past few years (Table 3). Growers now have a number of alternatives from which to choose, including pre-and post-plant soil applications and a number of foliar uses. *Soil uses*: are restricted to Admire and Plantinum, both neonicotinoids, and both of which can be applied pre- and post-planting. Admire is most consistent as a pre-plant application, but effective as a post-plant when applied through drip irrigation, whereas Platinum has demonstrated good activity as a side-dress application in furrow irrigated melons. *Foliar uses*: Two Reduced-risk products, Applaud and Fulfill, are available for foliar uses. Both are practically non-toxic to bees and natural enemies, and can be applied during periods of bloom. Applaud should be targeted towards immatures and Fulfill is primarily active against adults. Actara is a neonicotinoid (same a.i. as Platinum) with foliar activity, but because it is toxic to bees should not be used when bees are foraging. Calypso (registration pending) is a neonicotinoid product that can be used throughout the season due to its bee safety and good activity on immatures. *Note: for resistance management purposes, neither Actara or Calypso should be applied to melons previously treated with soil applications of Admire or Platinum.* Finally, Capture or Danitol, in combination with endosulfan, provide good broad-spectrum control of whiteflies, worms and other pests when bees are not present in the field.

Table 3

	Alternatives for Whitefly Control at Specific Melon Crop Stages				
	Soil		**Foliar**		
	At plant	***Post-plant***	***Pre-bloom***	***Bloom***	***Pre harvest***
Admire					
Platinum					
Applaud					
Fulfill					
Actara					
Calypso					
Capture/Thiodan					
Danitol/Thiodan					

Aphid Control in Leafy Vegetables: : Similarly, growers now have a number of alternatives for aphid control from which to choose (Table 4). *Soil uses*: Admire and Plantinum (pending registration in lettuce), can both be applied pre- and post-planting, but similar to above, are most consistent as pre-plant applications. Platinum has demonstrated good activity at planting and as a side-dress application in furrow irrigated melons. *Foliar approaches*: Two reduced risk products, Assail and Fulfill, are available. Both are very effective against aphids (primarily green peach and potato aphids) and can be used throughout the growing season. Additionally, Actara (pending registration in lettuce) and Pirimor (pending registration) provide good aphid control. Provado, used in combination with Orthene, not only provides good aphid control, but offers thrips suppression as well. These products represent several modes of action that can be alternated successfully to manage aphid populations, and

reduce resistance risks. *Note: For resistance management purposes, neither Actara, Assail or Provado should be applied to melons previously treated with soil applications of Admire or Platinum.* In areas where Lettuce and Foxglove aphids are present, Metasystox-R has shown to be very effective, as have Provado+Orthene, and Assail+Capture applied at 7-10 day intervals.

Table 4

	Alternatives for Aphid Control at Specific Lettuce Crop Stages				
	Soil		**Foliar**		
	At plant	**Post-plant**	**Thinning**	**Pre-heading**	**Pre- harvest**
Admire					
Platinum					
Assail					
Fulfill					
Actara					
Pirimor					
Provado/Orthene					
Provado/Thiodan					
Metasystox -R					

Leafminer Control: Success is the only Reduced-risk compound with activity against *Liriomyza* leafminers. It is particularly effective against *L. sativae*, but will provide *L. trifolii* control at higher rates. It is useful in lettuce where leafminer suppression is provided following application for worm control in fall crops. Under heavy pressure, AgriMek is an effective alternative in both melons and leafy vegetables.

Flea Beetle Control: Assail is the only Reduced-risk compound evaluated that provided control of striped and desert flea beetles. Several conventional products (Lannate, pyrethroids, diazinon) still provide excellent knockdown of flea beetles on a number of crops. In fall melons, Admire provides good protection from both flea beetles species.

Thrips Control in Leafy Vegetables: Two Reduced-risk compounds have activity against western flower thrips in head and leaf lettuce. Success is perhaps the most efficacious of the two, and is an effective alternative that should be used in rotation with Lannate+pyrethroid mixtures for thrips management in spring lettuce. Assail provides marginal suppression of thrips (~50% control), but will only be useful in rotational spray programs where Admire or Platinum have not been applied for spring aphid control. Agrimek (8 oz/acre) is an effective thrips material in lettuce, with efficacy similar to Success (6 oz/acre).

Sustaining Product Efficacy: The above information offers several options that can be used for managing insect pests at various times throughout the growing season. This information can also serve as a guide to PCAs and growers for avoiding the overuse of a single product, and as a reference for rotating chemistries throughout the season for the purpose of maximizing control and sustaining product efficacy. In addition, other tactics can be practiced to avoid the development of resistance to any of these new active ingredients. First, whenever possible, avoid making consecutive applications of the same active ingredient to the same field. This also includes pyrethroids. Second, do not apply any active ingredient below labeled rates. Finally, avoid tank-mixtures containing 2 or more of the new Reduced-risk chemistries when controlling insect pests. Not only is this expensive, but generally not necessary based on the past performance of the conventional and Reduced-risk products. Ideally, these strategies will optimize control of key insect pests and maximize the longevity of all these compounds. I recognize that in certain situations these management guidelines may be difficult to follow, but emphasize that they may be necessary for the long-term sustainability of these valuable chemistries on desert vegetable and melon crops.

Additional Information on Reduced–Risk Pesticides is available at these internet sites:

- IR-4, Minor Crops Program, *http://cipm.ncsu.edu/IR-4/*
- EPA, Office of Pesticide Programs, *http://www.epa.gov/pesticides/*
- UA, Arizona Crop Information Site, *http://ag.arizona.edu/crops/*

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Because labels are subject to frequent change, always consult the label attached to the product before using any pesticide. The user must assume responsibility for proper application and for residues on crops as well as for damage or injury caused by pesticides, whether to crop, person or property.