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PI224

The EPA Conventional Reduced Risk Pesticide Program[1]

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Introduction

The Food Quality Protection Act (FQPA) of 1996 initiated the U.S. Environmental Protection Agency's (EPA) Conventional Reduced Risk Pesticide Program. Its purpose is to expedite the review and registration process of conventional pesticides that pose less risk to human health and the environment than existing conventional alternatives. Riskier conventional alternatives are those pesticides EPA deems as having neurotoxic, carcinogenic, reproductive, and developmental toxicity, or groundwater contamination effects. It serves as a means to ensure that reduced risk pesticides enter the channels of trade and are available to growers as soon as possible. Reduced risk decisions are made at the use level. The program does not apply to biological or antimicrobial pesticides, which are handled through separate expediting processes.

Advantages of Reduced Risk Pesticides

Compared to existing conventional pesticides, reduced risk pesticides may provide a number of benefits:

- low impact on human health
- lower toxicity to nontarget organisms (e.g., birds, fish, plants)
- low potential for groundwater contamination
- low use rates
- low pest resistance potential
- compatibility with Integrated Pest Management (IPM) practices

Criteria for Consideration

EPA established an expedited review for manufacturers applying to register pesticides that may reasonably be expected to accomplish at least one of the following:

- reduce the risks of pesticides to human health
- reduce the risks of pesticides to nontarget organisms
- reduce the potential for contamination of groundwater, surface water, or other valued environmental resources
- broaden the adoption of IPM strategies, or make such strategies more available or more effective

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Carbamate and Organophosphate Pesticides and Current Use Trends

Carbamates and organophosphates (OPs) are a group of closely related pesticides used in agriculture and nonagricultural sites that affect functioning of the nervous system by targeting the cholinesterase system. A main concern with these insecticides is acute toxicity. Additionally, one member of the carbamates widely used in Florida, aldicarb, is strictly regulated largely because of groundwater contamination concerns. Carbamates and OPs are among EPA's first priority group of pesticides for review under the FQPA. EPA made alternatives to OP pesticides the first priority for review and regulatory decision-making. The conventional Reduced Risk Pesticide Program screens OP alternatives for this initiative. Table 1 provides a list of reduced risk and OP alternative pesticides currently registered for use in the United States. Some active ingredients listed in Table 1 are not registered for use in Florida.

EPA determines if a candidate is a potentially significant OP alternative by an approach that includes, but is not limited to, consideration of the following factors:

- The affected OPs collectively have a significant market share for the specified use pattern.
- Currently registered alternatives, if any exist, have constraints that prevented their widespread adoption as alternatives to the affected OPs, such as inferior efficacy or pest-resistance issues.
- The proposed reduced risk alternative appears to overcome many of the constraints of the alternatives.

The IR-4 (Interregional Research Project No. 4) program is involved in making sure that pesticides are registered for use on minor crops. Minor-use pesticides are those that, for a variety of reasons, produce relatively little revenue for their manufacturers; they may be registered for use with a seldom-seen pest or for a crop that is not grown by a large number of producers. However, in Florida's agricultural setting, minor crops include some high-revenue fruit, vegetable, and ornamental crops. Based on publicly available data from the California Department of Pesticide Regulation and the CropLife Foundation, a 2009 report by IR-4 indicated that from 1994 to 2006, OP use in the United States has shown an overall decline by approximately 50%. During the same period, carbamate use declined 70%.

A direct benefit of the reduction has been to the environmental load. The environmental load is the rate of application (lbs/acre) of chemicals to the environment. The reduced risk pesticides are generally used at significantly lower application rates than the conventional compounds they are replacing, which has the effect of decreasing the amount of chemical applied to the environment. The trend from 1994 to 2006 has shown a 45% combined decrease in the environmental load for the carbamate and organophosphate insecticides.

Acute toxicity concerns have also been addressed with the increased number of reduced risk pesticides currently registered for use. Of the cholinesterase-inhibiting insecticides, 73% of these compounds most widely used in the United States fall into the highest toxicity class of EPA and none are in the safest class. By contrast, 64% of the reduced risk insecticides fall into the highest safety class, and the rest are in the next safest group III.

Additional Information

Fishel, F.M. 2011. *Pesticide Toxicity Profile: Organophosphate Pesticides*. PI-50. Gainesville: University of Florida Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/pi087.

Fishel, F.M. 2012. *Pesticides and Cholinesterase*. PI-221. Gainesville: University of Florida Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/pi221.

Fishel, F.M. 2013. *Specifically Regulated Pesticides in Florida - Aldicarb*. PI-74. Gainesville: University of Florida Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/pi111.

Nesheim, O.N., F.M. Fishel, and M.A. Mossler. 2011. *Toxicity of Pesticides*. PI-13. Gainesville: University of Florida Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/pi008.

Olexa, M.T., and Z. Broome. 2011. *Handbook of Florida Water Regulation: Food Quality Protection Act*. FE589. Gainesville: University of Florida Institute of Food and Agricultural Sciences. http://edis.ifas.ufl.edu/fe589.

Viray, F.A., and R. Hollingworth. 2009. "The Use and Benefits of Reduced Risk Pesticides since the Passage of the Food Quality Protection Act." *The IR-4 Project Newsletter* Volume 40, Number 4. New Jersey Agricultural Experiment Station. Accessed March 2013. http://ir4.rutgers.edu/Newsletter/vol40no4.pdf.

Table 1. Reduced risk (RR)/OP alternative pesticides registered in the United States.

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
1994	*Hexaflumuron*	Insecticide	Belowground bait station (termites)	RR
	Methyl anthranilate	Repellent	Cherry, blueberry, grape, forestry	RR
1995	*Flumiclorac-pentyl*	Herbicide	Corn, soybean	RR
	Tebufenozide	Insecticide	Walnut	RR
	Hymexazol	Fungicide	Sugar beet (seed treatment)	RR
1996	*Fludioxonil*	Fungicide	Corn	RR
	Imazapic	Herbicide	Peanut	RR
	Mefenoxam	Fungicide	All metalaxyl uses	RR
1997	*Azoxystrobin*	Fungicide	Non-residential turf	RR
	Spinosad	Insecticide	Cotton	RR
	Alpha-metolachlor	Herbicide	All metolachlor uses	RR
	Imazamox	Herbicide	Soybean	RR
	Hexaflumuron	Insecticide	Aboveground bait station (termites)	RR
	Azoxystrobin	Fungicide	Grape, banana, peach, tomato, pecan, peanut	RR
1998	Fludioxonil	Fungicide	Potato and seed treatments (many crops)	RR
	Diflubenzuron	Insecticide	Belowground bait station (termites)	RR
	Cyprodinil	Fungicide	Stone fruit	RR
	Spinosad	Insecticide	Almond, apple, citrus, brassica leafy vegetables, fruiting vegetables, and leafy vegetables	RR
	Pyriproxyfen	Insecticide	Cotton	RR
	Tebufenozide	Insecticide	Pecan	RR
	Carfentrazone-ethyl	Herbicide	Wheat, corn	RR
1999	Azoxystrobin	Fungicide	Turf (residential), almond, cucurbit vegetables, rice, wheat, canola, potato, stone fruit	RR
	Diflufenzopyr	Herbicide	Corn	RR
	Tebufenozide	Insecticide	Leafy, brassica, and fruiting vegetables, cranberry, forestry, ornamentals, berry crop group, mint, pome fruit, cotton, sugarcane, turnip, canola	RR/OP
	Pyriproxyfen	Insecticide	Pome fruit, walnut	RR/OP
	Glyphosate	Herbicide	Glyphosate-tolerant corn, canola, sugar beet	RR
	s-Dimethenamid	Herbicide	Corn, soybean, peanut	RR
	Spinosad	Insecticide	Sweet corn, cucurbit and legume vegetables, stone fruit, cereal grains	RR/OP
	Fenhexamid	Fungicide	Grape, strawberry, ornamentals	RR
	Bifenazate	Insecticide	Ornamentals	RR/OP
	Trifloxystrobin	Fungicide	Pome fruit, grape, cucurbit vegetables, peanut, turf, banana, ornamentals	RR
	Fipronil	Insecticide	Outside home use (termites)	OP
	Pymetrozine	Insecticide	Tuberous and corm vegetables, ornamentals, tobacco	RR/OP

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2000	Pyriproxyfen	Insecticide	Citrus, fruiting vegetables, tree nuts	RR/OP
	Tebufenozide	Insecticide	Ornamentals (residential), tree nuts	RR/OP
	Ecolyst	Herbicide/ Insecticide/Plant growth regulator	Orange	RR
	Spinosad	Insecticide	Non-grass animal feed crop group, grain amaranth, cilantro, grass, buckwheat, rye, pistachio, oat, barley, millet, apple, popcorn, ti leaves, watercress, tropical fruit, teosinte, turnip greens	RR/OP
	Fenhexamid	Fungicide	Almond, stone fruit	RR
	Prohexadione calcium	Herbicide/ Plant growth regulator	Apple	RR
	Methoxyfenozide	Insecticide	Cotton, pome fruit	RR/OP
	Trifloxystrobin	Fungicide	Almond, fruiting vegetables, hops, potato, sugar beet, wheat, ornamentals	RR
	Carfentrazone-ethyl	Herbicide	Cereal grains	RR
	Buprofezin	Insecticide	Cucurbit vegetables, head lettuce	RR/OP
	Fenpyroximate	Insecticide	Ornamentals (greenhouse)	RR/OP
	Indoxacarb	Insecticide	Cotton, fruiting and brassica leafy vegetables, lettuce, sweet corn, pome fruit	RR/OP
	Flucarbazone-sodium	Herbicide	Wheat	RR
	Glyphosate	Herbicide	Many: refer to http://www.epa.gov/opprd001/workplan/completionsportrait.pdf	RR
	Azoxystrobin	Fungicide	Barley, onion, citrus, corn (field, sweet, pop), cotton, leafy, root, and tuberous vegetables, soybean	RR

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2001	Fipronil	Insecticide	Home lawn, golf course, commercial and recreational turf and sod farms (fire ant), potting medium mixtures (fire ant)	OP
	Thiamethoxam	Insecticide	Barley, canola, cotton, sorghum, wheat (all seed treatment), cotton, pome fruit, cucurbit, fruiting, tuberous, and corm vegetables (all foliar)	OP
	Fludioxonil	Fungicide	Strawberry, bulb vegetables, turf	RR
	Pyriproxyfen	Insecticide	Food handling establishments	RR
			Pistachio	RR/OP
	Imidacloprid	Insecticide	Leaf petioles, citrus	OP
	Zoxamide	Fungicide	Grape, cucurbit vegetables, tomato	RR
	Prohexadione calcium	Plant growth regulator	Grass (grown for seed)	RR
	Pyriproxyfen	Insecticide	Pistachio	RR/OP
	Mesotrione	Herbicide	Corn (field)	RR
	Cyprodinil	Fungicide	Onion (dry, bulb, and green), strawberry	RR
	Buprofezin	Insecticide	Almond, citrus, cotton, grape, tomato	RR/OP
	Carfentrazone-ethyl	Herbicide	Cotton (defoliant use)	OP
			Turf	RR
	Fluazinam	Fungicide	Peanut, potato	RR
	zeta-Cypermethrin	Insecticide	Alfalfa, corn (field, pop, sweet), head and stem brassica vegetables, leafy brassica greens, leafy vegetables, onion (green), sugar beet, sugarcane, rice	OP
	Azoxystrobin	Fungicide	Leafy brassica greens, blueberry, eggplant, grass (grown for seed), jackfruit, juneberry, lingonberry, loquat, mint (spearmint, peppermint), okra, pawpaw, pepper, persimmon, salal, strawberry, tamarind, tropical fruit, turnip (greens), watercress, wax jambu, white sapote	RR
	Novaluron	Insecticide	Ornamentals (indoors, non-food)	RR
	Spinosad	Insecticide	Artichoke (globe), asparagus, bushberry, cranberry, foliage of legume vegetables, garden beet (root), juneberry, leaves of root and tuber vegetables, lingonberry, okra, pistachio, pome fruit, salal, strawberry, sugar beet (root), tree nuts	RR/OP

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2002	Chlorfenapyr	Insecticide	Post-construction control of termites	OP
	Imazamox	Herbicide	Alfalfa, canola, legume vegetables, wheat	RR
	Pymetrozine	Insecticide	Cotton, leafy, head and stem brassica, and leafy brassica vegetables, hops	RR/OP
			Pecans	OP
	Bifenazate	Insecticide	Cotton, grapes, hops, nectarine, peach, plum, pome fruit, strawberry	RR/OP
	Acetamiprid	Insecticide	Cotton, pome fruit, citrus, grapes, brassica leafy, leafy (excl. brassica), and fruiting vegetables, ornamentals	RR/OP
	Trifloxystrobin	Fungicide	Citrus, corn (field, pop), pecan, rice, stone fruit	RR
	Cyhalofop-butyl	Herbicide	Rice	RR
	Indoxacarb	Insecticide	Alfalfa, peanut, potato, soybean	RR/OP
	Fludioxonil	Fungicide	Caneberry, pistachio, stone fruit, watercress	RR
	Pyriproxyfen	Insecticide	Stone fruit, blueberry, lychee, guava	RR/OP
	Imazethapyr	Herbicide	Rice	RR
	Diflufenzopyr	Herbicide	Corn (pop, sweet), grass (forage, hay)	RR
	Macalayea extract	Fungicide	Greenhouse ornamentals	RR
	Azoxystrobin	Fungicide	Legume vegetables	RR
	Methoxyfenozide	Insecticide	Fruiting, leafy, and brassica leafy vegetables, grapes, corn (field, sweet), stone fruit, tree nuts	RR/OP
	Fenamidone	Fungicide	Lettuce	RR
	Lambda-cyhalothrin	Insecticide	Legume and fruiting vegetables, sugarcane	RR (sugarcane)/OP (all)
	Spinosad	Insecticide	Berry group, fig, grape, herbs, peanut, root and tuber vegetables	RR/OP

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2003	Lambda-cyhalothrin	Insecticide	Termite barrier	RR
	Pyriproxyfen	Insecticide	Brassica leafy and cucurbit vegetables, olive	RR/OP
	Cyprodinil	Fungicide	Bushberry, caneberry, pistachio, watercress, brassica leafy vegetables, carrot, herbs, lychee fruits	RR
	EH-2001 Rodenticide	Rodenticide	Richardson/Wyoming ground squirrel	RR
	Mesotrione	Herbicide	Corn (pop)	RR
	Noviflumuron	Insecticide	Aboveground bait station	RR/OP
	Pyriproxyfen	Insecticide	Avocado fruits, fig, okra, sugar apple fruits	RR/OP
	Clothianidin	Insecticide	Canola, corn (seed treatments)	OP
	Methoxyfenozide	Insecticide	Cranberry, cucurbits, okra, peas (black-eyed, southern), turnip (greens)	RR/OP
	Azoxystrobin	Fungicide	Artichoke (globe), asparagus, head and stem brassica subgroup, herbs	RR
	Emamectin benzoate	Insecticide	Cotton, fruiting vegetables, tobacco	OP
	Buprofezin	Insecticide	Bean (succulent), lychee fruits, pistachio	RR/OP
	Boscalid	Fungicide	Berries, bulb, fruiting, legume (root except sugar beet, garden beet, radish, turnip), tuberous and corm vegetables, grape, lettuce (head, leaf), peanut, stone fruit, strawberry, tree nuts, turf	RR
	Thiamethoxam	Insecticide	Ornamentals, succulent beans (seed), stone fruit, sunflower (seed)	OP
	Trifloxystrobin	Fungicide	Root vegetables leaf petioles (except sugar beet) subgroup, except radish	RR
	Flonicamid	Insecticide	Ornamentals (greenhouse)	OP
	Acequinocyl	Insecticide	Ornamentals (greenhouse)	RR
	Bifenazate	Insecticide	Cucurbits, fruiting vegetables, mint, pistachio, tomato (greenhouse), tree nuts	RR
	Fenhexamid	Fungicide	Cucumber (greenhouse), fruiting vegetables (except non-bell pepper), kiwifruit, leafy green subgroup (except spinach), stone fruit	RR
	Etoxazole	Insecticide	Cotton, pome fruit, strawberry	RR
	Quinoxyfen	Fungicide	Grape, hops, cherry	RR
	Glufosinate-ammonium	Herbicide	Rice	RR

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2004	Fluroxypyr	Herbicide	Corn (field, sweet)	RR
	Mesosulfuron-methyl	Herbicide	Wheat	RR
	Gamma-cyhalothrin	Insecticide	Alfalfa, brassica head and stem subgroup, canola, corn (field, sweet), cotton, fruiting and legume (edible-podded) subgroup vegetables, garlic, lettuce (head, leaf), tree nuts, onion (dry bulb), pea and bean dry shelled (except soybean) subgroup, pea and bean succulent shelled subgroup, peanut, pome fruit, rice, sorghum, soybean, stone fruit, sugarcane, sunflower, wheat	OP
	Novaluron	Insecticide	Cotton, pome fruit	OP
	Fenpyroximate	Insecticide	Cotton, grape, pome fruit	RR
	Acequinocyl	Insecticide	Strawberry, almond, citrus, pome fruit, field ornamentals	RR
	Lufenuron	Insecticide	Termite bait station	RR
	Indoxacarb	Insecticide	Fire ant bait	RR/OP
	Pyrimethanil	Fungicide	Almond, grape, onion (dry bulb, green), pome and stone fruit, strawberry, tomato, tuberous and corm vegetables	RR
	Dinotefuran	Insecticide	Leafy vegetables	RR/OP
	Penoxsulam	Herbicide	Rice	RR
	Tebufenozide	Insecticide	Citrus, grape, tuberous and corm vegetables	RR
	Fenamidone	Fungicide	Cucurbit vegetables, onion (dry bulb, green), potato, tomato	RR
	Cyazofamid	Fungicide	Cucurbit vegetables, potato, tomato	RR
	Bispyribac-sodium	Herbicide	Turf	RR
	Deltamethrin	Insecticide	Corn (field), cucurbit, fruiting, root and tuber vegetables, onion (dry, bulb, green), sorghum, tree nuts	OP

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2005	Fenamidone	Fungicide	Ornamentals	RR
	Diflubenzuron	Insecticide	Horse oral larvicide feed-through treatment	RR
	Dinotefuran	Insecticide	Public health use, cotton, brassica head and stem subgroup, cucurbit and fruiting vegetables, grape, potato	RR/OP
	Clothianidin	Insecticide	Turf, ornamentals, pome fruit, tobacco	OP
	Thiamethoxam	Insecticide	Mint	OP
	Clofentezine	Insecticide	Grape	RR
	Mesotrione	Herbicide	Corn (sweet)	RR
	Buprofezin	Insecticide	Avocado, guava, peach, pome fruit, sugar apple	RR/OP
	Acetamiprid	Insecticide	Potato	RR/OP
	Spiromesifen	Insecticide	Brassica leafy, fruiting, tuberous, and corm vegetables, corn (field), cotton, cucurbits, leafy greens, ornamentals, strawberry	RR
	Pymetrozine	Insecticide	Asparagus	OP
	Etoxazole	Insecticide	Grape, tree nuts	RR/OP
	Pinoxaden	Herbicide	Barley, wheat	RR
	Aminopyralid	Herbicide	Range and pasture lands, rights-of-way, roadsides, industrial vegetation management	RR
	Flonicamid	Insecticide	Cotton, cucurbit and fruiting vegetables, pome and stone fruit, potato, nursery and landscape ornamentals	OP
2006	Boscalid	Fungicide	Celery, spinach	RR
	Flumiclorac-pentyl	Herbicide	Cotton defoliant use	RR/OP
	Spinosad	Insecticide	Alfalfa, fruit fly bait, mint, onion (green)	RR
	Fenhexamid	Fungicide	Ginseng, pear, cilantro, pepper (non-bell), pomegranate	RR
	Flonicamid	Insecticide	Head and stem brassica	OP
	Trifloxystrobin	Fungicide	Barley, oats	RR
	Azoxystrobin	Fungicide	Herbs, spices, safflower, sunflower	RR
	Methoxyfenozide	Insecticide	Soybean	RR/OP
	Fenpyroximate	Insecticide	Citrus, hops, mint, pistachio, tree nuts	RR
	Quinoxyfen	Fungicide	Lettuce (head, leaf), melons, pepper (bell, non-bell), strawberry	RR
	Bifenazate	Insecticide	Stone fruit, edible-podded pea, tuberous and corm vegetables	RR/OP

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
2007	Fluthiacet-methyl	Herbicide	Cotton	OP
	Spiromesifen	Insecticide	Tomato (greenhouse)	RR
	Flazasulfuron	Fungicide	Turf	RR
	Penoxsulam	Herbicide	Turf, aquatic use	RR
	Indoxacarb	Insecticide	Grape	RR
	Spinosad	Insecticide	Mosquito larvicide use	RR
	Spinetoram	Insecticide	Many: refer to http://www.epa.gov/opprd001/workplan/completionsportrait.pdf	RR
2008	Mandipropamid	Fungicide	Brassica leafy, bulb, cucurbit, fruiting, tuberous and corm, and leafy vegetables, grape	RR
	Mesotrione	Herbicide	Berry group, cranberry, flax, turf (sod farm, golf courses)	RR
	Chlorantraniliprole	Insecticide	Cotton, grape, pome and stone fruit, potato, turf, ornamentals, brassica leafy, cucurbit, fruiting, and leafy vegetables	RR
	Spirotetramat	Insecticide	Almond, citrus, grape, hops, onion (bulb), brassica head and stem, brassica leafy greens, cucurbits, fruiting, leafy, and tuberous and corm vegetables	RR
	Etofenprox	Insecticide	Mosquito adulticide use	RR
2009	Etofenprox	Insecticide	Rice	RR
	Mesotrione	Herbicide	Turf (commercial, residential)	RR
	Spiromesifen	Insecticide	Corn (pop, sweet), low-growing berry group	RR
	Penoxsulam	Herbicide	Grape, tree nuts	RR
	Chlorantraniliprole	Insecticide	Tree nuts, pistachio	RR
	Cyazofamid	Fungicide	Fruiting vegetables (regional tolerance), okra	RR
	Saflufenacil	Herbicide	Cereal grains, citrus, cotton, foliage of legume vegetables, forage, fodder, and straw of cereal grains, grape, legume vegetables, pome and stone fruit, sunflower, tree nuts	RR
2010	Dinotefuran	Insecticide	Brassica leafy greens, turnip (greens)	RR
	Chlorantraniliprole	Insecticide	Artichoke, asparagus, caneberry, cacao, citrus, coffee, corn (field, sweet, pop), fig, forage, fodder, and straw of cereal grains, grass forage, fodder, and hay, herbs and spices, hops, legume vegetables (ex., soybean), mint, non-grass animal feeds, oilseed crops, okra, olive, peanut, persimmon, pomegranate, prickly pear cactus, rice, small vine-climbing fruits, strawberry, sugar, cane, tea, tobacco, tropical fruits, tuberous and corm vegetables, termiticide use	RR

Year	Pesticide*	Pesticide type	Site	Reduced risk (RR)/OP alternative†
	Tolfenpyrad	Insecticide	Ornamentals (greenhouse)	RR
	Cyazofamid	Fungicide	Brassica leafy vegetables, hops, spinach, turnip (greens)	RR
	Spiromesifen	Insecticide	Pea, dry	RR

*New active ingredient reduced risk/OP alternative actions are indicated by italics.
†OP alternative status was not considered by the Reduced Risk Program for conventional pesticides until 1999.