Report on the Status of Products Registered for use as Wide Area Public Health Mosquito Adulticides in Maine-2013

And

Summary of EPA's Most Recent Public Health and Environmental Risk Assessments

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MOSQUITO WIDE AREA PUBLIC HEALTH ADULTICIDES IN MAINE 2013

BACKGROUND

The pesticides registered for use for mosquito control in Maine include:

Adulticides, products which kill adult mosquitoes, ten of which are discussed below

Repellents, products used on human skin, human gear and animals to repel adult mosquitoes

Aquatic larvicides, products added to water at breeding sites to prevent the development of the mosquitoes, these include the biological insecticides, the insect growth regulator methoprene and monomolecular films which mechanically control the larvae

Non-aquatic larvicides, insect growth regulators which are labelled for use indoors, outdoors and on animals

Of the 1,322 products registered for use on mosquitoes in Maine -2013, 1,125 of these products contain at least one adulticide and approximately 30 have specific directions for use in wide area public health uses (NSPIRS 2013). This review is limited to a subset of these products which are registered for use in public health wide area mosquito control projects used to address an outbreak of either Eastern Equine Encephalitis (EEE) or West Nile Virus (WNV). Since the labels are legal documents and are approved by EPA in accordance with their risk assessments, human health and environmental, the label statements limiting the areas of use and specifics of applications go a long way to limiting exposure while providing efficacy in control of adult mosquitoes.

There are two chemical classes of insecticides, pyrethrins-pyrethroids-PBO (including etofenprox, permethrin. piperonyl butoxide (PBO) (synergist), permethrin, phenothrin, prallethrin, pyrethrins and resmethrin) and the organophosphates (chlorpyrifos, malathion and naled). The synergist PBO is found in all but two of the pyrethroid-pyrethrin products and is not in the organophosphate products. A synergist increases the activity of the pyrethroid-pyrethrin insecticides while having no insecticidal efficacy of its own.

HUMAN RISK ASSESSMENT

The human health risks are evaluated by comparing the most sensitive endpoint in lab animals, to expected environmental exposures. The standard measure of human health risk is the 'margin of exposure' (MOE). The MOE is the ratio of the most sensitive toxicity result from the animal study to the expected exposure dose resulting from the use in question. A pesticide product with a higher calculated MOE has a lower risk to humans. EPA has established chemical specific 'levels of concern' (LOC) for short (1 to 7 days) and intermediate (1 to 6 months) term exposures. Risks higher than the LOC are deemed acceptable. Human health risks are evaluated for toddlers for exposure following an application via incidental oral route (putting hands or objects in mouth after playing on grass, or eating grass) and dermal (skin) exposure and inhalation, and for adults via skin and inhalation routes (EPA 2012c).

With regard to the pyrethrins-pyrethroids and piperonyl butoxide (PBO), with the exception of prallethrin (a component of Duet EPA# 1021-1795-8329) the MOE exceed EPA's LOC by approximately ten to over a million times for both aerial and ground applications at the maximum use rate for public health adult mosquito control. EPA has yet to finalize the human health risk assessment for prallethrin. The human health risk associated with the use of these materials is exceedingly low. Mosquito adulticides are applied by ultra-low-volume equipment by air or by ground. For the adulticide products containing pyrethrins-pyrethroids-PBO, risks from aerial applications by ultra-low-volume are lower and efficacy against mosquitoes is better than those made by ground ultra-low-volume.

Given the low risks from exposure to the pyrethrins- pyrethroids-PBO, any could be used in a wide area public health adulticiding program. The phenothrin-PBO containing product, Anvil 10+10 (EPA# 1021-1688-8329) has been used in other states, because of its very low application rate (0.0036lbs ai/A), its low risk to humans, its allowed use over agricultural areas (40 CFR 180.647) and the tolerances in all raw agricultural commodities as a result of mosquito adulticiding.

The three organophosphates, chlorpyrifos, malathion and naled, registered for wide area adult mosquito control have lower margins of exposure (higher risk to people) than do the pyrethrins-pyrethroids-PBO compounds. However, with the exception of chlorpyrifos at 0.01 lb ai/A, the risk of inhalation exposure in both toddlers and adults is higher (the MOE is lower) than EPA's levels of concern for these applications. For air applications of the organophosphate pesticide naled, the calculated risks to toddlers range from 54 times higher than the level of concern for oral exposure to approximately 240 times higher for dermal exposure (EPA 2002a, EPA 2006a). Similar to phenothrin, there is a universal tolerance on agricultural products intended for human consumption for naled residues following wide area mosquito adulticiding applications (40CFR180.215). Among organophosphates, naled and malathion, are considered the lowest risk, effective pesticides and are often used in the southern and mid-western U.S. for wide area mosquito control.

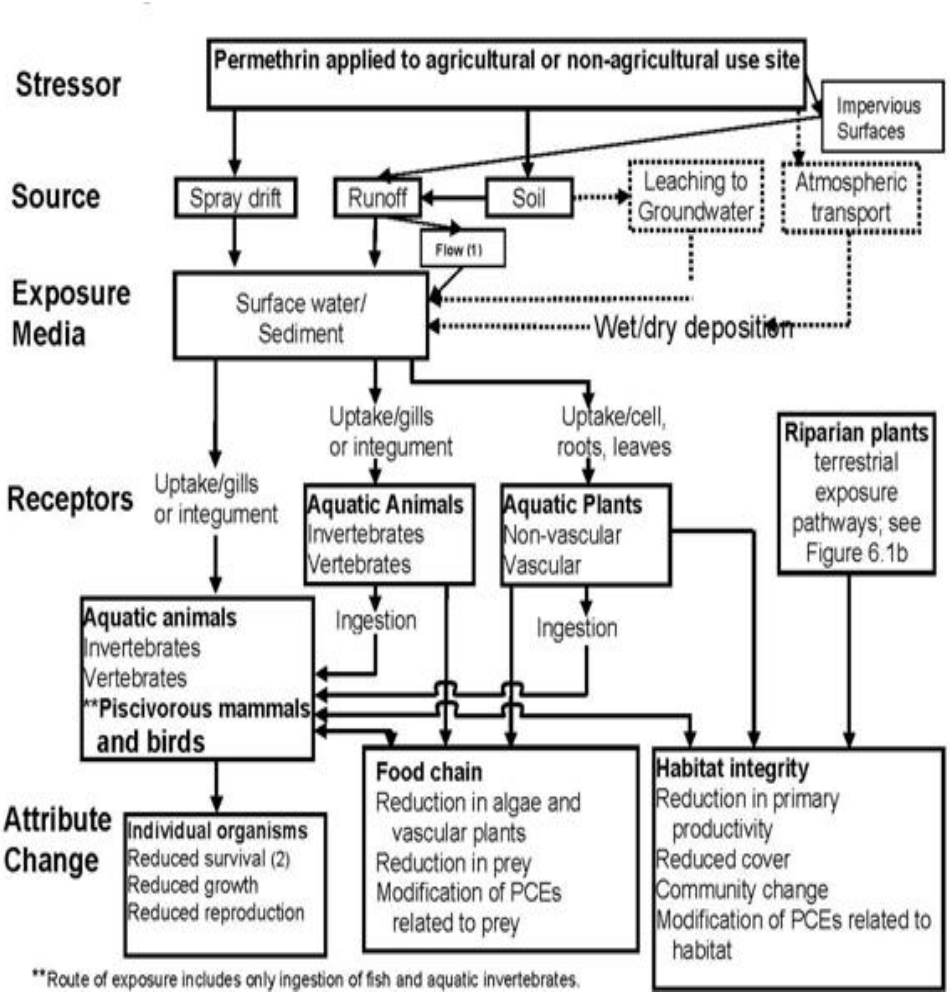
The potential for pesticides to cause an increase in cancer rates in the human population is considered in EPA risk assessments. The cancer potentials for the adulticides are categorized as "not likely" or "no evidence" for phenothrin, and naled, "not likely at low doses" for etofenprox and pyrethrins, suggestive or possible for PBO and malathion, and likely for permethrin and resmethrin (EPA 2012a). However, the cancer risks from exposure to permethrin following ultra-low-volume ULV applications is 3 orders of magnitude (1,000 times) lower than EPA's acceptable risk level of 1 in a million by ground and eleven orders of magnitude lower, when the application is done by air (EPA 2009d). The residential cancer risks following mosquito adulticiding with permethrin both by air and ground are lower than EPA's acceptable risk level 1 in a million (EPA 2006f).

Allergy reactions as a result of insecticide exposure, including asthma exacerbations are difficult to predict. Because of this, the message to the public if a municipal adulticiding application were to occur, would include, persons with allergies, take extra care (stay inside, close windows etc.) to reduce exposure.

Environmental Risk Assessment

Because of the wide variety of ecological niches and species occupying those niches, assessing risks to organisms in the environment is much more complicated (Figure 1) than human health assessments.

Figure 1 Aquatic Conceptual Model of Exposure pathways for Permethrin (EPA 2011h)



Laboratory species are used to determine the critical toxicology value and exposure is estimated using a combination of modeling and environmental sampling. Unlike the human health process, the environmental risks are evaluated using the risk quotient method; estimated environmental concentration divided by the toxicity factor. In this case the lower the risk quotient, the lower the risks. The levels of concern (LOC) used by EPA have been established for acute (short term exposure, LOC = 0.5), chronic (long term exposure, LOC = 1).

Fish and aquatic invertebrates lack the metabolic capability of the mammalian liver and lack the protective barrier found in humans or other mammals, therefore they are generally more sensitive to insecticides. This is reflected in both the toxicity of the insecticides as wells as the risks. Exposure to birds and wild mammals is estimated using the T-REX model (EPA 2012b). The risks to birds and

wild-mammals parallels the risks to humans. Because there was no toxicity seen in the animal studies, EPA did not perform risk assessments for etofenprox (EPA 2009a) and phenothrin (d-phenothrin; Sumithrin[tm]) (EPA 2008f).The other pyrethrins-pyrethroids and PBO risks are within EPA's level of concern of acute and chronic exposures at rates used for mosquito control (EPA 2005g, EPA 2006i, EPA 2006b, EPA 2006d, EPA 2010b, EPA 2011h, EPA 2011i, EPA 2012h, EPA 2012i). The risk quotients for the organophosphates for birds and mammals are generally higher (more risky) than the pyrethrins-pyrethroids-PBO compounds (EPA 2008d, EPA 2008e, EPA 2008g, EPA 2009g) . They are still within EPA's level of concern for acute and chronic exposure.

The data currently in the EPA reviews indicate that the highest risks from ultra-low-volume mosquito adulticiding applications are to freshwater and marine invertebrates living in the water column and to those dwelling in the sediment. The toxicity of the pyrethrins and pyrethroids to sediment dwelling invertebrates is an area of active research. EPA has issued data-call-ins for the pyrethrins and most of the pyrethroids.

EPA's aquatic risk assessments rely on modeling for estimating environmental exposure. The assumptions are for multiple aerial applications 25 to 50 per year with intervals ranging from 1 day (EPA 2011h) to 7 days (EPA 2012h). They also assume that temperature is 85^{o} F and the relative humidity is 90%. Most of the ultra-low-volume mosquito adulticide labels require a temperature of above 50^{o} F. Given the climate in Maine and our relatively short warm season permitting mosquito development, and the fact that EEE and WNV are often not detected in mosquitoes until late in the season, the likelihood of more than one or two applications per year is low.

CONCLUSIONS

Adult mosquito control is only one part of a comprehensive IPM approach that includes education to promote the use of repellents and staying indoors when risk is high, and when possible, eliminating standing water where mosquitoes breed, or treating mosquito breeding habitats with lower risk larvicides. However, the use of adulticides can be a lower risk and necessary means for protecting communities when the risk of WNV or EEE reaches critical levels. When risks of mosquito borne illness are high and mosquito habitat reduction and larval control are infeasible and/or insufficient to reduce adult mosquito populations, aerial or ground-based applications of insecticides are often a necessary component of an integrated mosquito management program (CDC 2003).

The overview of mosquito products and the label review are appended for consultation. The risk assessment information (100+ pages) is compiled and will be made available at your request.

SECTION 1. SCOPE; UNIVERSE OF PESTICIDE PRODUCTS REGISTERED FOR USE ON MOSQUITOES IN MAINE 2013 AND PESTICIDE PRODUCTS LABELED FOR USE AS PUBLIC HEALTH MOSQUITO ADULTICIDES

The 53 active ingredients in the 1,322 products currently registered in Maine with mosquito control on their labels. The active ingredients are summarized in Table 1.1. These products have been grouped as to function: adulticide, aquatic larvicides, insect growth regulators, repellents, and products with multiple uses. When a product has two or more active ingredients in the same group, adulticide, larvicide or repellent, that is consider a single group. For example a product with two pyrethroids would be considered an adulticide, a product with one pyrethroid and an insect growth regulator would be considered a multi-use-product. One thousand one hundred and twenty five of the mosquito products registered in Maine-2013 contain at least one adulticide, 206 products contain at least one insect growth regulator (for purposes this classification products containing methoprene with non-aquatic uses are grouped with the IGRs and aquatic uses are grouped with the aquatic larvicides), 163 contain at least one repellent and 47 are aquatic larvicides. Three hundred and sixty five of these products contain one of two synergists, either PBO (piperonyl butoxide) or MGK 264 (N-Octyl bicycloheptene dicarboximide).

In addition to the active ingredients, pesticide products contain "inert" or "other" ingredients. These ingredients are present to increase the activity of the active ingredient, but they have no pesticidal action against the target pest. A review of the inert ingredients in the public health adulticides, could be undertaken, but was beyond the scope of the current project.

The products included in the current review were limited to the adulticide products with specific directions for wide area public health uses and include pyrethrins, five synthetic pyrethroids (etofenprox, permethrin, phenothrin, prallethrin and resmethrin) and three organophosphates (chlorpyrifos, malathion and naled) (Table 2.1). Future reviews of the other types of mosquito products may be done.

The most common active ingredients in mosquito products are: permethrin is also found in over 300 products, the synergist, PBO (over 300 products) and pyrethrins (over 200 products). These three active ingredients are found in the public health products listed in Table 2.1. Permethrin has uses on human gear, indoor, outdoor and direct uses on animals. PBO and pyrethrins have a variety of indoor, outdoor and direct uses on animal (NSPIRS 2013).

Table 1.1 Overview of Mosquito Products Registered in Maine in 2013; The Active Ingredients in Bold are found in the Public Health Wide Area Mosquito Products			
Type	**# Products**	**Active Ingredients**	**Notes**
Biological larvicides	32	Bti-Bs	Microbial disruptors of insect midgut membranes (IRAC 2013)
Repellents	179	DEET	These repellents are registered for use on human skin and are recommended by the federal CDC as mosquito repellents.
		IR3535	
		Oil of Lemon Eucalyptus	
		Picaridin	
		PMD	
		MGK 326 Repellent (Dipropyl isocinchomeronate) is registered for use on human gear in products with indoor and outdoor uses. BPG (Butoxypolypropylene glycol) is found in combination with other repellents pyrethroids and synergist. Registered for agricultural use on livestock. Linalool is registered in impregnated materials (candles torches etc.) to repel mosquitoes outdoors. The linalool products also have indoor uses. Other repellents: Oil of Eucalyptus (can be used on skin), Metofluthrin, Oil of Citronella	
Synergists	455	**PBO (piperonyl butoxide)**	PBO used in most of the pyrethrin-pyrethroid products used in public health wide area projects.
		MGK 264 (N-Octyl bicycloheptene dicarboximide)	MGK 264 is found in a dozen products with human skin and gear on their labels and numerous indoor outdoor and animals use products.
Insect Growth Regulators	258	Methoprene	Methoprene is a juvenile hormone analogue (IRAC 2013) and is found in aquatic larvicide 12 products; the non-aquatic uses of methoprene are on cats and dogs for flea and tick control
		Pyriproxyfen	Pyriproxyfen is a juvenile hormone analogue (IRAC 2013). The primary uses of pyriproxyfen are on cats and dogs for flea and tick control

Table 1.1 Overview of Mosquito Products Registered in Maine in 2013; The Active Ingredients in Bold are found in the Public Health Wide Area Mosquito Products			
Type	**# Products**	**Active Ingredients**	**Notes**
Neonicotinoids	38	Acetamiprid, Dinotefuran, Imidacloprid	These compounds activate the insect nicotinic acetylcholine receptor (nAChR) (IRAC 2013).
Organophosphates	39	**Chlorpyrifos, Malathion, Naled**	Organophosphate insecticides act by irreversibly inhibiting the enzyme acetylcholinesterase in the nervous system (IRAC 2013).. These may be used in public health wide area projects.
		DDVP, Tetrachlorvinphos	Six impregnated strips containing 18.6% DDVP.and one DDVP/ tetrachlorvinphos are registered for agricultural uses. DDVP is also found as a metabolite of naled
		Temephos	Temephos is an aquatic larvicide.
Carbamates	10	Carbaryl	Carbamate insecticides act by reversibly inhibiting the enzyme acetylcholinesterase in the nervous system (IRAC 2013
Pyrethrins - Pyrethroids	1181	**Ethofenprox, Permethrin, Phenothrin, Prallethrin, Pyrethrins, Resmethrin**	Pyrethrins and pyrethroids act by modulating the sodium channels in neurons (IRAC 2013). Ethofenprox, Permethrin, Phenothrin, Prallethrin, Pyrethrins, or Resmethrin may be used in public health wide area projects. All of the public health products contain the synergist PBO except for the etofenprox products.
		Other pyrethroids: Allethrins-d and d-trans, Bifenthrin, Bioallethrin-s, Cyfluthrins, Cyhalothrins, Cypermethrins, Deltamethrin, Esfenvalerate, Fluvalinate, Tetramethrin	
Others	148	2-Phenylethyl propionate, d-Limonene, Fipronil, Mineral oil, NEEM, POE isooctadecanol, Soap, Spinosad, Triethylene glycol	Includes two aquatic larvicides with mechanical means of control; mineral oil and POE isooctadecanol. Fipronil acts by blocking the GABA gated chloride channels in nerves. Spinosad acts as a nACh allosteric activator (IRAC 2013)

SECTION 2. TYPICAL ADULTICIDE PRODUCTS LABELED FOR WIDE AREA PUBLIC HEALTH ULV USES

In an effort to summarize the potential for human and environmental hazards associated with public health mosquito abatement programs, a product search was conducted for Maine 2013 registration, followed by a search for active federal registrations for public health mosquito adulticide products. The search terms included: adult mosquito, and aerial or ultra-low volume (ULV) (NSPIR 2013). There were approximately 30 products identified by the search, with the language on their labels specifying:

> *"For use only by federal, state, tribal, or local government officials responsible for public health or vector control, or by persons certified in the appropriate category or otherwise authorized by the state or tribal lead pesticide regulatory agency to perform adult mosquito control applications, or by persons under their direct supervision"*

The EPA registration numbers (EPA#) for the selected public health wide area mosquito adulticide products registered in Maine in 2013 containing synthetic pyrethroids, pyrethrins and PBO, their diluents, are found in Table 2.1. Similar information for the organophosphate containing products is found in Table 2.2.

The review is based on selected products because the number of products could change, with the Maine registration of a federally registered product. The federal search identified 108 products, 27 of which are currently registered Maine. Of the remaining 84 products, 78 have the same mosquito adulticide active ingredients and similar formulations as those registered in Maine-2013. The other six products, may be registered in Maine -2013, but do not have public health mosquito control uses on their labels. Four of these contain the active ingredients carbaryl (one home owner; three agricultural products), 2 contain the synthetic pyrethroid, lambda cyhalothrin. Wide area mosquito adulticiding public health uses are not on these federal labels (Bayer 2009, Tessendro-Kerley 2012, Tessendro-Kerley 2013, Loveland Chemical 2011, Syngenta 2010, LG Lifesciences 2009).

The maximum use rates in pounds pyrethroid-pyrethrins and PBO active ingredient per acre (lbs ai/A) are presented in Table 2.3. The organophosphate active ingredient maximum use rates are found in Table 2.4. The use rates for malathion are 0.23 lbs ai/A by air and 0.11 lbs ai/A by ground (Table 2.4.). Use rates for the synthetic pyrethroids, pyrethrins and the organophosphates chlorpyrifos and naled are the same for both aerial and ground ultra-low volume (ULV) applications.

Table 2.1 Typical Public Health Adult Mosquito Products Containing Pyrethroids-Pyrethrins-Piperonyl Butoxide (PBO) Registered in Maine for 2013 sorted by Active Ingredient (NSPIRS 2013) [a]				
Active ingredients	**Percent Active Ingredients**	**Diluent**	**EPA REG #**	**References**
Etofenprox	4% Etofenprox	Ready to use	2724-807	Wellmark 2010a, Wellmark 2010b,
	20% Etofenprox	Oil	2724-791	Wellmark 2009a, Wellmark 2009b,
Permethrin-PBO	2% Permethrin, 2% PBO [b]	Ready to use	73748-3	Univar 2013a, Univar 2013b
	< 5% Permethrin, < 5% PBO	Oil	655-898	Prentiss 2012a, Prentiss 2012b
	20% Permethrin, 20% PBO	Water	432-796	Bayer [c] 2013a, Bayer 2013b
	20.6% Permethrin, 20.6% PBO	Oil or Water	53883-274	Control Solutions 2010a, Control Solutions 2010b,
	> 30 % Permethrin, > 30% PBO	Oil	73748-5	Univar 2013g, Univar 2013h
Phenothrin-PBO	10% Phenothrin[d], 10% PBO	Oil	1021-1688-8329 [h]	Clarke [e] 2013a, Clarke 2009
Phenothrin- Prallethrin-PBO	5% Phenothrin [d], 1% Prallethrin, 5% PBO	Oil	1021-1795-8329 [h]	Clarke 2013b, Clarke 2008
Pyrethrins-PBO	5 to 12% Pyrethrins, 25 to 60% PBO	Oil	1021-1199	MGK [f] 2013a, MGK 2013b
Resmethrin-PBO	4.14 to 18% Resmethrin, 12.42 to 54% PBO	Oil	432-716	Bayer 2012a, Bayer 2012b

a) Selection of a product for label review does not constitute an endorsement
b) PBO = Piperonyl butoxide, pesticide synergist
c) Bayer = Bayer Environmental EPA Company number 432
d) Phenothrin = Sumithrin

e) The company number for these products is McLaughlin Gormley King (MGK) company number, 1021, the product number varies with the product and 8329 is the company number for the distributer, Clarke Mosquito Products
f) MGK = McLaughlin Gormley King

Table 2.2. Selected Public Health Adult Mosquito Products Containing Organophosphate Insecticides Registered in Maine for 2013 (NSPIRS 2013, Label) [a]				
EPA REG #	**Active Ingredients**	**Diluent**	**lbs ai/gal**	**References**
53883-251	19.36% Chlorpyrifos [b]	Oil	1.5	Control Solutions 2009a, Control Solutions 2010d
67760-34	96.5% Malathion	Oil	9.9	Cheminova 2011a, Cheminova 2011b,
5481-479	62% Naled	Water	7.5	AMVAC 20012a, AMVAC 20012b
5481-481	78% Naled	None	10.8	AMVAC 2010a, AMVAC 2010b
5481-480	87.4% Naled	Oil	13.2	AMVAC 2009a, AMVAC 2009b

a) Selection of a product for label review does not constitute an endorsement
b) There are a number of other chlorpyrifos containing products registered for public health mosquito adulticide use (NSPIRS 2013)

Table 2.3 Use Rates for Active Ingredients (lbs ai/A and lbs ai/A/year) for Public Health Adult Mosquito Products Containing Pyrethroids-Pyrethrins and PBO			
Active Ingredients	**Rate (lbs ai/A)**	**Annual Rate (lbs ai/A/year)**	**Reference**
Etofenprox	0.007	0.18	Wellmark2010a, EPA 2009a
Permethrin	0.007	0.18	Bayer 2011f, EPA 2009c
Phenothrin (Sumithrin)	0.0036	1	MGK 2012a, EPA 2007, EPA 2008
PBO	0.08	2	EPA 2004b
Prallethrin	0.0008	0.02	Clarke Mosquito 2013b
Pyrethrins	0.008	0.2	MGK 2013a, EPA 2006b
Resmethrin	0.007	0.2	Bayer 2012a

Table 2.4 Use Rates for Active Ingredients (lbs ai/A and lbs ai/A/year) for Public Health Adult Mosquito Products Containing Pyrethroids-Pyrethrins and PBO			
Active Ingredients	**Rate (lbs ai/A)**	**Annual Rate (lbs ai/A/year)**	**Reference**
Chlorpyrifos	0.01	0.26	Control Solutions 2009a, Control Solutions 2009b
Malathion (air)	0.23	Not more than 3 times in any one week. More frequent treatments may be to control mosquito-borne diseases in animals or humans	Cheminova 2011a, EPA 2004a, EPA 2009b
Malathion (ground)	0.11		
Naled (air and ground)	0.1	10.73	AMVAC 20012a, AMVAC 20012b

SECTION 3. LABEL REVIEW

Pesticide labels are legal documents. The statement "**It is a violation of Federal Law to use this product in a manner inconsistent with its labeling"** is required on all pesticide labels (EPA 2007 to 2012). The pesticide product label language requirements are spelled out in the EPA Label Review Manual found at: http://www.epa.gov/oppfead1/labeling/lrm/ (EPA 2007 to 2012). These statements are required based on the toxicity databases for the technical grade active ingredient and the pesticide end use product (active and inert ingredients).

For the public health mosquito adulticide the label sections summarized below are signal words, hazards to humans and domestic animals and personal protective equipment. EPA assigns mammalian toxicity categories for the technical grade active ingredients (TGAI) and the end use products offered for sale and use based on acute toxicity data. The criteria for EPA's toxicity categories are set in 40CFR156.62 and the relationship with required label language are found in Appendix II.

SIGNAL WORDS, HAZARDS TO HUMANS AND DOMESTIC ANIMALS

PYRETHROIDS- PYRETHRINS-PBO PRODUCTS

Signal Words

Etofenprox, Permethrin-PBO, Phenothrin (Sumithrin [tm])-PBO, Phenothrin (Sumithrin [tm])-PBO-Prallethrin, Pyrethrins-PBO, Resmethrin-PBO

All of the wide area public health mosquito adulticide products containing pyrethrins, pyrethroids and PBO have "caution" signal words indicating low risks to mammals from acute exposure.

Hazards to humans and domestic animal

Etofenprox, Permethrin-PBO, Phenothrin-PBO, (Anvil 10 +10-oil based), Pyrethrins-PBO, Resmethrin-PBO, have warnings for moderate eye irritation. Anvil 10 + 10 (EPA# 1021-1688-8239) also has a warning for moderate eye irritation

Phenothrin-PBO (Aqua Anvil-water based), Phenothrin (Sumithrin [tm])-PBO-Prallethrin (Duet-oil based and Aqua Duet-water based) have no eye warnings.

Personal Protective Equipment

In Table 2.1, the Pyrethrins-Pyrethroids-PBO containing products are primarily permethrin-BPO at a variety of concentrations. There are two products with etofenprox as the sole active ingredient, two phenothrin (Sumithrin [tm])-PBO products, two phenothrin (Sumithrin [tm])-PBO-prallethrin products, three pyrethrins-PBO products and two Resmethrin-PBO containing products. The personal protective equipment statements are found below.

Etofenprox containing products have no personal protective equipment requirements on the labels of the two mosquito adulticide product labels.

Ten of the eleven permethrin-PBO containing products registered for use in Maine 2013 have labels approved by EPA in 2011, 2012 and 2013 with the following personal protective equipment requirements:

"Mixers, loaders, applicators and other handlers must wear:

- Long-sleeved shirt and long pants,
- Shoes plus socks,
- Chemical-resistant gloves for all handlers except for applicators using motorized ground equipment, pilots, and flaggers
- Chemical-resistant apron for mixers/loaders, persons cleaning equipment, and persons exposed to the concentrate"

The other permethrin product, PBO/Permethrin 20:20, (EPA# 53883-274), has no PPE requirements and the label was approved in 2010. Since the RED for permethrin was issued in 2009 (EPA 2009c), most likely the next iteration of this label would incorporate the PPE requirements from the RED.

Anvil 10 + 10 (EPA# 1021-1688-8329), hydrocarbon based, Multicide® Mosquito Adulticiding Concentrate 2705 (EPA# 1021-1688) requires applicators, mixers and loaders to wear: long-sleeve shirt and pants, shoes and socks, and chemical resistant gloves made of barrier laminate nitrile rubber, neoprene rubber or viton.

Aqua Anvil, water based (EPA# 1021-1807-8329)*:* Multicide® Mosquito Adulticiding Concentrate 2807 (EPA# 1021-1807) labels require applicators mixers and loaders wear: long-sleeve shirt and pants and shoes and socks.

Duet (EPA#1021-1795-8329) petroleum base, Multicide Fogging Concentrate 2798 (EPA# 1021-1795) and Aqua Duet (EPA#1021-2562-8329), Multicide Fogging Concentrate 2922 (EPA# 1021-2562) labels require applicators mixers and loaders wear: long-sleeve shirt and pants and shoes and socks.

Two resmethrin products registered in Maine 2013 for adult mosquito control in public health settings are SCOURGE® Insecticide with resmethrin/piperonyl butoxide 18% + 54% MF FORMULA II (EPA# 432-667) and SCOURGE® Insecticide with SBP-1382/Piperonyl Butoxide 4%+12% MF FII (EPA# 432-716).

The personal protective equipment requirements from both labels are:

- Long-sleeved shirt and long pants
- Shoes plus socks
- Chemical-resistant gloves for all handlers except applicators.

The Scourge product label for product with the higher concentrations, (EPA# 432-667), chemical resistant gloves are require for all applicators except applicators using motorized ground equipment pilots and flaggers.

Organophosphates

Signal Words

The organophosphate products containing chlorpyrifos and malathion also have "caution" signal word. The naled containing products have "danger" signal words due to irreversible corrosive effects on the skin and eyes.

Hazards to humans and domestic animal

Chlorpyrifos and Malathion

Technical grade chlorpyrifos is more acutely toxic than technical grade malathion (Table B). The adulticide products are a soluble concentrate containing 19.36% chlorpyrifos (1.5 lbs/gal) product and a ready to use 96.5% malathion (9.9 lbs/gal) product. Both the chlorpyrifos product and the malathion product labels have "caution" as the signal word. The different human and domestic animal hazard sections reflect the differences in potency.

Chlorpyrifos

CSI 1.5 (EPA# 53883-251) human and domestic animal hazard section reads:

"Harmful if swallowed. Avoid contact with skin or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals (Control Solutions 2009a, Control Solutions 2009b)."

The Fyfanon (EPA# 67760-34) malathion containing product label states:

"Harmful by swallowing, inhalation or skin contact. Avoid contact with skin. Avoid breathing spray mist" (Cheminova 2011a, Cheminova 2011b.)"

Naled

All of the naled containing products registered for use as public health mosquito adulticides are classified **RESTRICTED USE PESTICIDE DUE TO EYE AND SKIN CORROSIVITY HAZARD** and have **DANGER** signal words because of corrosiveness to eyes and skin.

Human health hazard statements include:

- "Causes irreversible eye and skin damage.

- Causes skin bums.
- May be fatal if swallowed.
- Harmful if inhaled or absorbed through the skin.
- Do not get in eyes, on skin, or on clothing.
- Do not breathe vapor or spray mist.
- Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a.)"

Personal Protective Equipment Requirements

The organophosphate containing products include one chlorpyrifos, one malathion and three naled products. The personal protective equipment statements are found below.

Chlorpyrifos

CFI 1.5 containing 19.36% chlorpyrifos (1.5 lbs/gal) (EPA# 53883-251) has the following directions for personal protective equipment:

> "Personal Protective Equipment (PPE): All mixers and loaders involved in ground application must wear coveralls over long-sleeved shirt and long pants, shoes plus socks, chemical-resistant gloves, and a NIOSH-approved dust mist filtering respirator with MSHAINIOSH approval number prefix TC21C or a NIOSH-approved respirator with any R, P, of HE filter. Applicators involved in ground ULV application must use an enclosed cab as described in the

Engineering Controls Section of this label and must wear long-sleeved shirt and long pants, shoes plus socks, and chemical-resistant gloves. Aerial applicators and pilots must use an enclosed cockpit and wear long-sleeved shirt, long pants, shoes, and socks (Control Solutions 2009a, Control Solutions 2009b.)"

Malathion

Fyfanon ULV containing 96.5% malathion (9.9 lbs/gal) (EPA# 53883-34) label directions for personal protective equipment are:

"For all formulations and use patterns - mixers, loaders, applicators, flaggers, and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves
- Shoes plus socks (Cheminova 2011a, Cheminova 2011b)"

Naled

Personal protective equipment from the naled product labels read:

"If engineering controls are in use:

- Protective eye wear (goggles, face shield, or safety glasses)
- Long-sleeved shirt and long pants
- Socks plus shoes
- Chemical-resistant gloves (barrier laminate, butyl rubber, nitrile rubber, or viton, selection category E) and apron when mixing or loading. See engineering controls for additional requirements

In the absence of engineering controls:

- Protective eye wear (goggles, face shield, or safety glasses)
- Coveralls over long-sleeve shirt and long pants
- Chemical-resistant gloves
- Chemical-resistant footwear plus socks
- Chemical-resistant apron if exposed to the concentrate • Chemical-resistant headgear for overhead exposure
- A respirator with an organic-vapor removing cartridge with a prefilter approved for pesticides (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a.)"

ENVIRONMENTAL HAZARD STATEMENTS

PYRETHROIDS- PYRETHRINS-PBO CONTAINING PRODUCTS

The environmental hazard statement from Zenivex E20 (EPA#2724-791) containing 20% etofenprox label states:

"**This pesticide is toxic to aquatic organisms, including fish and aquatic invertebrates**. Runoff from treated areas or deposition into bodies of water may be hazardous to fish and other aquatic organisms. Do not apply over bodies (of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), **except when necessary to target areas where adult mosquitoes are present,** and weather conditions will facilitate movement of applied material away from water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or washwasters. [Emphasis added].

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Time applications to provide the maximum possible interval between treatment and the next period of bee activity. Do not apply to blooming crops or weeds when bees are visiting the treatment area, **except when applications are 'made to prevent or control a threat to public and/or animal health determined by a state, tribal, or local health or vector control agency on the basis of documented evidence of disease-'causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations**, or if specifically approved by the state or tribe during a natural disaster recovery effort (Wellmark 2010c, Wellmark 2010d.)" [e**mphasis added]**.

Similar extensive environmental hazard warnings are found on all of the pyrethrins-pyrethroid-PBO have warnings similar or identical to the Zenivex E20 (EPA# 2724-791) (Wellmark 2010c, Wellmark 2010d.)"
In addition, the two Scourge products containing resmethrin and PBO are classified as restricted use products because of acute toxicity to fish (Bayer 2012a, Bayer 2012b, Bayer 2012c, Bayer 2012d). The restricted use classification means that certification and licensing are needed to purchase and use the products.

ORGANOPHOSPHATE CONTAINING PRODUCTS

Pyrofos 1.5 ULV Vector Control Insecticide containing 19.36% chlorpyrifos (1.5 lbs/gal) (EPA# 53883-251) has the following environmental hazard statements:

> "This pesticide is toxic to fish, aquatic invertebrates, small mammals and birds. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries) ~ **except when necessary to target areas where adult mosquitoes are present, (emphasis added)** and weather conditions weather facilitate movement of applied material beyond the body of water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment rinsate or wash waters.
>
> This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treated area**, except 'When applications are made to prevent or control a threat to public and/or animal health determined by a state, or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes, or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort** (**emphasis added)** (Control Solutions 2009a, Control Solutions 2009b**)**."

The environmental hazard section of the Fyfanon ULV containing malathion read much the same as the synthetic pyrethroids:

> "This pesticide is toxic to aquatic organisms, including fish and invertebrates. Use care when applying in or to an area which is adjacent to any body of water, and do not apply when weather conditions favor drift from target area. Poorly draining soils and soils with shallow water tables are more prone to produce runoff that contains this product. When applying as a wide area mosquito adulticide, before making the first application in a season, it is advisable to consult with the state or tribal agency charged with primary responsibility for pesticide regulation to determine if other regulatory requirements exist.
>
> This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow to drift onto blooming crops or weeds while bees are actively visiting the treatment area, **except when applications are made to prevent or control a threat to public**

and/or animal health determined by a state, tribal or local public health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or tribe during a natural disaster recovery effort (**emphasis added).**

When applying as a wide area mosquito adulticide, do not apply over bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposition into the water body. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA (Cheminova 2011a, Cheminova 2011b.)"

Another consideration not found on other public health mosquito products is: "undiluted spray droplets of Fyfanon ULV Mosquito will permanently damage vehicle paint finishes unless the aircraft used for the ultra-low volume application meets all of the specifications listed under AERIAL APPLICATION (Cheminova 2011a, Cheminova 2011b).

Regarding non-target toxicity the naled labels read:

"This pesticide is toxic to fish, aquatic invertebrates, and wildlife. Runoff from treated areas or deposition of spray droplets into a body of water may be hazardous to fish and aquatic invertebrates. Before making the first application in a season, consult with the primary State agency responsible for regulating the pesticides to determine if permits are required or regulatory mandates exist. Do not apply over bodies of water (e.g., lakes, swamps, rivers, permanent streams, natural ponds, commercial fish ponds, marshes or estuaries), **except when necessary to target areas where adult mosquitoes are present (emphasis added),** and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposition into the water body. Do not contaminate bodies of water when disposing of equipment washwaters or rinsate (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a).

This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. To minimize hazard to bees, it is recommended that the product is not applied more than two hours after sunrise or two hours before sunset, limiting application to times when bees are least active. Do not apply this product or allow it to drift to blooming crops or weeds while bees are visiting the treatment area, except when applications are made to prevent or control a threat to public and/or animal health determined by a state, tribal or local health or vector control agency on the basis of documented evidence of disease causing agents in vector mosquitoes or the occurrence of mosquito-borne disease in animal or human populations, or if specifically approved by the state or the tribe during a: natural disaster recovery effort (AMVAC 2009a, AMVAC 2010a, AMVAC 20012a).

LABEL LANGUAGE FOR USE OVER FARMS AND AGRICULTURAL AREAS

PYRETHROIDS- PYRETHRINS-PBO PRODUCTS

Depending on the existence of US food or feed tolerances (Appendix III), the label language for the pyrethrins-pyrethroid containing adulticides is different.

Piperonyl butoxide (PBO), is present in all of the pyrethrins-pyrethroid products with the exception of the etofenprox products. PBO is exempt from tolerance on raw agricultural commodities when used according to good agricultural practice (40CFR180.905).

There are no tolerances for etofenprox in raw agricultural commodities with the exception of rice (40CFR180.620). Etofenprox containing products have label directions to "Cover exposed drinking water in corrals, feedlots, swine lots cropland or any exposed drinking water" and "do not spray or allow drift onto pastureland, cropland or potable water sources. Given the "cover drinking water" sources for livestock and "do not spray or allow drift" statements on the etofenprox labels, food residues resulting from public health mosquito applications should not be an issue.

Permethrin has many tolerances in raw agricultural commodities (40 CFR180.378) these are for the commodities listed on the permethrin product labels. Permethrin-PBO products, in one form or another have the following label language, "Do not spray this product on or allow it to drift onto cropland (other than crops listed) or potable water supplies (followed by the list of commodities which have tolerances for permethrin and PBO residues). In the treatment of corrals feedlots animal confinements/houses swine lots poultry ranges and zoos cover any exposed drinking water drinking fountains and animal feed before application.

Phenothrin has a universal tolerance 0.01 ppm for raw agricultural commodities (40CFR180.647) and PBO is exempt from tolerance (40CFR180.905). Prallethrin only has a universal tolerance for uses in food and feed establishments and no tolerances on raw agricultural commodities (40CFR180.545). Anvil 10 + 10, oil based and Aqua Anvil, water-based, have the following statement regarding use over agricultural areas: "May be applied over agricultural areas for the control of adult mosquitoes within or adjacent to the treatment areas" Because of the presence of prallethrin and the lack of tolerances, the Duet and Aqua Duet, Phenothrin-PBO-Prallethrin have the following statement regard agricultural areas: "Do not spray this product on or allow it to drift onto rangeland cropland poultry ranges or potable water supplies In treatment of corrals feed lots swine lots and zoos cover any exposed drinking water drinking water fountains and animal feed before application"

Pyrethrins are exempt from tolerance on raw agricultural commodities (40CFR180.905).

Pyrethrins-PBO product labels state: "This concentrate may be diluted or used as supplied for mosquito control programs involving residential, industrial, recreational and agricultural areas where adult mosquitoes are present in annoying numbers in vegetation surrounding swamps, marshes, overgrown waste areas, roadsides and pastures. Use in agricultural areas should be in such a manner as to avoid residues in excess of established tolerances for pyrethrins and PBO on crops or commodities"

Similar to prallethrin, resmethrin has a universal tolerance for uses in food and feed establishments and no tolerances on raw agricultural commodities (40CFR180.525.). Given the site limitations on the resmethrin containing product labels, food residues resulting from public health mosquito applications should not be an issue. The two Scourge products containing resmethrin and PBO labels state: "Scourge is designed for application as an Ultra-Low Volume (ULV) aerosol to control adult mosquitoes and flies in residential industrial urban recreational areas and other areas where the labeled pests are a problem.

ORGANOPHOSPHATE CONTAINING PRODUCTS

There are at least 80 tolerances (40CFR180.342) for chlorpyrifos, given the non-crop-land statement on the chlorpyrifos label, food residues resulting from public health mosquito applications should not be an issue. Chlorpyrifos containing product, CSI 1.5 ULV (EPA# 53883-251) is designed for application either as a thermal fog or as an ultra-low volume (ULV) non-thermal aerosol (cold fog) to control adult mosquitoes in: "Outdoor residential and recreational areas and other non-cropland areas where these insects are a problem"

Malathion has tolerances in over 150 commodities (40CFR180.111). Given the site limitations on the malathion containing product label, food residues resulting from public health mosquito applications should not be an issue. Aerial Applications for Fyfanon ULV are limited to "Rangeland, Pasture, and Other Uncultivated Non-Agricultural Areas (Wastelands, Roadsides). There are no such limits on ground applications.

There are 38 tolerances for naled. In addition, a universal tolerance of 0.5 part per million is established for the pesticide naled in or on all raw agricultural commodities, except those otherwise listed in this section, from use of the pesticide for area pest (mosquito and fly) control (40CFR180.215). Two of the three products containing naled have mosquito (and nuisance fly) uses only, Dibrom Concentrate (EPA# 5481-480) and Trumpet EC (EPA# 5481-481). The third product, Dibrom 8 Emulsive (EPA# 5481-479) has the mosquito, nuisance fly and agricultural uses on its label. The two products with no agricultural uses on their labels have the following directions regarding use over agricultural areas:

> "It is not necessary to avoid farm buildings, dairy barns, pastures, feed or forage areas. Use in agricultural areas must be in a manner as to ensure that residues do not exceed the established federal tolerance for the active ingredient in or on raw agricultural commodities resulting from use for wide area pest control. Treat shrubbery and vegetation where mosquitoes may be present. Shrubbery and vegetation around stagnant pools, marshy areas, swamps, residential areas, municipalities, woodlands, pastures, farm buildings and feedlots may be treated."

The product with both agricultural and mosquito/ nuisance fly uses, Dibrom 8 Emulsive (EPA# 5481-479) in the section on controlling mosquitos reads:

> "It is not necessary to avoid farm buildings. Make applications during peak of infestation and repeat as necessary. See crop recommendation for use limitations near harvest. Treat shrubbery and

vegetation where mosquitoes may rest. Shrubbery and vegetation around stagnant pools, marshy areas, ponds and shorelines may be treated.

References

40CRF180.215, 2013, Tolerances for Naled

40CRF180.647, 2013, Tolerances for Phenothrin (Sumithrin)

AMVAC 2009a, Dibrom Concentrate, EPA# 5481-480, containing 87.4% naled, EPA Label

AMVAC 2009b, Dibrom Concentrate, EPA# 5481-480, containing 87.4% naled, ME-2013 Label

AMVAC 2010a, Trumpet EC Insecticide, EPA# 5481-481, containing 78% naled, EPA Label

AMVAC 2010b, Trumpet EC Insecticide, EPA# 5481-481, containing 78% naled, ME-2013 Label

AMVAC 2012a, Dibrom 8 Emulsive, EPA# 5481-479, containing 62%, naled, EPA Label

AMVAC 2012b, Dibrom 8 Emulsive, EPA# 5481-479, containing 62%, naled, ME-2013 Label

Bayer CropSciences 2009, Sevin Brand RP4 Carbaryl Insecticide, EPA# 264-335, containing 43% Carbaryl EPA Label

Bayer Environmental Services 2011a, Aqua-Permanone, EPA# 432-796, containing 20% permethrin-20% PBO, EPA Label

Bayer Environmental Services 2011b, Aqua-Reslin, EPA# 432-796, containing 20% permethrin-20% PBO, ME-2013 Label

Bayer Environmental Services 2011c, Omen 30-30 ULV, EPA# 432-1235, containing 30% permethrin-30% PBO, EPA Label

Bayer Environmental Services 2011d, Permanone 30-30, EPA# 432-1235, containing 30% permethrin-30% PBO, ME-2013 Label

Bayer Environmental Services 2011e, Permanone Insecticide Concentrate, EPA# 432-1250, containing 31.28% permethrin-66% PBO, EPA Label

Bayer Environmental Services 2011f, Permanone 31-66, EPA# 432-1250, containing 31.28% permethrin-66% PBO, ME-2013 Label

Bayer Environmental Services 2011g, Pyrenone Crop Spray, EPA# 432-1033, EPA Label

Bayer Environmental Services 2012a, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 4%+12% MF FII, EPA# 432-716, containing 4.14% resmethrin-12.42% PBO, EPA Label

Bayer Environmental Services 2012b, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 4%+12% MF FII, EPA# 432-716, containing 4.14% resmethrin-12.42% PBO ME-2013 Label

Bayer Environmental Services 2012c, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 18% + 54% MF FII, EPA# 432-667, containing 18% resmethrin-54% PBO, EPA Label

Bayer Environmental Services 2012d, Scourge Insecticide w/ Resmethrin/Piperonyl Butoxide 18% + 54% MF FII, EPA# 432-667, containing 18% resmethrin-54% PBO, ME-2013 Label

Centers for Disease Control and Prevention (CDC) 2003, Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention and Control

Cheminova 2011a, Fyfanon ULV Mosquito Insecticide, EPA# 67760-34, containing 96.5% malathion, EPA Label

Cheminova 2011b, Fyfanon ULV Mosquito Insecticide, EPA# 67760-34, containing 96.5% malathion, ME-2013 Label

Clarke Mosquito Control 2013a, Anvil 10+10 ULV, EPA# 1021-1688-8329, containing 10% sumithrin (phenothrin)-10% PBO, ME-2013 Label

Clarke Mosquito Control 2013b, Duet EPA# 1021-1795-8329, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, ME-2013 label

Clarke Mosquito Control 2013c, Aqua Anvil Water Based Adulticide, EPA# 1021-1807-8329, containing 10% sumithrin (phenothrin)-10% PBO, Label from Clarke mosquito Website: http://www.clarke.com/index.php?option=com_content&view=category&layout=blog&id=47&Itemid=126

Clarke Mosquito Control 2013d, Aqua Duet, EPA# 1021-2562, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, Label from Clarke mosquito Website: http://www.clarke.com/index.php?option=com_content&view=category&layout=blog&id=47&Itemid=126

Control Solutions 2009a, Pyrofos, EPA# 53883-251, containing 19.36% chlorpyrifos (1.5 lbs/gal) EPA Label

Control Solutions 2010e Pyrofos, EPA# 53883-251, containing 19.36% chlorpyrifos (1.5 lbs/gal) ME-2013 Label

Control Solutions 2010a, PBO/Permethrin 20:20, EPA# 53883-274, containing 20.6% permethrin-20.6% PBO, EPA Label

Control Solutions 2010b, Vector-Flex 20:20, EPA# 53883-274, containing 20.6% permethrin,-20.6% PBO, ME-2013 Label

Direct AG Source 2013, Permethrin 3.2 AG, EPA# 83222-3, containing 36.8% Permethrin [3.2 lbs/gal] EPA Label

Dow AgroSciences 2012, Dursban 50W in Water Soluble Packet,s EPA# 62719-72, Wettable Powder in Water Soluble bags Containing 50% Chlorpyrifos EPA Label

EPA 2002a, 2006a, Interim Re-registration Eligibility Decision for Naled; Finalized in 2006

EPA 2005g, Screening Ecological Risk Assessment for the Re-registration of Piperonyl Butoxide Insecticide Synergist

EPA 2006b, Revised Pyrethrins RED Chapter after Additional 60-Day Comment Period Phase 5

EPA 2006d, Re-registration Eligibility Decision (RED) for Resmethrin

EPA 2006f, Revised Occupational and Residential Exposure Assessment and Recommendations for the Re-registration Eligibility Decision (RED) for Resmethrin

EPA 2006i, The Agency Revised Risk Assessment for the Registration Eligibility Decision for Permethrin Following Public comments, Phase III

EPA 2006j,Glyphosate Human Health Risk Assessment for Proposed Use on Indian Mulberry and mended Use on Pea, Dry. PC Code: 417300, Petition No: 5E6987, DP Num: 321992, Decision No. 360557.

EPA 2008d, EFED Registration Review-Preliminary Problem Formulation for the Ecological Risk Assessment of Naled

EPA 2008e, EFED Registration Review – Preliminary Problem Formulation for Ecological Risk and Environmental Fate, Endangered Species and Drinking Water Assessments Chlorpyrifos (PC Code 059101; DP Barcode D355212)

EPA 2008f, EFED Preliminary Environmental Fate And Effects Assessment Science Chapter for the Re-registration Eligibility Deciscion of D-phenothrin (Sumithrin)

EPA 2008g, Risks of Naled Use to Federally Threatened California Red Legged Frog *(Rana aurora drayonii)*

EPA 2009a, Environmental Fate and Ecological Risk Assessment for Etofenprox New Uses on Rice and Vector Control

EPA 2009d, Permethrin: Sixth Revision of the HED Chapter of the Re-registration Eligibility Decision Document (RED)

EPA 2009g, Registration Review Preliminary Problem Formulation for the Ecological Risk, Environmental Fate and Endangered Species Assessments for Malathion (PC code 057701; DP Barcode D359863)

EPA 2010b, EFED Registration Review Problem Formulation for Piperonyl Butoxide

EPA 2011h, EFED Registration Review Preliminary Problem Formulation for Permethrin

EPA 2011i, EFED Registration Review Preliminary Problem Formulation for Pyrethrins

EPA 2012a, Chemicals Evaluated for Carcinogenic Potential, Office of Pesticides Programs 2012

EPA 2012b, Use's Guide to T-REX Version 1.5

EPA 2012c, Standard Operating Procedures for Residential Pesticide Exposure Assessment

EPA 2012h, EFED Registration Review: Preliminary Problem Formulation for Environmental Fate, Ecological Risk, Endangered Species, and Drinking Water Exposure Assessment for Prallethrin

EPA 2012i, EFED Registration Review:Preliminary Problem Formulation for Resmethrin

LG Lifesciences 2009, Lamdastar 1 CS-PCO, EPA# 71532-27, containing 12% lambda cyhalothrin Fed Label

Loveland Chemical 2011, Carbaryl 4L, EPA# 34704-447, containing 43% Carbaryl EPA-Label

McLaughlin Gromley King 2012a, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7395, EPA# 1021-1570, containing 12% pyrethrins-60% PBO, ME-2013 Label

McLaughlin Gromley King 2012b, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7395, EPA# 1021-1570, containing 12% pyrethrins-60% PBO, EPA Label 2012

McLaughlin Gromley King 2012c, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2705, EPA# 1021-1688, containing 10% sumithrin (phenothrin)-10% PBO, EPA-2012 Label

McLaughlin Gromley King 2012d, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2795, EPA# 1021-1795, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, EPA-2012 Label

McLaughlin Gromley King 2012c, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2705, EPA# 1021-1807, containing 10% sumithrin (phenothrin)-10% PBO, EPA-2012 Label

McLaughlin Gromley King 2012d, Multicide Mosquito Adulticiding Concentrate for ULV Fogging 2795, EPA# 1021-2562, containing 1% Prallethrin 5% sumithrin (phenothrin)-5% PBO, EPA-2012 Label

McLaughlin Gromley King 2013a, Pyrocide Fogging Formula 7067, EPA# 1021-1199, containing 5% pyrethrins-25% PBO, EPA Label

McLaughlin Gromley King 2013b, Pyrocide Fogging Formula 7067, EPA# 1021-1199, containing 5% pyrethrins -25% PBO, ME-2013 Label

McLaughlin Gromley King 2013c, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396, EPA# 1021-1569, containing 5% pyrethrins-25% PBO, EPA Label

McLaughlin Gromley King 2013d, Pyrocide Mosquito Adulticiding Concentrate for ULV Fogging 7396, EPA# 1021-1569, containing 5-pyrethrins-,25% PBO, ME-2013 Label

NuFarm Americas 2012, ATERA GC 2+1 SC Insecticide, EPA# 228-557, containing 21.99% [2 lbs/gal] imidacloprid and bifnenthrin 10.654% [1 lb./gal]

Prentiss 2012a, Prentox Perm-X UL 4-4, EPA# 655-898, containing 4% permethrin-4% PBO, EPA Label

Prentiss 2012b, Prentox Perm-X UL 4-4, EPA# 655-898, containing 4% permethrin-4% PBO, ME-2013 Label

Prentiss 2012c, Prentox Perm-X UL 30-30, EPA# 655-811, containing 30% permethrin, 30% PBO, EPA Label

Prentiss 2012d, Prentox Perm-X UL 30-30, EPA# 655-811, containing 30% permethrin-30% PBO, ME-2013 Label

Prentiss 2012e, Prentox Perm-X UL 31-66, EPA# 655-812, containing 31% permethrin-66% PBO, EPA Label

Prentiss 2012f, Prentox Perm-X UL 31-66, EPA# 655-812, containing 31% permethrin-66% PBO, ME-2013 Label

Syngenta 2010, Demand Pest Tabs, EPA# 100-1082, containing 10% lambda-cyhalothrin, EPA Label

Tessendro-Kerley 2012 Sevin Brand 4F Carbaryl Insecticide, PA# 61842-38, containing 43% Carbaryl, EPA-Label

Tessendro-Kerley 2013 Sevin Brand 85 Sprayable Carbaryl Insecticide, EPA# 61842-33, containing 85% Carbaryl, EPA-Label

United Phosphorous 2012, Up-Cyde Pro 2 0 EC Termiticide/lnsecticide (EPA # 70506-19) EPA Label

Univar Environmental Services 2013a, Masterline Kontrol 2-2, EPA# 73748-3, containing 2% permethrin-2% PBO, EPA Label

Univar Environmental Services 2013b, Masterline Kontrol 2-2, EPA# 73748-3, containing 2% permethrin-2% PBO, ME-2013 Label

Univar Environmental Services 2013c, Masterline Kontrol 4-4, EPA# 73748-4, containing 4.6% permethrin-4.6% PBO, EPA Label

Univar Environmental Services 2013d, Masterline Kontrol 4-4, EPA# 73748-4, containing 4.6% permethrin-4.6% PBO, EPA Label

Univar Environmental Services 2013e, Masterline Aqua Kontrol Concentrate, EPA# 73748-1, containing 20% permethrin-20% PBO, ME-2103 Label

Univar Environmental Services 2013f, Masterline Aqua Kontrol Concentrate, EPA# 73748-1, containing 20% permethrin-20% PBO, EPA Label

Univar Environmental Services 2013g, Masterline 30-30, EPA# 73748-5, containing 30% permethrin-30% PBO, ME-2103 Label

Univar Environmental Services 2013f, Masterline 30-30, EPA# 73748-5, containing 30% permethrin-30% PBO, EPA Label

Wellmark International 2010c, Zenivex E20, EPA# 2724-791, containing 20% etofenprox, EPA Label

Wellmark International 2010d, Zenivex E20, EPA# 2724-791, containing 20% etofenprox, ME-2013 Label

Wellmark International 2010a, Zenivex E4 RTU, EPA# 2724-807, containing 4% etofenprox, EPA Label

Wellmark International 2010b, Zenivex E4 RTU, EPA# 2724-807, containing 4% etofenprox, ME-2013 Label