AQUAHALT™

WATER-BASED PYRETHRINS*

Adulticide for Mosquito Control

Droplet Optimization Technology yields a more consistent droplet

Use areas include agriculture and pastures

*Botanical insecticide derived from the chrysanthemum flower

RESOURCE GUIDE

WATER-BASED FORMULATION DELIVERS CONSISTENT PERFORMANCE

Traditional oil-based formulations of pyrethrins have been utilized in many mosquito control programs, even though they deliver inconsistent performance. But now, AquaHalt™ — formulated with Droplet Optimization Technology (DOT) — delivers pyrethrins in a water-based colloidal suspension. AquaHalt provides optimal stability and consistent performance.

AQUAHALT'S BENEFITS >>

"DOT" yields a more consistent and effective droplet

Use areas include agriculture and pastures

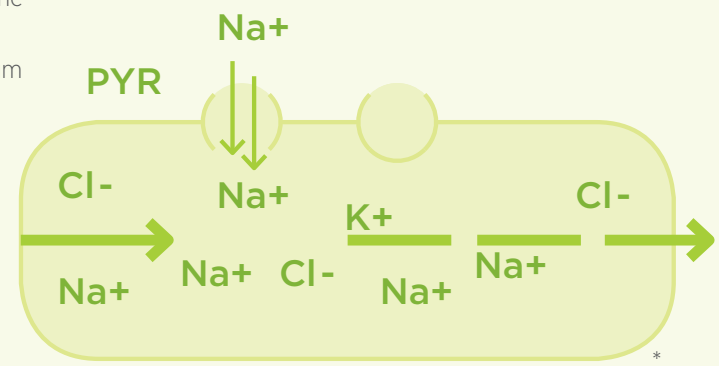
Botanical insecticide, derived from the chrysanthemum flower

We believe that an important part of being an environmental steward is product rotation. Product rotation maximizes the effectiveness of every program by preventing cross-resistance.

To help select products for rotation in your program, visit clarke.com/mosquitocontrolproducts to view our full line of product offerings.

Nerve Axon With Pyrethrins Present

Pyrethrins; a botanical insecticide that acts on an insect's axons in the peripheral and central nervous systems by interacting with sodium channel complex.



*Coats J; Mechanism of Toxic Actions and Structures Activity Relationships for Organic Chlorine and Synthetic Pyrethroids. Environmental Heath Perspective, Vol. 87, p.255-262, 1990.

Ideal for Sensitive Environments

Pyrethrins can be an excellent choice for integrated pest management programs in communities where mosquito control meets with resident resistance.

Derived from the botanical extracts of chrysanthemum flowers, natural pyrethrins have long been the choice of mosquito control professionals who need to address sensitive ecologies.

AquaHalt breaks down quickly in the environment and is non-persistent. It is labeled for use in or around agriculture, including:

» Croplands

» Pastures

» Livestock and horses

» Animal feeding areas

Active Ingredients:

Pyrethrins (5%)

Piperonyl Butoxide, (25%)

Other Ingredients (70%)

DROPLET OPTIMIZATION TECHNOLOGY (DOT) ENHANCES EFFICACY

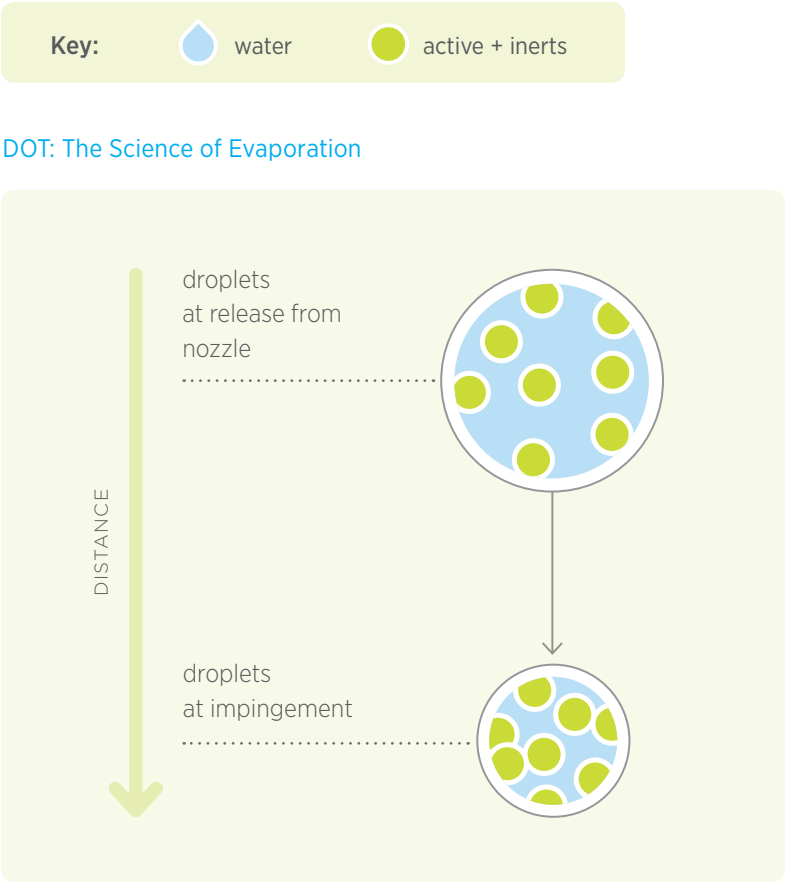
Droplet Optimization Technology provides optimal stability for AquaHalt™'s active ingredient particles and protects them from evaporation within the droplet. As a result, **a more concentrated delivery of the active is better able to impinge on adult mosquitoes.** This consistent performance results in higher kill rates.

How DOT Results in Better Performance

Initial operational field trials have shown improved kill rates over traditional pyrethrin options — even when applied at low rates. Why is AquaHalt so effective?

The DOT formulation of AquaHalt allows larger active particles to be present in an optimized spray droplet. As the droplet leaves the spray nozzle, the aqueous carrier begins to evaporate until it reaches an optimized droplet size. At this point, evaporation ceases and the droplet is stabilized.

When airborne, a water-based droplet will lose about 50% of it's volume immediately after it is released from the nozzle. In AquaHalt, the "DOT" droplet becomes more concentrated as the water evaporates. This phenomenon is what makes AquaHalt so effective, even by air, as the droplets are heavier and better able to traverse the atmosphere and penetrate the canopy.



Evaporation:

Spray droplet evaporation is limited to:

$$\sqrt[3]{\text{non volatile fraction}^*} \times \text{Original droplet diameter}^{/1}$$

Example:

A spray droplet has a beginning diameter of 42 µm and the non volatile fraction = **50% (0.50)**

$$\sqrt[3]{0.50} = 0.794$$

0.794 x **50** = **39.7** µm – Minimum droplet diameter

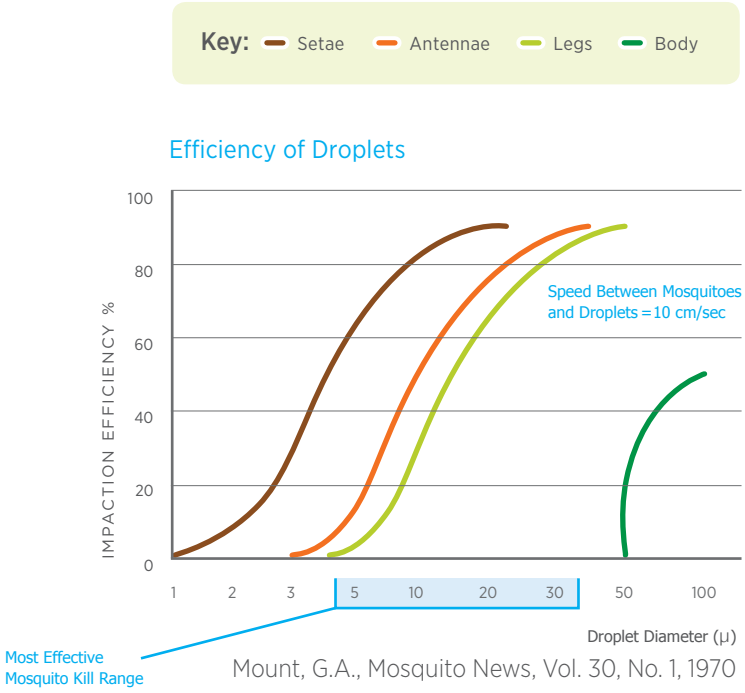
/1 1 R.E. Mickle, RemSPEC 2006

*Non volatile fraction for AquaHalt is 50%

The DOT formulation also ensures that when applied at the recommended droplet size of 40-42 microns from the air and 18-20 microns from the ground, the AquaHalt concentrated spray droplet will fall within the ***optimized*** size range that has been demonstrated to have the best chance of impinging upon flying mosquitoes.

Additional Benefits of AquaHalt™

- Yields a more consistent droplet from the beginning of the application to the end
- Unique colloidal suspension won't break down nor gum up high-pressure nozzles
- Offers excellent storage stability
- Flushes from equipment simply with 50/50 mix of water/isopropyl alcohol, or windshield washer fluid



Mount, G.A., Mosquito News, Vol. 30, No. 1, 1970

This graph illustrates that there is an optimum size range for mosquito adulticide sprays. This range has been found to be between 5—30 microns.

PROFILE
A LOW TOXICITY, NON-PERSISTENT ADULTICIDE

Toxicology

ACUTE TOXICOLOGY	AQUAHALT
Oral LD50 (rats)	500 – 5,000 mg/kg
Dermal LD50 (rats)	> 2000 mg/kg
Eye Irritation (rabbits)	Irritation*
Inhalation LC50 (rats)	2.03 mg/l
Skin Sensitization (guinea pig)	Negative**

* Cleared within 24 hours

** Slight irritation within 72 hours, Primary irritation index = 1.4

Product Density

ACTIVE INGREDIENT	PYRETHRINS
Specific Gravity	1.012 @20C
Viscosity	25.67 CPS @23°C
Density	8.34 lbs/gal.

Environmental Fate & Toxicity

In Sunlight: An important, well-documented characteristic of pyrethrins are that they are photolabile. The molecules easily decompose in the presence of sunlight. The half-life of pyrethrins in the presence of light range from 4 to 8 hours, depending on the position of the radiolabel. The degradation products of pyrethrins are also nonpersistent. Microbial degradation of pyrethrins in aerobic soil have a half life of 10.5 days.

In Soil: Pyrethrins are not readily transported from the site of application. Very little movement of pyrethrins and their degradation products from soil into plants or through soil columns were observed using radiolabeled material. Pyrethrins do not bioaccumulate and are subject to both oxidation and cleavage of their ester linkage in biological systems.

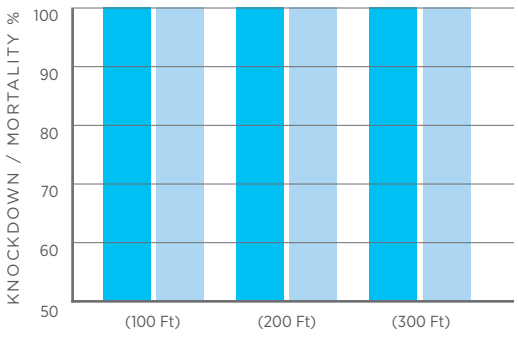
In Nontarget Species: Studies found the oral LD50 of >2000 mg/kg body weight for bobwhite quail and mallard ducks. The LC50 was >5500 ppm of diet for the bobwhite quail and mallard duck. The 96 hour acute flow through LC50 for Bluegills and Rainbow Trout are 10µg and 5.2µg total pyrethrins/liter, respectively.

Eco-Tier™ Ranking:

The Clarke Eco-Tier™ Index offers three tiers of products, equipment and services ranked by their impact on the environment. AquaHalt™ is ranked as an “Advanced” product.

CAGED TRIAL RESULTS YIELD SUPERIOR PERFORMANCE

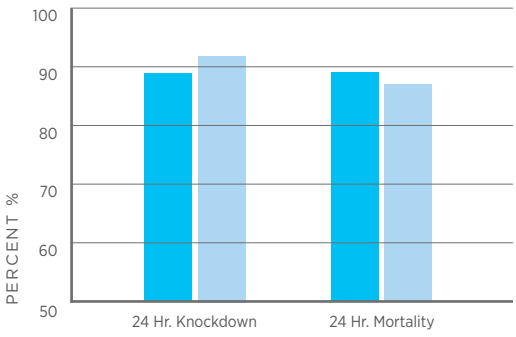
Aquahalt Ground ULV
Location: Chambers Co., TX – 3/7/06
Rate: 0.0009# ai/acre



Culex salinarius, An. crucians

Key: 1-Hour Knockdown 24-Hour Mortality

Aquahalt Ground ULV
Location: Colusa County, CA – 9/19/06
Rate: 0.0025# ai/acre



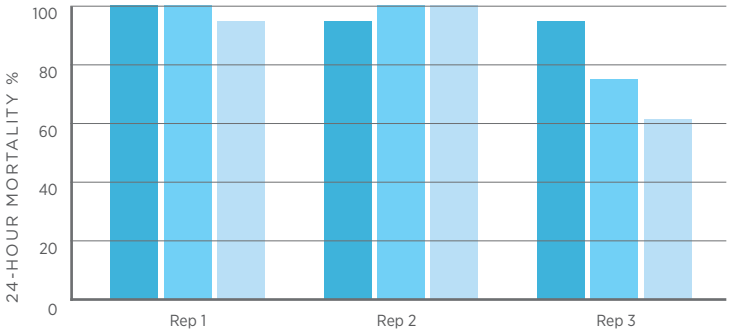
Key: *Oc. melanimon* *Culex pipiens*

AquaHalt™ is proving to bring performance consistency to an active ingredient that has been sometimes challenging to use in an oil-based formulation.

We have seen field trials with 100% control even in low relative humidity conditions. A Moses Lake, WA. trial with daytime highs in the 90s and nighttime temperatures in the mid to high 70s, relative humidity was 44 — 54%. There, diluted 1:2 with water and applied aerially at low label rates, fast knockdown and exceptional mortality were achieved.

Other trials shown here demonstrate AquaHalt's performance by ground and air.

Aquahalt Ground ULV
East Side Mosquito Abatement, Modesto, CA – 10/11/06
Rate: 0.0018# ai/acre



Oc. melanimon, Culex pipiens, An. freeborni

Key: 100′ 200′ 300′

APPLICATION METHODS OPTIMIZED FOR YOUR EQUIPMENT

AquaHalt™ has been proven effective whether applied by air or ground (truck, ATV, backpack). Optimized for all standard ULV application equipment and nozzles, AquaHalt is non-corroding to your application apparatus.

Applying AquaHalt by Air

Aerial applications can be completed with fixed wing or rotary aircraft. Using AquaHalt at a rate of .76 fl. oz/acre delivers maximum mosquito control coverage over a wide area. Droplet VMD (volume median diameter) should be optimized at 40-42 microns. This size factors in the evaporation process that reduces the droplet's volume after atomization. In wind tunnel atomization studies, AquaHalt has shown to effectively produce this droplet size range when sprayed through equipment that has been correctly calibrated.

To Optimize Your Aerial Application:

1

Select the Proper Nozzle

Refer to the table to achieve droplet VMD of between 40-42 microns. Some of the best nozzles for AquaHalt usage are rotary (e.g. Beecomist or Micronair). Be aware that conventional agriculture nozzles, or flat fan nozzles, may not produce droplets within the appropriate size spectrum.

AIRCRAFT TYPE	NOZZLE TYPE	SIZE	ANGLE
Fixed wing	Flat fan	80-110º small orifice 005-04	135° forward
Fixed wing	Micronair Nozzles AU5000	Standard cage mesh	Straight back
Fixed wing	Beecomist	40 m screen	Straight back
Rotary wing	Micronair Nozzles AU5000	Standard cage mesh	Straight back
Rotary wing	Beecomist	40 µm screen	Straight back

Note: Data is for general information only. Actual droplet size will depend on the application conditions and factors such as nozzle and atomizer condition. Always calibrate sprayers to ensure required dosage rate and conditions are met. **As always, read and follow label directions.**

2

Calibration Process

To adjust your spray system for proper flow rate:

» Determine the number of acres per minute your aircraft will treat by using the first formula shown.

» Select the AquaHalt™ labeled flow rate (in ounces per acre) required for your needs.

» Using the second formula, multiply the figures derived from the two steps above to determine the proper Calibration Flow.

$$\frac{\text{Swath} \times \text{Speed}}{495} = \text{Acres} / \text{Min}$$

$$\left(\frac{\text{Acres}}{\text{Min}}\right)\left(\frac{\text{Oz}}{\text{Acre}}\right) = \frac{\text{Oz}}{\text{Min}}$$

↓

Calibration Flow

PYRETHRINS	PBO	AQUAHALT
0.0025 Pounds a.i./Acre	0.0125 Pounds a.i./Acre	0.76 Fl. oz/Acre
0.0018 Pounds a.i./Acre	0.0090 Pounds a.i./Acre	0.55 Fl. oz/Acre
0.0009 Pounds a.i./Acre	0.0045 Pounds a.i./Acre	0.28 Fl. oz/Acre

3

Droplet Dynamics

Droplet VMD should be characterized from the ground at 25-30 microns to achieve maximum performance. Droplets can be collected and measured by utilizing a rotary impinger equipped with magnesium-coated slides as described in the diagram. Wind speed should not exceed label limits.

Droplets on slides can be measured using a compound microscope with a mechanical stage and an ocular micrometer. Starting at one end of the slide, measure each droplet as they pass through the eyepiece micrometer. The spread factor for magnesium-coated slides is 0.86.

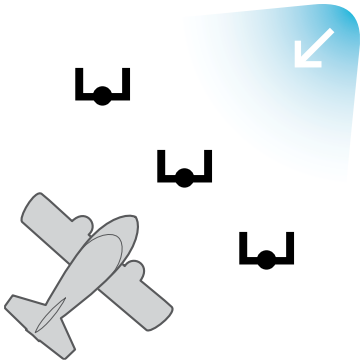
A minimum of 200 droplets should be measured to obtain an adequate sample. Make necessary adjustments to spray apparatus to achieve desired droplet size.

To Determine Appropriate Offset:

» Place droplet collectors 50 ft apart and 90 degrees to the wind direction.

» Fly directly into wind over slides at 75 ft. Spray for 15 seconds after passing over slide collectors.

» Wait 10 minutes after application for upwind droplets to reach collectors.



Applying AquaHalt™ by Ground

Ground applications of AquaHalt can be completed via truck-mounted equipment or with hand-held or backpack ULV equipment. It should be applied using cold aerosol generators capable of producing ULV spray droplets with a VMD of less than 30 microns.

Use the Following Guidelines, Assuming a 300 Ft Swath:

Pounds a.i./Acre		AquaHalt	Flow rates in fluid oz/min at truck speeds of:			
PYRETHRINS	**PBO**	**FL. OZ/ACRE**	**5 MPH**	**10 MPH**	**15 MPH**	**20 MPH**
0.0025	0.0125	0.76	2.3 oz	4.6 oz	7.0 oz	9.3 oz
0.0018	0.0090	0.55	1.7 oz	3.3 oz	5.0 oz	6.7 oz
0.0009	0.0045	0.28	0.8 oz	1.7 oz	2.5 oz	3.3 oz

Use these calculations to ensure compliance with labeled re-treatment intervals and annual limits.

When using non-thermal ULV portable backpack spray units, apply at a walking speed of 2 mph, making sure that the same amount of active ingredient is applied per acre.

To Optimize Your Ground Application:

To achieve maximum performance, droplet VMD should be optimized between 18-20 microns. Droplet spectrum may be determined by using the hot-wire method using a DCIII (AIMS) unit that measures and calculates VMD or MMD. Application equipment must be tested at least annually to confirm that pressure at the nozzle and nozzle flow rate(s) are properly calibrated.

Standard Droplet Collection:

- Use standard magnesium-coated microscope slide
- Attach slide to 3′—4′ rod
- Stand 10′—25′ downwind from nozzle
- Distance is dependent on sprayer velocity
- Higher velocity of sprayer = further distance from nozzle (not to exceed 25′)
- Swing rod (with coated slide facing the insecticide) once rapidly in a baseball swing/diagonal motion toward the sprayer, through the spray cloud

Standard Droplet Measurement:

- Use a compound microscope equipped with a mechanical stage and an ocular micrometer placed in the eyepiece.
- Starting at one end of the slide, measure each droplet as they pass through the eyepiece micrometer.
- A minimum of 200 droplets should be measured to obtain an adequate sample.
- Spread factor for AquaHalt is 0.86.

ENVIRONMENTAL CONDITIONS FOR AIR AND GROUND APPLICATION

AquaHalt should be applied when conditions are favorable for ULV applications. Favorable application conditions occur when the atmosphere at application height to immediately above ground level is stable. This condition is characteristic of an inversion, which occurs when temperatures increase with height. Stability is also influenced by solar radiation and heat exchange between air, soil and vegetation. As a result, favorable conditions for ULV applications usually occur prior to sunrise and after dusk. AquaHalt has been shown have to a negative temperature coefficient. This means it is extremely effective, early and late season when temperatures are between 50°-65° F and most mosquitoes are active.

FREQUENTLY ASKED QUESTIONS

Q: What is AquaHalt™?
A: AquaHalt is an adult mosquito control product that delivers pyrethrins in a water-based formulation. The active ingredients are pyrethrins, a botanical extract from chrysanthemum flowers, and a synergist (piperonyl butoxide) to enhance efficacy.

Q: Does AquaHalt pose a health risk to humans?
A: All pesticide products involve a balance between risks and benefits. The active ingredients in AquaHalt have been carefully tested. AquaHalt is registered for ground and aerial application in outdoor residential and recreational areas.

Q: Will this chemical harm the finish on my car and/or house?
A: The ingredients of AquaHalt are not corrosive or staining and therefore should cause no chemical harm to the finish of a car and/or house.

Q: How will this spraying affect the mosquito population?
A: In the majority of spray applications, spraying with AquaHalt is highly effective at killing adult mosquitoes.

Q: How is AquaHalt applied? What are the optimal droplet sizes for air or ground application?
A: For best results, AquaHalt should be applied using droplets characterized to 40-42 microns by air or 18-20 microns via ground applications.

Q: How much is typically applied?
A: Approximately 7 tenths of an ounce per acre.

Q: How effective is AquaHalt?
A: For more than 150 years, pyrethrins (the active ingredients in AquaHalt) have been used to combat mosquitoes and other insects. Environmental conditions, droplet size of AquaHalt, and the weather might affect results.

Clarke

GLOBAL HEADQUARTERS

110 E. Irving Park Road, 4th Floor P.O. Box 72197 Roselle, Il 60172

Phone: 1.800.323.5727 Fax: 1.630.894.1774

www.clarke.com

Clarke is a global environmental products and services company. Each year, Clarke helps make communities around the world more livable, safe and comfortable by pioneering, developing and delivering environmentally responsible disease prevention and habitat management solutions. In 2008, Clarke founded The Clarke Cares Foundation, a non-profit created to provide disease prevention support for communities with critical needs.

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