

# AQUABAC<sup>®</sup>

## TECHNICAL BULLETIN

AQUABAC is produced from a strain of *Bacillus thuringiensis* subspecies *israelensis*, a naturally occurring bacterium that produced a protein toxin (crystals) and a spore. The activity of the AQUABAC formulations and all BTI formulations is due to the presence of the protein toxin. The spore has no effect on the larvicide activity.

AQUABAC formulations are unique and specifically manufactured to enhance larvicidal effects of the protein toxin and to ensure the toxin's biological stability.

Four formulations of AQUABAC are available: (1) AQUABAC xt Biological Larvicide Aqueous Suspension, (2) Aquabac (200G) Corn Cob Granule (5/8 and 10/14 mesh available), (3) AQUABAC DF Water Dispersible Granule, and (4) AQUABAC Primary Powder.

The potency of AQUABAC is controlled within specific limits using a bioassay procedure based on toxicity to larvae of *Aedes aegypti*. Quality control bioassays are conducted prior to release of each lot product. Other laboratories conduct analyses on each lot to assure there are no microbial contaminants present in the formulations.

### **AQUABAC xt Biological Larvicide Aqueous suspension is available in the following package sizes:**

- A. 2.5 gallon plastic jugs, packaged 2 per case
- B. 30 gallon HPDE Drums
- C. 220 gallon mini-bulk containers
- D. Bulk shipments in 4,000 to 5,000 gallon tanker trucks
- E. AQUABAC (200G) in 40 pound and 1,200 to 1,500 pound bulk bags
- F. AQUABAC DF Water Dispersible Granule in five pound HDPE Pails

### **MODE OF ACTION**

Mosquito and blackfly larvae are killed by ingesting the protein crystal (deltaendotoxin). The crystal is broken down in the larval midgut by a combination of enzymes and the alkaline environment. The epithelium of the midgut is destroyed resulting in gut paralysis, complete loss of ionic regulation between the midgut and hemocoel and larval death. Because the AQUABAC must be ingested to be effective, the products do not affect pupae, adults, or late larval stages when active feeding has ceased.

Death of larvae is rapid often occurring within one hour at field use rates. Complete mortality occurs in the laboratory within 24 hours. Blackfly larvae usually die within eight hours of treatment of the stream or river.

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AQABAC xt is specifically formulated to enhance its effects on mosquito and blackfly larvae. Particle size is small averaging 2 to 10 microns, but a significant amount of the formulated crystal protein is in agglomerated form so that ULV deposition is enhanced. These particle size characteristics improve both ground and aerial applications.

## EFFECT ON NON-TARGET ORGANISMS

### ENVIRONMENTAL FATE:

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AQUABAC is naturally occurring and safe to the environment. It shows no cross resistance to chemical larvicides and is especially well suited for use in areas where there is demonstrated resistance to organophosphates or pyrethroids.

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AQUABAC does not persist in soil or water. The protein crystals separate from the aquatic environment and settle to the bottom. They are deactivated by becoming food for other microorganisms or being absorbed to soil or other organic particles. Spores do not recycle or regenerate in the field.

### INVERTEBRATE TOXICOLOGY:

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*Bacillus thuringiensis* subspecies *israelensis* (BTI) has no toxic effects on beneficial insects such as lady bird beetles, honeybees, mayflies, dragonflies, damselflies, stoneflies, caddisflies, and true bugs. Among Diptera *Chaoborous* species *Ephydra riparia*, *Musca domestica*, *Odontomyia* species, and *Polpedilum* species are not susceptible to BTI. Some mortality occurs among *Chironomous pulmosus*, *Chironomous stigmaterus*, *Diza species*, *Goeldichironomous holoprasinus* and *Palpomyia* species but at rates of 10 to 1,000 times the field use rates for mosquito control.

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Some mortality has been observed against *Toxorhynchites* larvae that ingested prey immediately following intoxication. Filter feeding first instar *Toxorhynchites* larvae are as susceptible to BTI as mosquito larvae. Later instars are relatively insensitive to BTI when intoxicated prey are absent.

### OTHER NON-TARGET SPECIES:

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No toxicity was observed against crustacea including copepod species, *Gambusia*, oysters, shrimp, crabs, mollusks, flatworms and amphibia.

In addition to safety to non-target vertebrates and invertebrates, BTI based larvicides have been used in large-scale mosquito and blackfly control programs for 20 years with no adverse effects on humans.

### FORMULATION:

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AQUABAC xt is an aqueous suspension specifically formulated to meet the needs of the mosquito control industry. The product is a tan, aqueous suspension. Formulation characteristics have been manipulated to suspend the active ingredient in the feeding zone of mosquito larvae for an extended period of time.

AQUABAC xt is a partially agglomerated aqueous suspension with a potency of 1.200 ITU/mg. Physical characteristics are: (1) viscosity; <600 cps, and (2) specific gravity; 1.06 to 1.10. These physical characteristics permit ULV ground and aerial application and also provide desirable suspension qualities when mixed with water.

The formulation contains a high concentration of individual spores and protein crystals as well as agglomerated crystals. The agglomerates improve desprostitution when the formulation is applied ULV. The high number of individual spores and protein crystals enhances and prolongs the suspension of the product in the mosquito feeding zone.

To ensure high potency and to regulated the physical properties of AQUABAC xt, a method of concentration superior to centrifugation is utilized during the manufactruing process. This results in a homogenous formulation whis is twice filtered throught 100 mesh secreens to remove any extraneous particulate matter.

**AQUABAC xt**  
**APPLICATION INSTRUCTIONS**

**MOSQUITOES:**

HABITAT	RATE REQUIRED FOR CONTROL
Flood water, roadside ditches, irrigation ditches, rice fields, pastures, woodland pools, snow melt ponds .....	0.25 to 0.50 pts/A
Tital water, salt marshes, catch basins, Storm water retention areas .....	0.5 to 1.0 pts/A
Polluted water (sewage lagoons, etc.), water with moderate organic matter, water with a high concentration of suspended solids .....	1.02 to 2.0 pts/A

AQUABAC xt may be applied in conventional aerial and ground application equipment with sufficient water to provide thorough coverage of the target area. The amount of water needed will be dependent on weather, type of spray equipment, and mosquito habitat.

Ground application should be made in 5 to 100 gallson per acre in conventional equipment. As low as one gallon per acre surface area can be used when the target is ipen with light vegetative cover. areial applications may be done diluted or undiluted. For helicopters equipped with conventional boom and nozzles or rotary mist stomizers. For diluted applications, fill the mis tank or air craft hopper with the appropriate voluem of water and agitate vefore adding AQUABAC xt. Maintain agitation during loading and spraying.

**BLACKFLIES:**

Suggested concentration range ..... 0.5 to 75 ppm  
(0.5 to 75 mg/liter of stream water)

The concentration should be maintained in the stream for 15 minutes.

**SPECIFIC APPLICATION INSTRUCTIONS**

For blackfly control, apply with conventional ground and aerial application equipment or metered release systems from infested sites to schieve larvicidal concentrations. Insecticidal activity should occur within 24 hours. Reapply as needed. AQUABAC xt may be applied through appropriate ULV equipement.

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**FACTORS AFFECTING PERFORMANCE**

Water conditions such as temperature, organic matter content, chlorine, some inorganic salts, and pH may affect performance of AQUABAC formulations. Larval feeding rates, subsequent ingestion of AQUABAC protein toxin and larval mortality rates are positively correlated with water temperature. Organic matter and algae represent an alternative food source for mosquito larvae. Therefore, the higher labeled rates are required a greater dose of AQUABAC for effective larval control.

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Presence of free chlorine or some inorganic salts such as BaCO3, K2CO3, and MgCO3 can inhibit the activity of the protein toxin. The effectiveness of BTI is not impacted by pH levels near 7. Higher rates of AQUABAC are recommended for alkaline habitats with pH levels equal to or greater than 9.4.

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The effectiveness of BTI is also influenced by larval feeding behavior. Lower mortality rates have been observed with all BTI based formulations among Anopheles larvae because of the genera's preference for feeding at the surface. Although AQUABAC xt has been specifically formulated to enhance its suspension in the upper feeding horizon, the protein toxin does gradually settle out of the upper levels of water becoming inaccessible to these larvae.

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**PERFORMANCE RESULTS**

AQUABAC xt has been widely tested and used worldwide for the past

Analysis of field results from trials conducted in the United States indicate 95 to 100% mortality against Culex, Aedes, and Anopheline species.

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State	Mosquito Species	Type of Application	Rate/HA	% Reduction
LA	Psorophora columbiae	Diluted aerial	1.200 ml	100%
LA	Culex pipiens	Diluted ground	2,400 ml	97%
UT	Culex tarsalis	Diluted aerial	2,400 ml	95%
UT	Culex tarsalis	Diluted aerial	2,400 ml	98%
UT	Aedes darsalis	Sand ground	2,400 ml	97%
	Culex tarsalis			
	Culex pipiens			

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**BLACKFILES:**

Application of AQUABAC@xt against blackfly species in Washington, Oregon, Utah, and Pennsylvania provided 85 to 100% control at label rates.

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For more information regarding the use and application of AQUABAC formulations, please refer to sepeimen labels which are available up request from:  
**Biocontrol Network, 5116 Williamsburg Road, Brentwood, TN 37027**  
**Tel: (800) 441-2847      FAX: (615) 370-0662**