VALENT BIOSCIENCES

TECHNICAL USE BULLETIN

VectoMax®

Biological Larvicide

MADE WITH

BioFuse™

TECHNOLOGY

Combining our strengths™

VectoMax® BIOLOGICAL LARVICIDE

U.S. Patent Nos. 7,989,180 and 8,454,983

For Organic Production

MADE WITH BioFuse™ TECHNOLOGY

VectoMax® Biological Larvicide is an advanced mosquito larvicide based on BioFuse™ technology—a patented formulation and manufacturing process that combines the time-proven and environmentally compatible bacterial active ingredients *Bacillus thuringiensis* subsp. *israelensis* strain AM65-52 and *Bacillus sphaericus* strain ABTS-1743 into a single microparticle. The mosquito larvae get a dose of a carefully selected ratio of both toxins when VectoMax particles are ingested.

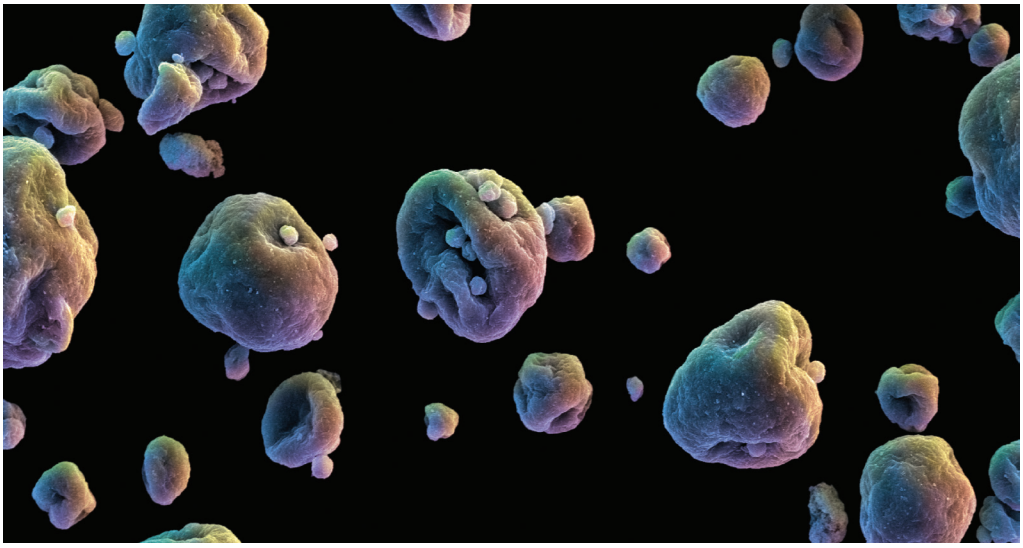
Features and Benefits

FEATURES	BENEFITS
Biorational larvicide Highly specific activity on mosquitoes	• Not harmful to non-target organisms
BioFuse patented technology (combines *Bti* and *Bsph* in a carefully selected ratio in every microparticle)	• VectoMax WSP provides up to 56 days of residual control in catch basins* • VectoMax FG provides up to 28 days of residual control in open habitats*
Quickly kills mosquito larvae	• Results observed quickly in the field
Offers residual control of several mosquito species	• Reduced number of applications
Controls all mosquito species Can be used in clean and polluted habitats VectoMax WSP is easy to apply (malleable, slips into tight spots)	• Application flexibility
National Organic Program (NOP) listed	• Peace of mind when treating mosquito larval habitats on organic farms
VectoMax WSP initially releases product/activity at water surface	• Does not get hung up in debris or sludge at the bottom of catch basins
Virtually dust-free granules	• Less respirable and particulate dust
Dust-free catch basin option	• Eliminates cleanup of PPE
Uniform carrier	• Even applications with no bridging at lower application rates

*Length of control dependent on local conditions and rate used.

BioFuse™ Technology

MADE WITH BioFuse™ TECHNOLOGY



Biological mosquito larvicides have gained considerable acceptance around the globe. The value of *Bti* and *Bsph* to mosquito control programs worldwide is well established.[1] *Bti* and *Bsph* each offer unique advantages relative to traditional chemical and biochemical insecticides. Both *Bti* and *Bsph* offer relative safety to humans and non-target organisms.[2,3,4] *Bti* provides broad-spectrum activity against mosquitoes, rapid control, and low potential for resistance; while *Bsph* exhibits extended residual control, efficacy in polluted water, and high target specificity.[5]

Due to these unique advantages, Valent BioSciences developed BioFuse technology, a globally patented technology that combines *Bti* and *Bsph* in a specific toxin ratio into every microparticle. This technology offers mosquito control professionals the ability to take advantage of each biological larvicide's strengths while significantly reducing the limitations that each possesses.

1. Becker N, Petric D, Zgomba M, Boase C, Dahl C, Lane J and A Kaiser. 2003. Mosquitoes and their control. Kluwer Academic; Plenum Publishers, New York: ISBN 0-306-47360-7

2. Lacey LA and RW Merritt. 2003. The safety of bacterial microbial agents used for black fly and mosquito control in aquatic environments. In: "Environmental Impacts of Microbial Insecticides: Need and Methods for Risk Assessment" (HMT Hokkanen and AE Hajek, eds.), pp 151-168. Kluwer Academic Publishers; Dordrecht, The Netherlands.

3. World Health Organization, 1999, Environmental health criteria 217 microbial pest control agent Bacillus thuringiensis, WHO, Geneva, Switzerland; ISBN 92 4 157217 5.

4. Siegel JP and DA Shadduk. 1990. Mammalian safety of Bacillus sphaericus, Chp. 21 in "Bacterial Control of Mosquitoes and Black Flies" (de Barjac & Sutherland eds.). Rutgers University Press, ISBN 0-8135-1546-7

5. Lacey LA. 1990. Chp. 18 In: "Bacterial control of mosquitoes and black flies" (deBarjac H and DJ Sutherland eds.). Rutgers University Press, New Brunswick, NJ.

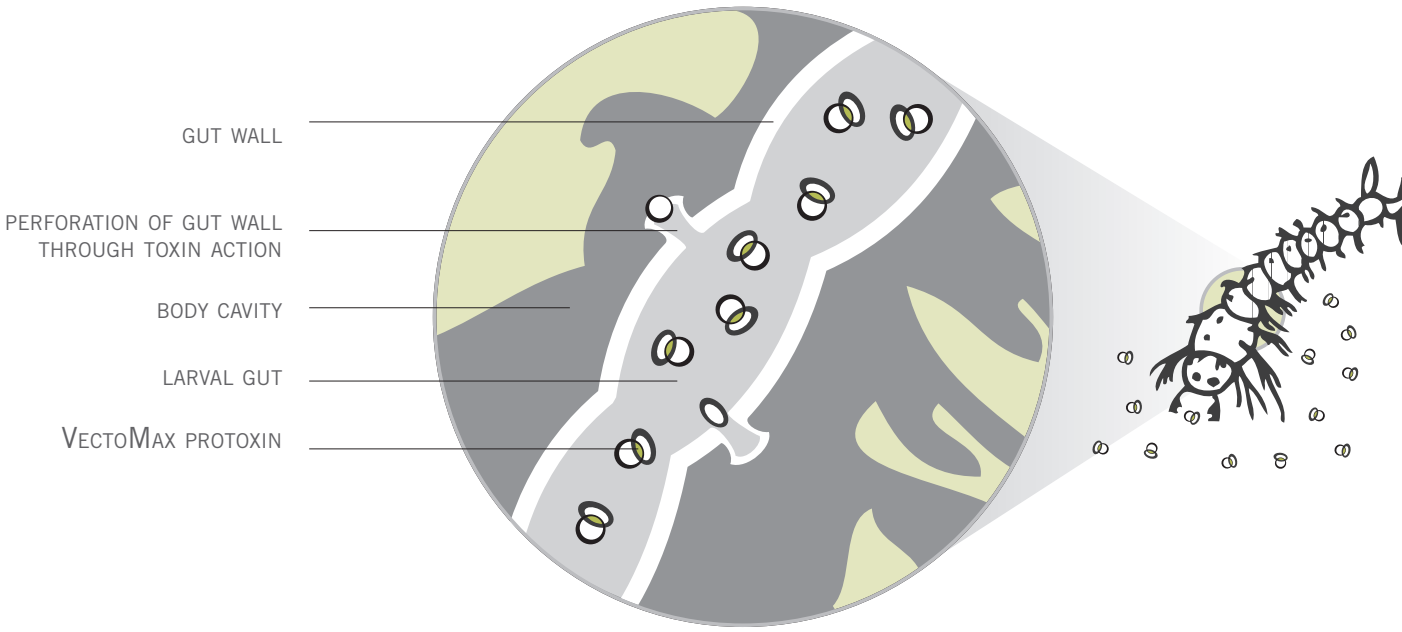
Mode of Action

Both *Bti* and *Bsph* produce complex crystal proteins known as protoxins during sporulation. When these proteins are applied to larval habitats of mosquitoes, the mosquito larvae ingest them by filter feeding. The crystal proteins are solubilized by the alkaline juices in the larval midgut and are cleaved by the midgut proteases, yielding active peptide toxins called delta-endotoxins. The delta-endotoxins cause the formation of holes in the midgut cell wall, leading to lysis of cells and larvae death.

However, activity of the delta-endotoxin for *Bsph* differs from that of *Bti* in several important ways. For *Bsph*, the toxin is attached to the bacterial spore, while *Bti* toxins are not attached to the spore (parasporal). The toxins of *Bsph* and *Bti* bind to chemically different receptor sites on cells. They are not related immunologically and are thought to have completely different molecular modes of action.

Operationally, the most important differences between the toxins of *Bsph* and *Bti* are speed of action and persistence in natural larval habitats. *Bsph* toxin is much slower-acting than *Bti* toxin. Larval mortality can take several days but is usually expressed within 48 hours of ingestion, while *Bti* provides quick kill. Initial results with *Bti* can be seen within 2–24 hours. *Bsph* toxin is also much more persistent in natural larval habitats than *Bti*. This persistence is thought to be the result of a combination of features, including protection of the protein by the spore coat; slower settling rate; and the unique ability of *Bsph* spores to germinate, grow, and produce toxins in cadavers of mosquito larvae treated with the material. VectoMax combines the quick kill seen with *Bti* in combination with the residual properties of *Bsph*.

ENLARGED SECTION OF MIDGUT



VECTOMAX MODE OF ACTION

- Mosquito larvae ingest specific protoxin ratio of *Bti* and *Bsph* with every microparticle
- Protoxin activated in alkaline environment of the midgut
- Larval proteolytic enzymes break down activated protoxin into polypeptide fractions
- Polypeptide fractions act on midgut cells
- Midgut cells lyse
- Larvae die

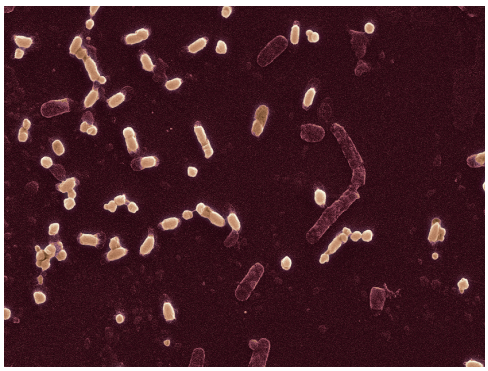
Low Risk, Environmentally Compatible

ORGANISM	STUDY TYPE	RESULT
Odonata		
Dragonflies/Damselflies		
T. corruptum	Lab/naiads fed infected larvae	No effect
E. civile	Lab/naiads fed infected larvae	No effect
Ephemoptera		
Mayflies		
C. pacificus	Field treatment (*Bti* technical powder 0.56 kg/ha)	No effect
C. pacificus	Field treatment (*Bsph* technical powder 0.22 kg/ha)	No effect
Heteroptera		
Corixids/Notonectids		
C. decolor	Field treatment (*Bsph* technical powder 0.25 kg/ha; *Bsph* technical powder 0.25 kg/ha)	No effect
N. undulata	Lab/fed infected larvae	No effect
A. bouvieri	Lab/LC50 (*Bsph*)	500X mosquito LC50
N. unifasciata	Field study/treated ponds	No effect
Buenoa spp.	Field study/treated ponds	No effect
Coleoptera		
Dytiscidae	Field studies	No effect
Hydrophilidae	Field studies	No effect
Crustacea		
Daphnia spp.		
E. bampo	Laboratory (*Bti*)	100-200X mosquito rate
D. similis	Laboratory (*Bsph*)	Effect at 27,000X mosquito rate
Fairy Shrimp		
S. dichotomus	Laboratory (*Bsph*)	Effect at 15,000X mosquito rate
Crawfish		
P. clarkii	Laboratory	Effect at 1,000X mosquito rate

Lacey and Mulla (1990). Safety of *Bacillus thuringiensis* subsp. *israelensis* and *Bacillus sphaericus* to non-target organisms in the aquatic environment. In "Safety of Microbial Insecticides" (Marshall Laird, Lawrence Lacey, and Elizabeth Davidson eds.), Chap. 12. CRC Press, Inc. Boca Raton, Florida. (Unless otherwise indicated, studies include evaluations of both *Bti* and *Bsph*.)

Bti and *Bsph* have been extensively tested, and they are not human health hazards when handled as instructed by the product label.

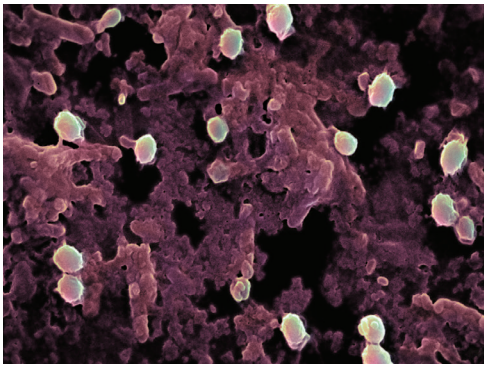
Biological Larvicides



BACILLUS THURINGIENSIS SUBSP. *ISRAELENSIS* (STRAIN AM65-52)

Bti is a naturally occurring spore-forming bacterium found in soil and aquatic environments throughout the world. At the time of sporulation, *Bti* produces a highly specific delta-endotoxin that is toxic upon ingestion only to larvae of mosquitoes, black flies, and closely related flies.

With over 30 years of field use in a variety of settings around the globe, *Bti* has been shown to provide effective, reliable, and environmentally compatible control of mosquito larvae. In addition to the effectiveness of *Bti*, it has an excellent safety record and very low mammalian toxicity: LD50 values for both oral and dermal toxicity are more than 30,000 mg/kg. The mosquitocidal crystal proteins, spores and vegetative cells of *Bti* administered by different routes have been found to be non-pathogenic and non-toxic to various animal species in maximum challenge tests.[1] *Bti* is safe for use in aquatic environments, including drinking water reservoirs, for the control of mosquito, black fly, and nuisance insect larvae.[2]



BACILLUS SPHAERICUS (STRAIN ABTS-1743)

Bsph is also a naturally occurring spore-forming bacterium found throughout the world in soil and aquatic environments. Early development of *Bsph* formulations for mosquito control focused on strains isolated and maintained by the Pasteur Institute, WHO Collaborating Center, Paris, France. Since 1995, *Bsph* strain ABTS-1743 has demonstrated the ability to provide residual control of mosquito larvae in a great variety of aquatic habitats. This biological larvicide is capable of providing residual control in highly organic environments, including catch basins, sewage effluent, sewage lagoons, oxidation ponds, animal waste lagoons, septic ditches, animal waste ponds, septic tanks, irrigation ditches and roadside ditches.

1. Becker N, Petric D, Zgomba M, Boase C, Dahl C, Lane J and A Kaiser. 2003. Mosquitoes and their control. Kluwer Academic; Plenum Publishers, New York: ISBN 0-306-47360-7.

2. Lacey LA and RW Merritt. 2003. The safety of bacterial microbial agents used for black fly and mosquito control in aquatic environments. In: "Environmental Impacts of Microbial Insecticides: Need and Methods for Risk Assessment" (HMT Hokkanen and AE Hajek, eds.), pp 151-168. Kluwer Academic Publishers Dordrecht, The Netherlands.

To learn more about **VectoMax**,
call **800.323.9597** or
scan the following **QR code:**

VALENT BIOSCIENCES

Valent BioSciences is an ISO 9001:2008 Certified Company

publichealth.valentbiosciences.com

Valent BioSciences
870 Technology Way
Libertyville, Illinois 60048
1-800-323-9597

FSC www.fsc.org 100% From well-managed forests FSC® C000000