Biological Control Basics

Georgia Mosquito Control Association, 2006

VALENT BIOSCIENCES. CORPORATION

What is Biological Control?

- The use of natural agents to control mosquitoes
- Considered to be highly specific with limited non-target or environmental effects
- Can be used to control immature as well as adult mosquitoes
- Effective tool for integrated mosquito control programs

Biological Control Agents

- Microbial agents
  - *Bacillus* bacteria
- Parasites
  - *Lagenidium giganteum* (fungus)
  - Nematodes
  - Protozoans
- Introduced predators
  - *Gambusia* (mosquito fish)
  - Copepods
  - *Toxorhynchites spp.*
  - Bats, purple martins (adult control ?)

Why Mosquito Control?

- Mosquitoes Carry Disease
  - Malaria, Dengue, Encephalitis, Filariasis
- Mosquitoes Cause Economic Issues
  - Tourism, Agriculture, Construction, Recreation & Real Estate
- Mosquitoes are a Nuisance

Mosquito Control Methods

- Source Reduction
- Larviciding
- Adulticiding

Source Reduction

"Source reduction (the removal or reduction of larval mosquito habitats) typically is the most effective and economical long-term method of mosquito control."

AMCA'S PESP Strategy Document

Larviciding

"Larviciding, the application of chemicals to kill mosquito larvae or pupae by ground or aerial treatments is typically more effective and target specific than adulticiding, but less permanent than source reduction."

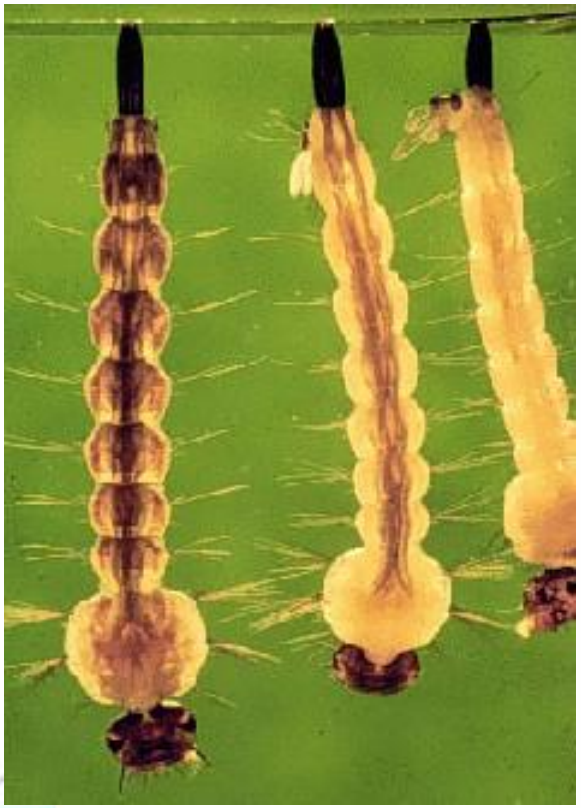
AMCA'S PESP Strategy Document

Adulticiding

"Adulticiding, the application of chemicals to kill adult mosquitoes by ground or aerial applications, is usually the least efficient mosquito control technique."

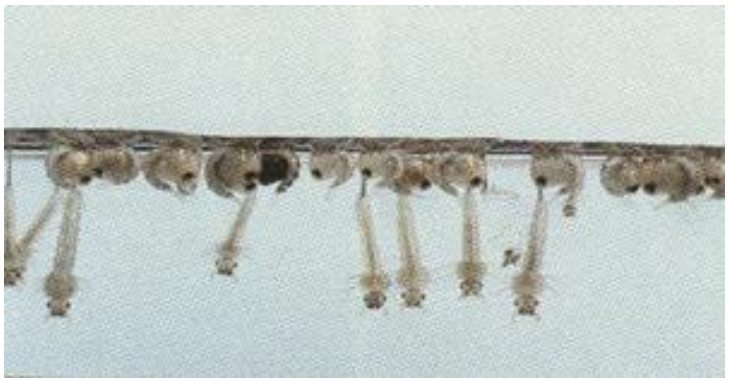
AMCA'S PESP Strategy Document

Larviciding Philosophy



The larvae live in water where they feed on microorganisms. The larvae have long breathing tubes at the posterior end.

The majority of the life cycle of a mosquito is spent in the water as larvae and pupae. The adults only live for a short time.



Planning for Effective Larviciding

- KNOW THE ENEMY
  - Adult Mosquito Surveillance
  - Larval Mosquito Surveillance
  - Data Analysis
  - Mapping Potential Sources
  - Prioritizing Potential Sources
  - Developing Action Plans

Implementing Larviciding Strategies

- Establish Treatment Thresholds
- Prioritize Surveillance and Treatment
- Select Appropriate Materials and Formulations
- Deliver Materials on Target and on Time
- Follow Up Efficacy Checks

Larvicide Choices

- Biologicals
  - *Bacillus* bacteria
  - Mosquito fish
- Insect Growth Regulators
  - Methoprene
- Chemicals
  - Temephos
- Oils & Surfactants

Methoprene (Altosid)

- Mode of Action
  - Insect growth regulator; synthetically produced juvenile growth hormone mimic prevents larvae from pupating or emerging into functional adults

- Formulations
  - Briquets
  - Pellets
  - Granules
  - Liquid

Temephos (Abate)

- Mode of Action
  - Chemical agent (organophosphate) which affects the central nervous system causing paralysis and death

- Formulations
  - Pellets
  - Sand granules
  - Biodac granules
  - Liquid concentrate

Oils & Surfactants

- Mode of Action
  - Surface control agent; produces a thin film on the water surface which prevents larvae and pupae from breathing
- Formulations
  - Golden Bear
  - Bonide
  - BVA

Bacillus Bacteria

- Mode of Action
  - Microbial agent; once ingested, bacteria break down into separate toxins which cause the gut wall to rupture

- Formulations
  - Briquets
  - Pellets
  - Corn cob granules
  - Liquid concentrate
  - Technical powder
  - Water soluble granules (powder)

Bti & *B. sphaericus*
Naturally Occurring Bacteria

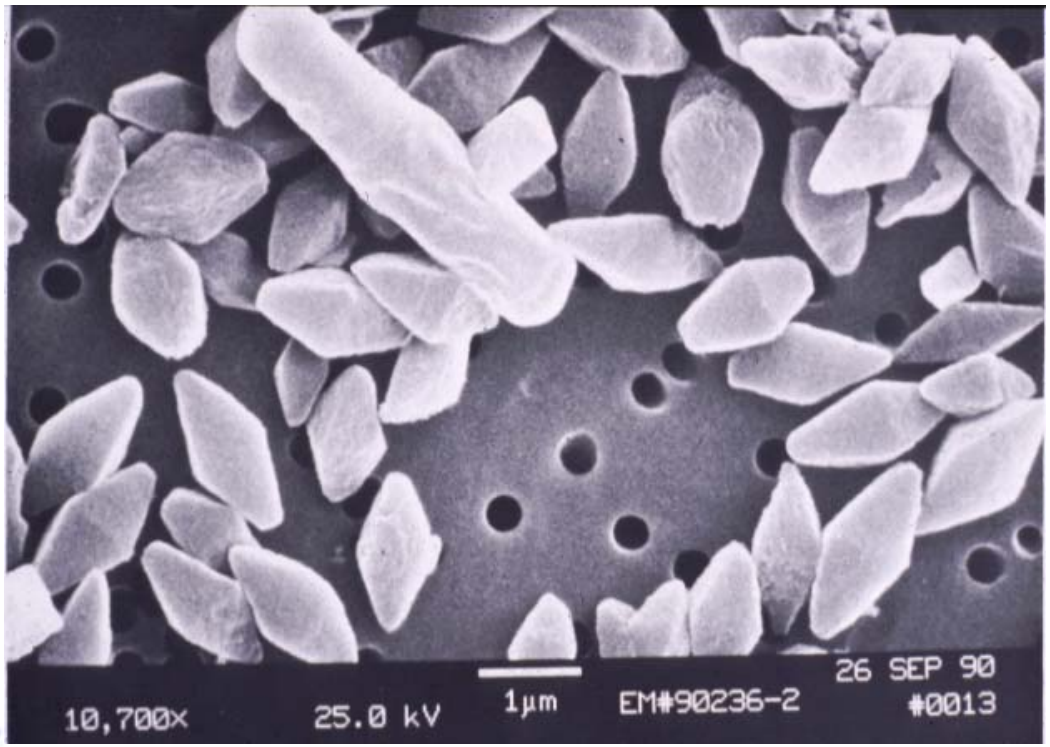
Bti (VectoBac)

– Found in stagnant ponds in Israel in 1976

B. sphaericus (VectoLex)

– Found in the soil throughout the world

Bti & *B. sphaericus* -
The Active Ingredients



Bti & *B. sphaericus*
Mode of Action

Bti

- death within 24 hours
- no residual

B.sphaericus

- death within 48 hours
- residual (recycling)
  - spores germinate and reproduce in the cadavers of the larvae

VALENT BIOSCIENCES CORPORATION

Bti & *B. sphaericus*
Mode of Action

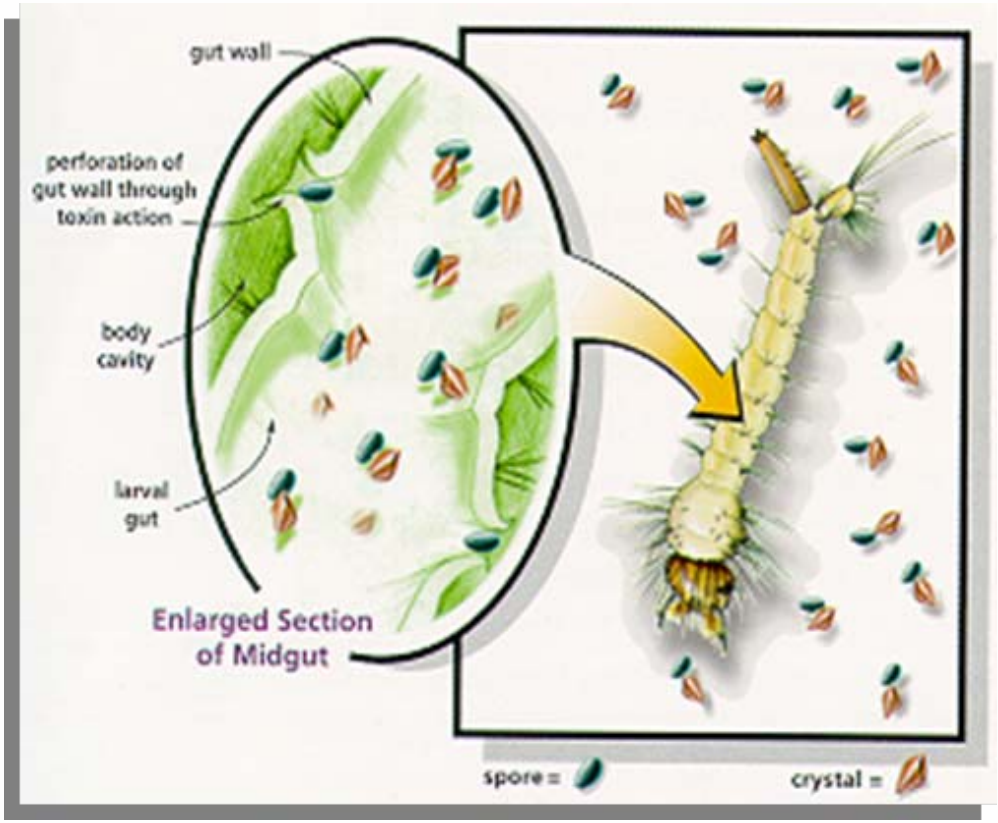
Bacteria produce a crystal and spore

Larvae ingest spores and crystal

- Ph of the gut digest and breakdown the crystal into protoxins
- Toxins attach to gut lining
- Breakdown lining and increase pore size

Larvae die in 24 to 48 hours

Bti & B. sphaericus
Mode of Action

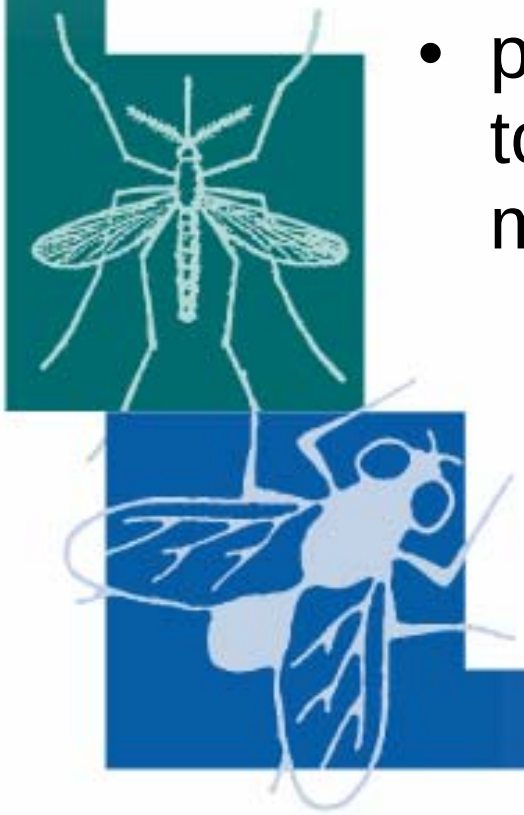


Bti & B. sphaericus - The Benefits

- Effective
- Target specific control
- Favorable Toxicological Profile to:
  - Aquatic organisms/Amphibians
  - Humans or domestic animals
  - Wildlife & environment
  - Beneficial insects

Bti : A Natural Choice

- used for more than 25 years in crop and non-crop habitats
- proven to be a reliable and cost effective tool for controlling larvae of nearly all mosquito species



VALENT BIOSCIENCES CORPORATION

Bti - Target Specific

- The highly specific action of *Bti* in controls only certain diptera
  - Filter feeding mosquitoes
    - Culicidae
  - Black flies
    - Simulidae
  - Filter flies and midges
    - Psychodidae, chironomidae

Bti : When to Use

- Univoltine broods or single generation species
- Sites that don't hold water long enough to develop a second brood
- Sites where residual control is not necessary due to single generation mosquito species

Bti Formulations

- Corncob granules
- Pellets
- Briquets
- Liquid
- Technical Powder

B. sphaericus:A Natural Choice

- introduced in 1996 by Abbott Laboratories for extended control of Culex larvae
- provides mosquito control professionals with another cost-effective option when choosing a biological mosquito larvicide
- Controls a wide range of mosquito species, and can be used in food crops and pastures

B. sphaericus - Target Specific

- The highly specific action of *B. sphaericus* in VectoLex controls certain mosquito species
  - Effective control of all *Culex* as well as several *Anopheles, Aedes and Psorophora species.*
  - Even effective in polluted water habitats
  - Offers long term control in many habitats
  - *B. sphaericus* recycles in larval cadavers

B. sphaericus : When to Use

- Multivoltine broods of suseptible mosquito species or multi generation species
- Known Culex sites
- Permanent fresh water habitats
- Intermittently flooded sites that stay wet long enough to develop a second brood
- Sites where residual control is needed

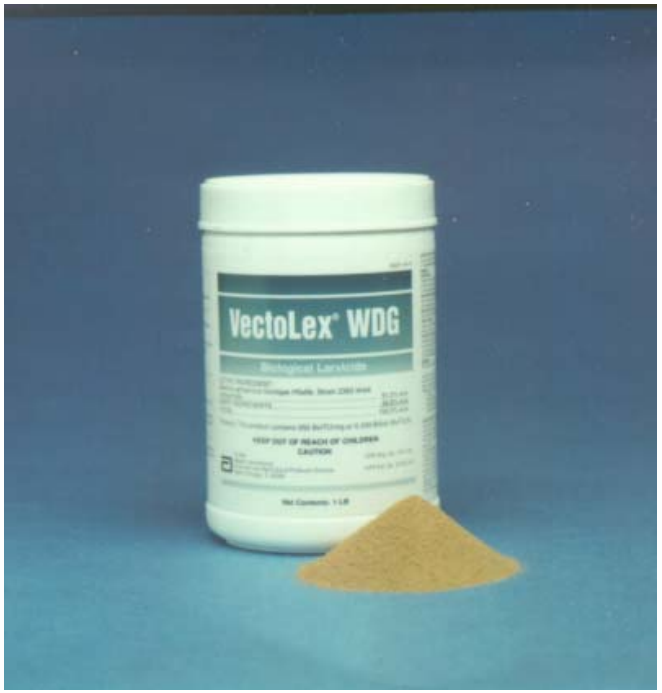
B. sphericus Formulations

Corncob Granules

- 10/14 mesh size
- Excellent penetration of vegetative canopy
- Stable in storage
- Application rates from 5 to 20 lbs/acre

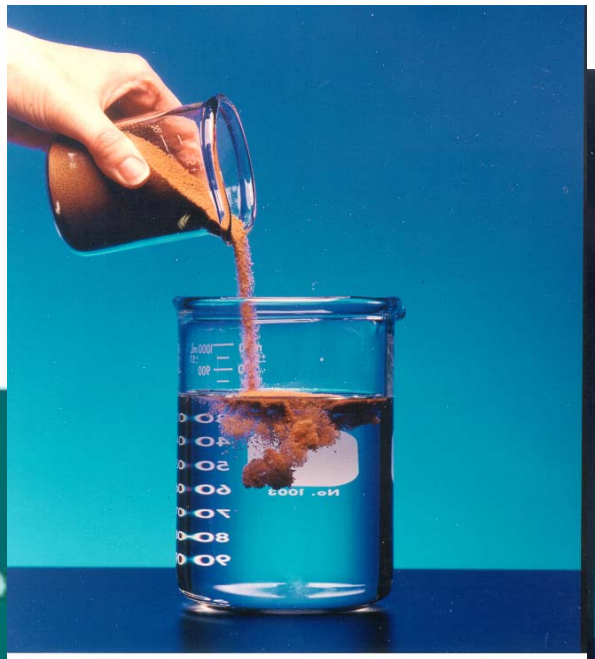
Water Dispersable Granules

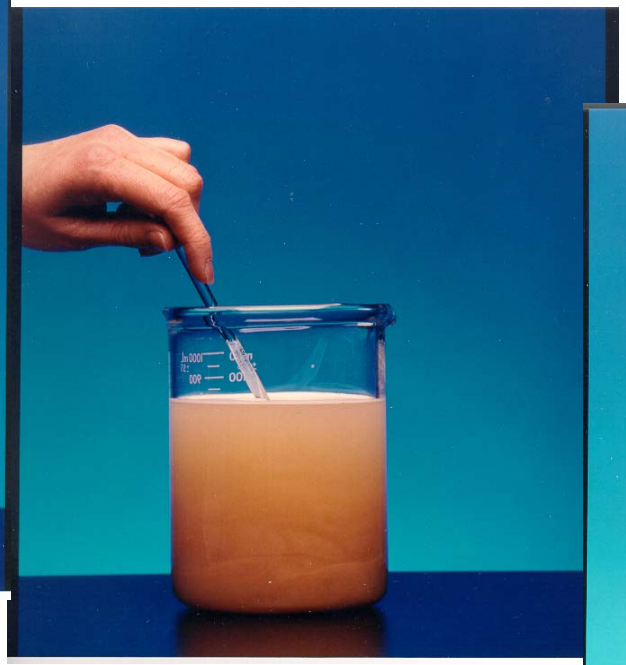
- Instant aqueous *B. sphaericus* (Just add WDG into water)
- Highly stable in storage
- Application rates from 0.5 to 1.5 lbs/acre (0.56 - 1.1 kg/ha)

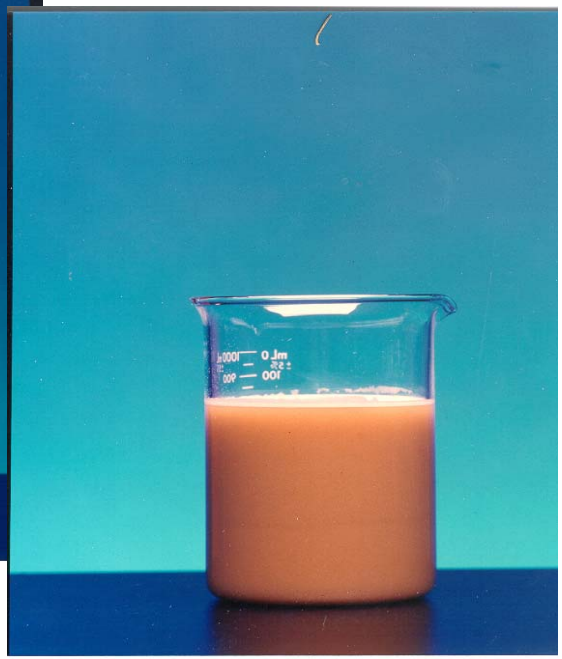


Water Dispersable Granules

The stability of a granule with the application flexibility of a liquid.







Water Soluble Pouch

- 10 gm granules
- Treats up to 50 sq ft
- Ideal for catch basins and other small breeding sites
- Apply by placement

Water Soluble Pouch

VALENT BIOSCIENCES CORPORATION

Product Performance Factors

- Application timing
- Equipment calibration
- Coverage
- Water quality & hydrology

VALENT BIOSCIENCES. CORPORATION

Product Performance Factors

- Application timing
  - *Bti* and *B. sphaericus* are not contact poisons
  - Must be consumed by larvae
  - Larvae stop feeding in late 4th instar
  - Important to apply to 1st thru early 4th instars
  - Monitoring essential to maximize efficiency

Product Performance Factors

- Equipment Calibration
  - Simple, but often overlooked step
  - Essential to assure correct application rate
  - Every applicator & piece of equipment slightly different
  - Must factor in the applicator, equipment & habitat

Product Performance Factors

- Coverage
  - *Bti* and *B. sphaericus* are not contact poisons
  - Must be consumed by larvae
  - Not water soluble & heavier than water
  - Will not disperse laterally
  - Entire habitat needs to be evenly treated
  - Includes vegetated areas (must penetrate vegetation)

Product Performance Factors

- Water quality & hydrology
  - Water pollution, temperature, salinity & pH can affect results to varying degrees
  - Fluctuations in water levels can stimulate new egg hatching and affect residual control

Product Performance Factors

- Larval recruitment
  - *Culex, Culiseta and Anopheles* mosquitoes will continually lay eggs
  - Shortly following application of *Bti* or *B. sphaericus* larval development will ensue, even though products are working
  - Timing of *Bti* treatments will maximize treatment window
  - *B. sphaericus* residual has broken when late 4th instars and pupae are present

Product Performance Factors

- Performance factors should be considered before choosing any larvicide
- Important to learn which products and which formulations are best for different habitats
- Product rotation can be beneficial

Larviciding Considerations

- All larvicides have their strengths and weaknesses
- In many situations, larviciding can significantly reduce the amount of adulticiding needed

Benefits of Larviciding

- Environmental Responsibility
- Public Relations Cost Savings
- Resistance Management
- Long Term Cost Efficiency
- Safety of Staff and Public
- Reduced Liability
- Improved Service

Conclusions

- Larviciding, adulticiding, and source reduction are all part of effective IMM (integrated mosquito management) practices
- Biological agents are an effective alternative when selecting larvicides
- Remember, no method is right for all situations
- Get informed, ask questions, and choose yours weapons wisely