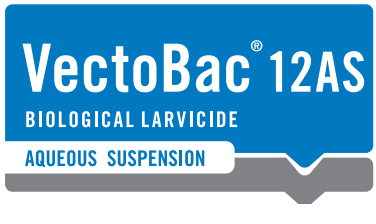
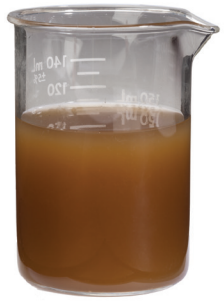
TECHNICAL USE SHEET

VectoBac® 12AS

Biological Larvicide



VectoBac® 12AS Biological Larvicide is an aqueous suspension formulation of *Bacillus thuringiensis* subsp. *israelensis* strain AM65-52 for control of mosquito and black fly larvae. VectoBac 12AS has a potency of 1,200 International Toxin Units (ITU) per milligram. VectoBac 12AS viscosity is less than 500 CPS at 25°C (77°F), is light brown in color and has a specific gravity slightly greater than 1.0. VectoBac 12AS is produced directly from fermentation slurry, which helps ensure an average particle size of 2 to 9 microns. The small particle size improves efficacy by maintaining maximum availability of particles in the feeding zone for mosquito and black fly larvae. Small particles stay suspended for a longer period of time in the target larval feeding zone.



FEATURES	BENEFITS
• Biological larvicide • Highly specific activity on mosquitoes	• Not harmful to non-target organism populations
• Aqueous suspension	• Ready-to-use formulation
• Quickly kills mosquito larvae (2–24 hours)	• Results assessed quickly in field
• Developed with black fly (*Simulium*) biology in mind	• A custom solution for greater peace of mind

Mosquito Control Applications

Do not apply VectoBax 12AS when wind speed favors drift beyond the area of treatment.

Mosquito habitats (such as irrigation ditches, roadside ditches, floodwater, standing ponds, woodland pools, snowmelt pools, pastures, catch basins, stormwater retention areas, tidal water, salt marshes and rice fields) require an application rate range of 0.25–2.0 pts/acre (0.3–2.3 liters/hectare).

In addition, standing water containing mosquito larvae in fields growing crops such as alfalfa, almonds, asparagus, corn, cotton, dates, grapes, peaches, rice and walnuts may be treated at the recommended rates.

When applying this product to standing water containing mosquito larvae in fields growing crops, do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

Polluted water (such as sewage lagoons and animal waste lagoons) requires an application rate range of 1.0–2.0 pts/acre (1.2–2.3 liters/hectare).

Use higher rate range in polluted water and when late 3rd and early 4th instar larvae predominate, mosquito populations are high, water is heavily polluted, and/or algae are abundant.

VALENT BIOSCIENCES

Black Fly Calculations Prior to Treatment

1. STREAM/RIVER CROSS-SECTIONAL AREA (SQUARE METERS)

Measure stream width at the application site. Measure depth at 5 to 10 points at equal intervals across the stream width. Calculate average depth of stream. Multiply depth by width to determine stream cross-sectional area (depth x width = stream cross-sectional area in square meters).

2. FLOW VELOCITY (METERS/SECOND)

Use citrus peel, small stick, or other buoyant object to measure flow rate of stream. Mark off 10-meter length of stream. Use a stopwatch to determine the length of time required for the buoyant object to travel the 10 meters. Divide the 10 meters by the time measurements (seconds) to determine meters per second. Repeat process three times and take an average of the meter per second tabulations.

3. FLOW VOLUME (CUBIC METERS/SECOND)

The flow volume is equal to the stream cross-sectional area multiplied by the flow velocity. This number represents the amount of water that will pass through a distance during a measured period of time (cross-sectional area x flow velocity = flow volume in cubic meters/second).

4. VECTOBAC REQUIRED FOR TREATMENT

Conversion of the flow volume expressed in cubic meters/second to liters/minute:

- Flow volume (cubic meters/second) x 1,000 x 60 = **Flow volume (liters/minute)**
- **Flow volume (liters/minute)** x 1,000 = **Flow volume (ml/minute)**
- **Flow volume (ml/minute)** x desired application rate (ppm) ÷ 1,000,000

Total volume (ml) of VectoBac required for the treatment of the stream

5. APPLICATION OF VECTOBAC

Apply required amount of VectoBac to stream over a period of 1 to 15 minutes by slowly applying product across stream width. If quantity to be applied is a very small amount (less than 4 liters), consider dilution with water prior to treatment to increase volume.

6. SUGGESTED RATES AND APPLICATION GUIDELINES

- 0.05 to 2.5 ppm for 10 minutes
- 0.5 to 25 ppm for 1 minute
- Swift streams (500–1000 m^3/second) generally require shorter dosage times
- Polluted or silty water generally requires higher rates
- Cold water (7°C to 10°C or 45°F–50°F) temperature requires higher rates
- Good dispersion of VectoBac improves control

NOTE: Each stream/river system is unique in its bed morphological/substrate profile, water chemistry and hydrological conditions. Stream/river dynamics are influenced by a gradient of physical factors formed by the drainage network. Black fly larval distribution is determined by hydrodynamics created by the uniqueness of the system. It is impossible to make specific recommendations on dose level and injection time that will provide effective control in all scenarios. Therefore, breeding sites should be properly identified and mapped, and pilot studies conducted to ascertain correct downstream distance of larval control (carry).

GENERAL APPLICATION PRECAUTION

VectoBac 12AS can cause corrosive effects to pure aluminum spray system components if diluted or undiluted product is left in prolonged contact with these parts. Rinse spray system with plenty of clean water after each use. Avoid spraying undiluted product and product mixtures over automobiles, as the dried deposits may be difficult to wash off.

TANK MIX STABILITY

Tests have shown that the VectoBac 12AS formulation will maintain useful activity for a period of 2 days when mixed with normal tap water. Diluted VectoBac tank mixes should be recirculated prior to use to maintain uniform suspension.

Mosquito Ground Applications

VectoBac may be applied either diluted in water or in undiluted ULV applications. For diluted applications, apply desired amount of VectoBac 12AS in 1 to 100 gallons of water per acre (10 to 1,000 liters per hectare). Applications may be made with hand pump backpack sprayers, compressed air sprayers, air blast units, mist blower sprayers, power backpack sprayers or hydraulic sprayers. Calibration of spray unit to assure proper delivery rates and an application technique that assures even coverage of area treated are essential to success. Ground ULV applications can successfully be made using truck-mounted, backpack or handheld equipment. These applications are dependent upon proper wind and atmospheric conditions for successful coverage of the larval habitat site. Applications using truck-mounted equipment may be impaired by obstructions such as buildings and dense vegetation. Backpack and/or handheld equipment may be of greater utility when making ground ULV applications in densely vegetated areas, because of increased access to the breeding areas. Diluted high-volume applications may be effective in a broader range of conditions. Droplet size recommended for ground ULV applications is 20–100µm. Smaller droplets will produce larger swaths due to downwind movement, and may penetrate vegetation and certain microhabitats more efficiently. Larger drops will provide greater surface deposit and more consistent deposition in narrower swaths.

Mosquito Aerial Applications

VectoBac 12AS may be applied either aerially undiluted or diluted with water. For undiluted applications, apply VectoBac 12AS at 0.25 to 2.0 pints per acre (0.3 to 2.3 liters per hectare), by fixed wing or helicopter aircraft equipped with either conventional boom and nozzle systems or rotary atomizers. Avoid excessive recirculation during application of undiluted VectoBac 12AS as this may change physical properties.

For diluted applications, the appropriate rate of VectoBac 12AS should be mixed with the desired amount of water. Maintain mechanical or hydraulic agitation to provide moderate circulation while loading or spraying.

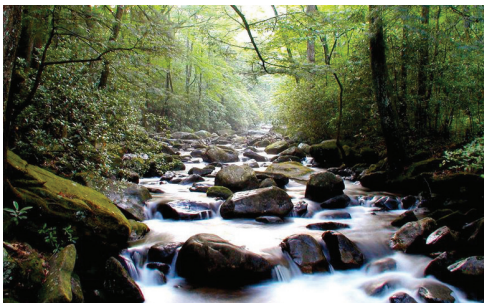
Selection of application volume per acre and droplet size range will depend on site characteristics, atmospheric conditions and local experience. For sites having very uniform, low vegetative cover such as rice fields, fine sprays in the 50–100 micron VMD droplet range and spray volumes as low as 4 ounces per acre (0.3 liters per hectare) have been effective. However, aerial applications using droplets in this size range are substantially affected by atmospheric conditions. Considerable downwind movement (drift) should be accounted for. Such applications should not be made if wind exceeds 5 mph (8 km/hr) or thermal activity is present. Arid conditions may result in significant evaporative loss of small droplets.

For these reasons, a larger droplet size and higher volumes are generally required. Consistent results can be achieved with total spray volumes of 16 oz to 5 gallons per acre (1.2–46.7 liters/ha). Droplets in the 150–1,000µm range provide more consistent ground deposit than smaller drops. Volume of ground deposit will increase with droplet size. However, coverage (drops per unit area) will decrease, and swath width may decrease. The ideal droplet size range for local conditions will depend upon habitat and atmospheric conditions.

A variety of aerial spray systems can be adapted to achieve the appropriate droplet size and coverage. When spray volumes >1 gallon/acre (> 9.4 liters/ha) are employed, DC, CP or flat fan nozzles have all been successful. A zero degree of “straight back” nozzle orientation will produce larger droplets than a downward deflection of the nozzle. Deflection should not exceed 45°. At least 20 nozzles should be used across the boom, which should not exceed 75% of wingspan.

Aerial application equipment should be characterized to verify swath width, droplet spectrum and distribution. Optimum applications will result when atmospheric conditions and characterization data are factored into the selection of lane separation, altitude and treatment offset. Atmospheric conditions can significantly impact the success of aerial applications. High winds (>10 mph; >16 km/hr), low humidity, and unstable atmospheric conditions negatively affect results.

Black Fly *(Simulium)* Control Applications



HABITAT	RATE RANGE*
Streams and rivers	
• Stream/river water+ (= ppm) for 1 minute exposure time	0.5–25 mg/liter
• Stream/river water+ (= ppm) for 10 minutes exposure time	0.05–2.5 mg/liter

* Do not apply when wind speed favors drift beyond the area of treatment.

+ Use higher rate range in cold water or when stream contains high concentration of organic materials, algae, or dense aquatic vegetation. Discharge is a principal factor determining carry of *Bti*. Use higher rate or increase volume by water dilution in low discharge rivers or streams under low-volume (drought) conditions.

WHERE TO APPLY

Black fly larvae can be found wherever there is running water. Although some species can be found in merely a trickle of water, most prefer rapid water flows high in oxygen content. When mapping treatment sites, look first in the rapids, waterfalls, and dam outlets. It is advised to map these areas under different flow conditions as the larval habitat will change during the course of a season.

WHEN TO APPLY

The timing of the treatments is probably the most critical factor in effective black fly control. It is desirable to begin treatment before the adult black flies become a problem. Since VectoBac kills only black fly larvae, not the eggs or pupae, the treatments should be timed when the majority of the population is still in the larval stages, preferably just before the insect enters the final larval stage. Final instar larvae can be recognized by predominant black spots, the respiratory histoblasts, on either side of the thorax.

It is advisable that the life history of the black fly species being treated be determined before major efforts in control are initiated. The water temperature is a good indicator of larval development for most black fly species and can be used to determine approximate treatment initiation and treatment cycles. At water temperatures of 78°F (25.5°C), development of black fly larvae can take less than 7 days, whereas at 50°F (10°C), development may take over 30 days. It should be noted that water temperatures will vary over the length of a stream/river; therefore, monitoring should be done carefully at many sites in the area to be treated.

Black Fly Control Applications

(Continued)

HOW TO APPLY

VectoBac 12AS can be applied undiluted or diluted using aircraft, handheld sprayers, watering cans or directly from the 12AS containers, depending upon the type and size of the target stream/river. Small streams are usually treated by hand, whereas large rivers and streams are treated by boats or aircraft.

Treatments should be made far enough upstream of the larval attachment sites to allow ample time for the VectoBac 12AS to mix throughout the water column and provide ample time for the larvae to feed. The exact distance that material is injected into the water above the larval attachment sites will depend upon many factors. Ideally, VectoBac should move in a well dispersed "slug" through the attachment sites for a period of 10 minutes or longer. To accomplish this, treatments need to be made upstream for at least 50 ft (15 m) in small streams/rivers and as much as 150 ft (46 m) in large river systems. Rate of application will be determined by the stream discharge and the required amount of VectoBac necessary to achieve the desired concentration (between 0.5 and 25.0 ppm) in the stream/river water. Under normal river conditions, 1.2 ppm for 10 minutes of exposure time (or 12.5 ppm or 1 minute equal to 720 ml/1,000 1/second or 1 m^3/second discharge) will control most black fly species, most of the time. When water temperatures are less than 50°F (10°C) and under high silt loads or concentrations of planktonic algae, the rate should be increased to 2.5 ppm or 10 minutes of exposure time (1,500 ml/1000 1/sec.) or 25.0 ppm per 1 minute. Treatment should be avoided in water clogged with vegetation and above deep pools. Care should be taken to treat the entire width of the stream/river, as many larvae can be found along the banks.

TROUBLESHOOTING CONTROL PROBLEMS

Optimum control with any *Bti* product depends upon qualified applicators and control personnel with a good understanding of the complex relationships of black fly biology and the environment that black flies inhabit. Black fly mortality depends upon several factors including the amount of VectoBac the larvae are able to trap and ingest, the duration of the exposure, the concentration of the exposure, and the rate of feeding. Feeding rate depends upon larval stage, concentration of suspended particles, temperature of the water, particle size of the *Bti*, and black fly species.

The following are a few examples of operational conditions that may affect black fly suppression programs:

CONDITION	POSSIBLE SOLUTION
Water contains high (>1500 cells/ml) planktonic algae or other suspended solids	Increase VectoBac rate.
Larvae feed slowly, don't receive lethal dose of *Bti*. Water temperature too cold (<10°C)	Increase VectoBac rate.
VectoBac passed over larvae too fast to allow enough time to ingest lethal dose of *Bti*	Application too close to attachment site. Move application further upstream.
VectoBac settles out before reaching attachment	Application was too far upstream. Check site for deep pools or aquatic vegetation between application site and attachment site.
Poor or eratic control	Adjust the exposure time and/or increase VectoBac rate. River discharge was underestimated; dosage was too diluted to give good control. Check discharge measurement calculations for accuracy.

A successful black fly control program requires standard procedures. The following methods are provided as guidelines for proper ground and aerial application of VectoBac 12AS in streams and rivers. Since the quantity of VectoBac 12AS required to achieve a desired dosage is dependent primarily on stream/river flow, it is necessary to calculate the discharge of a stream/river immediately preceding the point of application. This measurement should be made in a section of the stream/river that is straight and free-flowing. Pools, bends, turbulence, wind gusts, and debris may cause inaccurate results.

TECHNICAL USE SHEET

VectoBac® 12AS

Bacterial Larvicide

Packaging

VectoBac® 12AS is available in the following package sizes:

- 2.5 gallon (10 liter) HDPE plastic jugs, packaged 2 per case
- 50 liter HPDE plastic drums (international only)
- 30 gallon (113.6 liter) HDPE plastic drums
- 264 gallon (1,000 liter) totes
- Bulk shipments (4,000–5,000 gallon; 15,142–18,927 liters; tanker trucks; USA only)

Check with your local distributor or Valent BioSciences technical representative to see what packaging is available in your area.

VALENT BIOSCIENCES