VectoBac®









Technical Use Bulletin for ***VectoBac WG***
For Dengue Vector Control in Asia

VALENT HEALTH™
Protecting Life's Potential









VectoBac® WG is a Water Dispersible Granule formulation of *Bacillus thuringiensis* subsp. *israelensis* (Strain AM65-52). The product has a potency of 3,000 ITU/mg against *Aedes aegypti* larvae. It is designed for use in aqueous spray mixes and in direct application.

VectoBac WG

The water dispersible granule formulation offers the storage stability of a dry product with the application versatility of a liquid spray. Consisting of only Bti and food-grade (USEPA list 4) inert ingredients, VectoBac WG has received approval for application in organic crops and sensitive habitats in various countries around the world. This versatile formulation allows a variety of application modes and uses for mosquito control.

Features

- Dry formulation
- Mixes easily in water
- Reviewed by WHO Pesticide Evaluation Scheme
- Effective in direct application for residual control of dengue vectors
- Effective in spray application as aerosol or mist droplets for area-wide dengue vector control
- Highly-specific activity on mosquitoes
- Quickly kills mosquito larvae (2 - 24 hours)

Benefits

- Increased storage shelf-life
- Decreased weight to transport
- Aqueous spray or direct application
- Sprays easily through many equipment types
- Not harmful to non-target organisms
- Results assessed quickly in field

History

Bacillus thuringiensis subsp. *israelensis* (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, which is only toxic to larvae of mosquitoes, black flies and closely related flies upon ingestion.

During 25 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 Bti's effectiveness, 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]

Mode of Action

Bti produces 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 immediate lysis of cells and larvae death within 2 - 24 hours.

[1] Siegel JP and Shadduck JA. 1990. Mammalian safety of *Bacillus thuringiensis* subsp. *israelensis*. In: Bacterial Control of Mosquitoes and Black Flies. (de Barjac H, Sutherland DJ eds). pp. 202-220. Unwin Hyman Ltd. London.

[2] World Health Organization (WHO). 2004. Report on the 7th WHOPES Working Group Meeting. Geneva, Switzerland: WHO.

Application Rates and Directions

VectoBac WG is applied into all target dengue vector larval habitats.

Table 1. Application Of VectoBac WG into dengue vector larval habitats*

Dengue Vector Larval Habitat	VectoBac WG Application Method	Application Equipment
Water Reservoirs ≥ 50 L in volume capacity	**Direct Application into Containers**	**Calibrated scoop/spoon**
Container types: - Cement, earthen, plastic, metal, fiberglass	2 - 8 g / 1000 L	1 teaspoon/200 L (Dose = 8 g/1000 L)
Water Reservoirs ≤ 50 L in volume capacity	**Ground Spray**	**Ground spray equipment**
Container types: - Cement, earthen, plastic, metal, fiberglass - Concrete drainage system - Covered and uncovered drains - Roof gutters - Trash - Tires - Vegetation - leaf axils, tree holes, leaf litter - Natural pools with leaf litter	250 - 500 g / ha (1 ha = 10,000 m^2)	- Vehicle mounted sprayers - Motorized back pack or shoulder carried blowers - Hand carried pump sprayers

** Consult your Valent Health Technical Specialist to determine optimal application methods to meet your program objectives*

Direct Application

Apply directly (undiluted) to water reservoirs such as earthen or cement jars, plastic or metal drums, and fiberglass or cement tanks with a volume capacity of ≥50 L. Application rates of 2-8 g per 1000 liter of container capacity (100 - 400 mg/50 liters) should be used depending on habitat conditions



and program objectives. Application may be made with a calibrated scoop or spoon.

Monitor for efficacy and residual control by counting numbers of pupae in treated containers before and after treatment. Initial pupae reductions should be seen in 72 hours. Re-treatment interval is based on program objectives. Consult Valent Health for technical assistance.

Ground Spray Application

Ground aqueous spray mix applications should be targeted to natural and artificial larval habitats which are ≤ 50 L in volume capacity that cover a wide area such as covered and uncovered concrete drainage systems, trash accumulations, tires, roof gutters, vegetation - leaf axils, tree holes, leaf litter and ground pools.

The recommended dosage in a spray mix is 250 - 500 grams of VectoBac WG per hectare of target larval habitats. Studies in this region have shown that optimal results for dengue vector control is observed with 400 - 500 grams of VectoBac WG per hectare in a spray mix. The required amount of VectoBac WG is mixed with an amount of water that will provide complete and even coverage of the intended target area. Required amount of water will depend on sprayer calibration and habitat conditions. The recommended dilution rates for VectoBac WG per hectare are listed in Table 2.



Vehicle mounted, backpack or shoulder carried motorized sprayers and hand carried pump sprayers can be used to generate aqueous VectoBac WG spray droplets for complete and even coverage of the intended target area. Direct the spray to evenly cover the larval habitat and maximize spray penetration of vegetative canopy. For optimal VectoBac WG ground spray applications, apply during the cool hours of the day when it is not raining.

Table 2 Recommended Dilution Rates for VectoBac WG per Hectare

Dengue Vector Larval Habitat	VectoBac® WG Application	Application Equipment
1. Covered concrete drains	150 - 200 L (High volume application)	Motorized back pack or shoulder carried blowers
2. Uncovered concrete drains, roof gutters, sparse vegetation, containers, tires, etc.	30 - 60 L (Moderate volume application)	Motorized back pack or shoulder carried blowers
3. Trash, dense vegetation, leaf litter, etc.	15 – 30 L (Low volume application)	Motorized back pack or shoulder carried blowers
4. Wide open areas of larval habitat	7 – 10 L (Ultra low volume application)	Vehicle Mounted ULV Sprayers

Monitor VectoBac WG ground spray application by measuring *Aedes* sp. adult populations with ovitrap surveillance. Ovitrap surveillance measures the density of gravid female dengue vector mosquitoes. An ovitrap index can be used to determine re-treatment intervals.

NOTE

Studies in Malaysia and Singapore indicate vehicle mounted ULV generators with a power output of 18.0 hp and 4 adjustable nozzles delivering spray droplets of VMD ≤ 50 µm are able to deliver the VectoBac WG spray mixture into target larval habitats in wide areas. This ground spray application is to be conducted in the cool hours in late evening or early morning (1900 h - 0600 h). The cool air allows settling of the spray droplets into the target larval habitats. IGEBA ULV U40 is an example of a vehicle mounted ULV generator with its 4 adjustable nozzles dispersing the VectoBac WG spray mixture at 1 L/min without clogging the nozzle to an optimum distance of 15 m in dense vegetation.

Studies in Brunei, Malaysia, Thailand, and Singapore have indicated motorized back pack sprayers with an engine displacement of 56.5 cc, a power output of 3.5 hp, and with a standard mist blower nozzle can efficiently deliver the VectoBac WG spray mixture into target larval habitats (horizontal distance of 12 - 30 m; vertical height of 11.5 m). An example of a back pack sprayer capable of meeting these specifications for dengue vector control is the Stihl SR420, with its standard nozzle consisting of 6 dials that will disperse the VectoBac WG spray mixture without clogging the nozzle. Each dial with its discharge rate is able to disperse VectoBac WG droplets to increasing distance (swath). Dial No. 2 with a discharge rate of about 500 mL/min is recommended for dengue vector control. Other spray equipment models shall meet these specifications.

Clean Equipment After VectoBac WG Spray Application

Clean all equipment that was used to spray VectoBac WG at the end of each day. Immediate cleaning will prevent the coating of VectoBac WG onto spray equipment components. Immediate cleaning will ensure smooth flow of the VectoBac WG spray mix through the nozzles.

Do not store unused VectoBac WG spray-mix in the spray equipment overnight.

Clean the sprayer with liquid detergent and water. Flush the nozzle that was used with detergent and water.

Preparation of Spray Mixes for Ground Application

In the field, the required amount of VectoBac WG can easily be measured without the use of a weighing scale. For example, a kitchen-measuring jug can be used. One kg of VectoBac WG will fill 2 L of volume in a kitchen measuring jug. The required amount of VectoBac WG must be mixed with a sufficient amount of water under moderate agitation. VectoBac WG suspends readily in water and will stay suspended during normal application periods. Brief recirculation may be necessary if the spray mixture has sat for several hours or longer.

Do not mix more VectoBac WG than can be used in a 24-hour period.

Product Storage

VectoBac WG must be stored in its original, properly labeled container, well sealed and stored in a cool, dry and well-ventilated location.

Pesticide Disposal

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal

Triple rinse (or equivalent), then puncture and dispose in a sanitary landfill, or by incineration, or, if allowable by State and local authorities, by burning. If burned, stay out of the smoke. Do not reuse the container. Do not contaminate potable water, food or feed by storage or disposal.

Results of Dengue Vector Control Projects

A number of large-scale operational programs demonstrate that both direct and ground spray applications of VectoBac WG in a variety of habitats can significantly reduce adult dengue vector populations (Figures 1-6). Table 3 describes the experimental structure of these projects.

Table 3. Experimental summary of various large-scale dengue vector control projects

Figure	Habitat	Application	Study Site	Description of Study Site	Number of Dwellings Assessed	Cooperator
1,2	Water containers	Direct Application 8 g /1000 L	Cambodia; Kg. Tralach Province: Ou Ruessei and Peani Communes	Treated: 9 villages, 45 km^2; 1,343 households; Population: 5,439 Untreated: 9 villages, 80 km^2; 1,598 households; Population: 7,371	600 households per treated / untreated commune	To Setha, N Chantha, D Socheat; National Malaria Centre, Ministry of Health, Cambodia
3	Urban; artificial and natural habitats	Ground Spray Application 500 g/ha every two weeks for outdoor/indoor habitats; 1 kg/ha once every month for secondary rooftops	Singapore: Boon Lay Constituency	Treated: 30 ha, 37 dwelling blocks Untreated: 40 ha, 44 dwelling blocks Population: 9,244	33 and 28 ovitraps in the untreated and treated sectors respectively	R Chandramogan; Sanitation and Vector Control, South West Regional Office, Singapore
4	Natural habitats	Ground Spray Application 500-600 g/ha every two weeks	Singapore	Treated: 126 ha Untreated: 127 ha All larval habitats	30 and 40 ovitraps in the untreated and treated sectors respectively	PHY Lam; HQ Medical Corps, Ministry of Defense, Singapore
5,6	Cement containers with river water (Fig. 5) and well water (Fig. 6)	Direct Application 8 g/1000 L	Cambodia: Phnom Penh, Phum Thmei village	Treated: River Water - 10 cement containers Treated: Well water - 11 cement containers Untreated: 21 cement containers	21 of 366 households treated	To Setha, N Chantha, D Socheat; National Malaria Center, Ministry of Health Cambodia

VectoBac WG Effects

Fig. 1 *Aedes aegypti* Pupae (in Water Containers) and Indoor Adult Densities - Cambodia (Year 1, April to Aug)

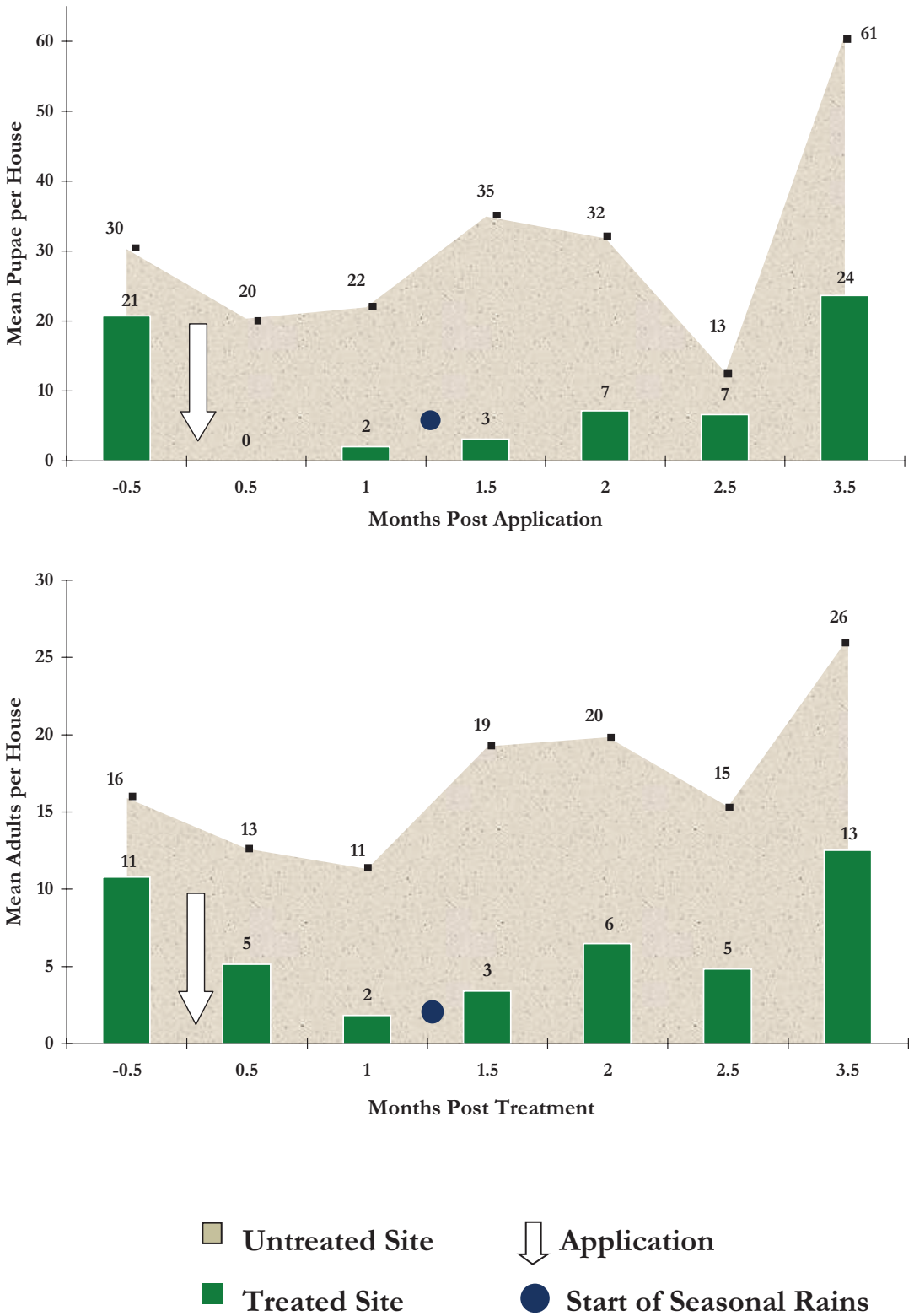


Fig. 2 *Aedes aegypti* Pupae (in Water Containers) and Indoor Adult Densities - Cambodia (Year 2, Jul-Nov)

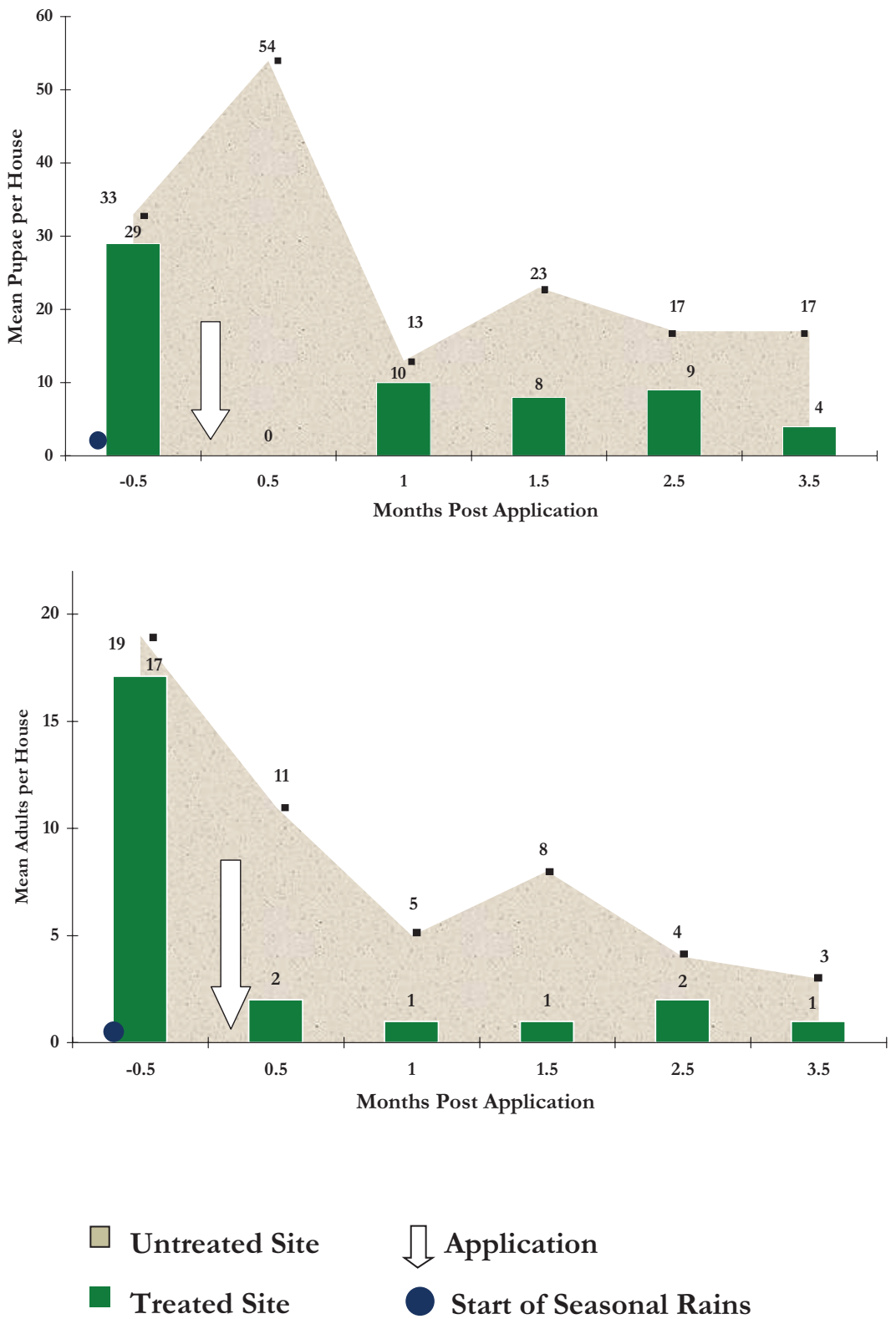


Fig. 3 ***Aedes aegypti*** **and** ***Aedes albopictus*** **Adult Densities in an Urban Center, Singapore**

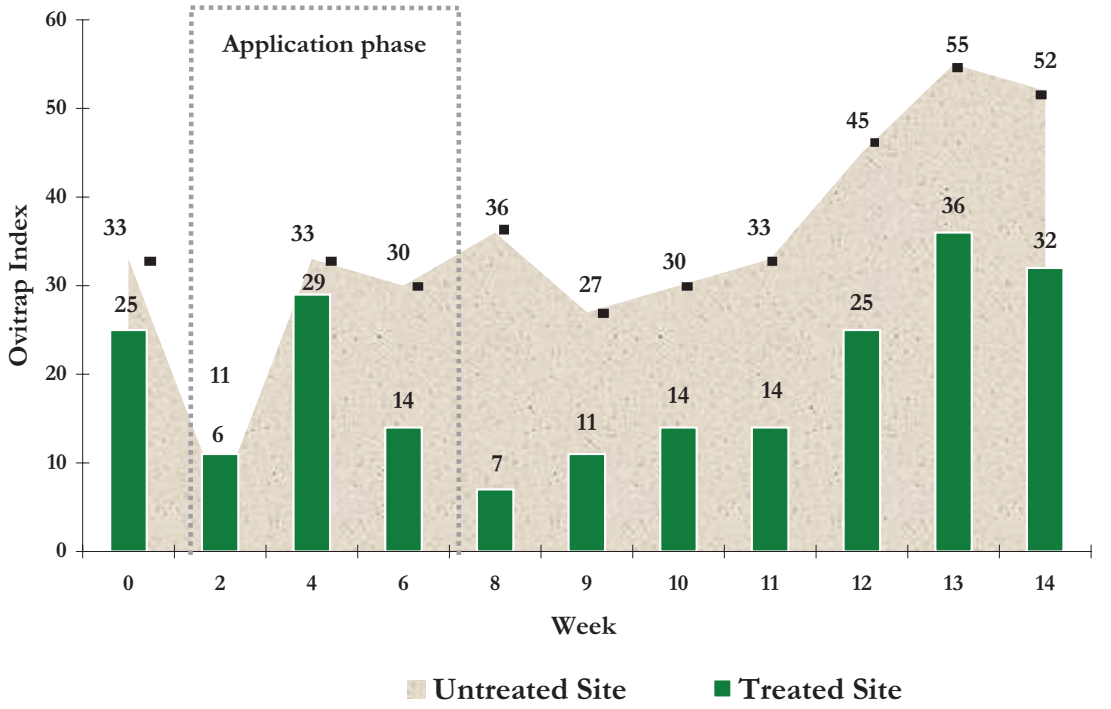


Fig. 4 ***Aedes albopictus*** **Adult Densities in a Rural Locale, Singapore**

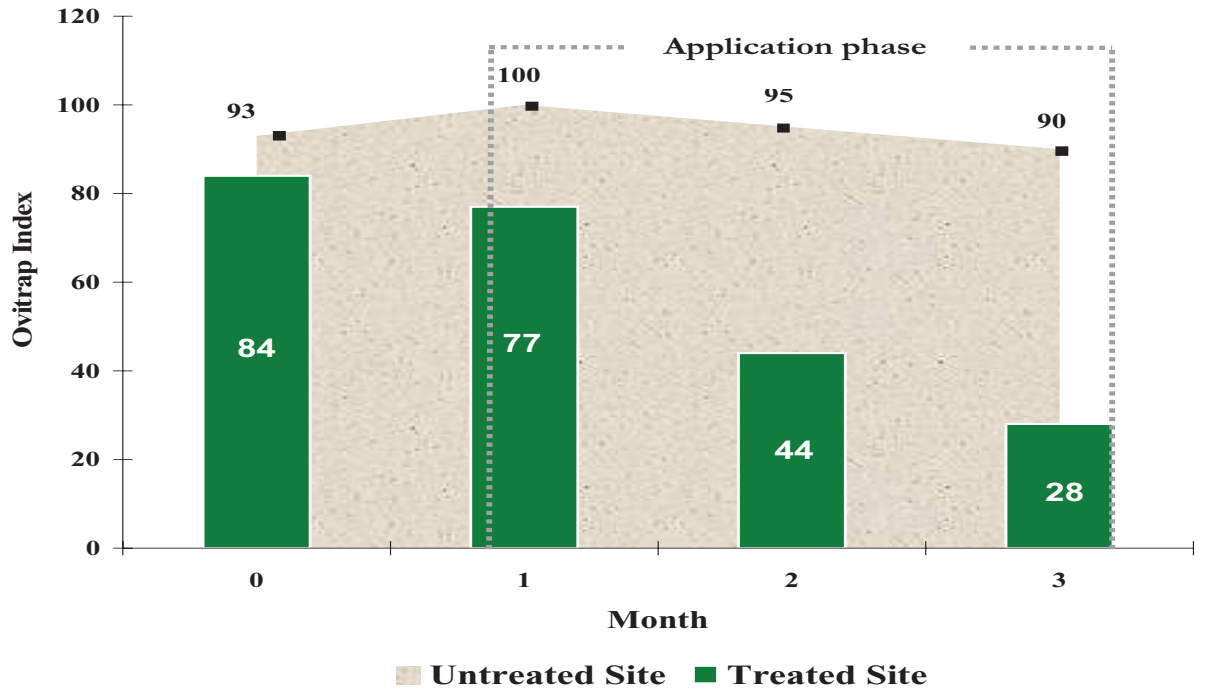


Fig. 5 *Aedes aegypti* Adult Emergence from Cement Containers with River Water, Cambodia

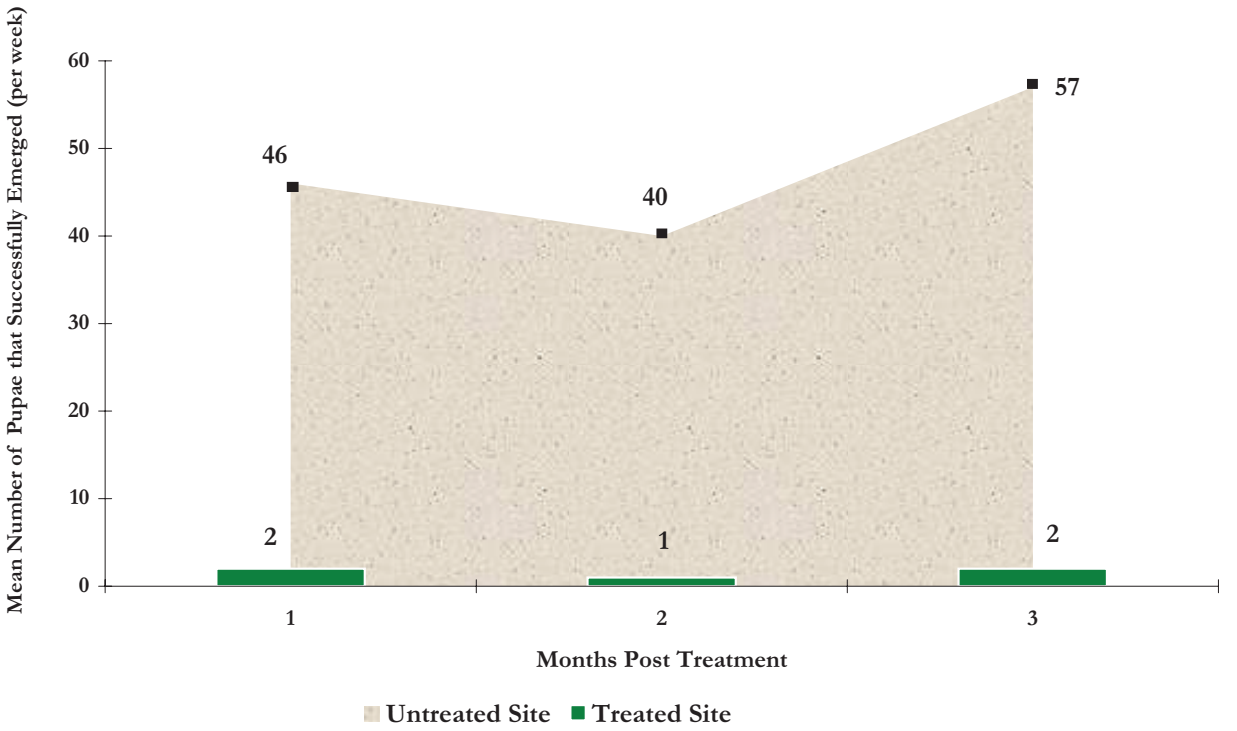
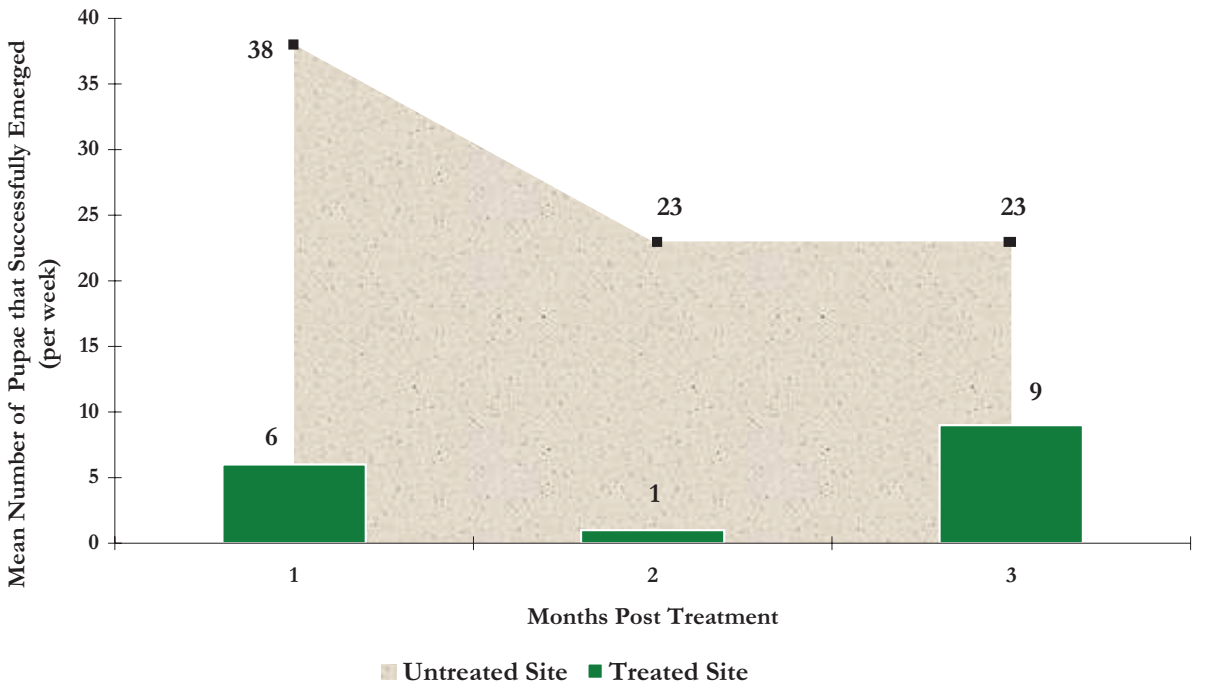


Fig. 6 *Aedes aegypti* Adult Emergence from Cement Containers with Well Water, Cambodia



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Read and follow the label instructions before using. **AG5387**

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