WEEKLY EPIDEMIOLOGICAL REPORT

A publication of the Epidemiology Unit
Ministry of Healthcare and Nutrition

231, de Saram Place, Colombo 01000, Sri Lanka
Tele: + 94 11 2695112, Fax: +94 11 2696583, E mail: epidunit@sltnet.lk
Epidemiologist: +94 11 2681548, E mail: chepid@sltnet.lk
Web: http://www.epid.gov.lk

Vol. 36 No. 28 04th – 10th July 2009

SRI LANKA - 2009

WER

Bacillus thuringiensis israelensis

Dengue, a common mosquito-borne infection in tropical and sub-tropical regions around the world, has become a major international public health concern recent times. The disease has placed about two fifths of the world's population risk of contracting dengue. Dengue has been well established in Sri Lanka in the past few decades and the disease pattern has been changing over the years. So far, the highest number of cases of dengue has been reported during this year in Sri Lanka. Another worrying factor in the current outbreak is the mounting number of deaths among dengue patients. Increasing numbers of patients coupled with high number of deaths have placed dengue as the top most priority for the public health sector. No wonder that it has raised eyebrows of many segments in the community and brickbats have been thrown at the public health practitioners and the health sector in general negating all productive efforts directed to control the disease in the last decade.

Disease control at present is focused on source reduction with a view to reducing the mosquito density and subsequent man mosquito contact. This could only be achieved by adopting extensive environmental modifications to keep high environmental sanitation standards. It requires a massive campaign to keep public awareness high, motivate people to transform this awareness to practice by being practical and mobilizing communities in this regard. However, it needs fairly a long period to produce effective results. The other biggest challenge is to sustain activities even when the public enthusiasm wanes in a case reduction scenario. Among many interventions, the Ministry of Healthcare has looked into newer strategies such as introduction of Bacillus thuringiensis israelensis as a bio-insecticide to eliminate mosquito larvae.

Bacillus thuringiensis israelensis

Bacillus thuringiensis is a Gram-positive, soil dwelling bacterium, commonly used as a pesticide. Additionally, it also occurs naturally in the gut of caterpillars of various types of moths and butterflies, as well as on the dark surfaces of plants. Generic name of the active ingredient is bacillus thuringiensis subspecies israelensis and strain EG2215. It consists of large sporangia and vegetative cells. Strain EG2215 contains spores that are ellipsoidal, paracentral, do not distend to the sides of the sporangium, and require oxygen for sporulation. When grown on NSM agar, the colonies are opaque, cream colored, round, flat, and with a dry smooth texture. The crystal is the portion of the bacteria that gives it insecticidal properties and identifies the bacteria as *Bacillus thuringiensis*. Flagella are assumed to be present because the cells are motile.

Use of Bti as a biological method to control mosquitoes

Bacillus thuringiensis serovar **israelensis** (***Bti***) is a group of bacteria used as biological control agents for larvae stages of certain Dipterans. It produces toxins which are effective in killing various species of mosquitoes, fungus gnats, and black flies, while having almost no effect on other organisms. Indeed one of the major advantages of *B. thuringiensis* products in general is that they are assumed to affect few non-target species.
The subspecies israelensis strain EG2215 is a manufacturing use product designed for production of end-use products for mosquito control. The end-use sites are outdoor sites only and they include irrigation ditches, roadside ditches, flood water, standing ponds, woodland pools, snow melt pools, pastures, catch basins, storm water retention areas, tidal water, salt marshes, and rice fields.Unless used on a community-wide basis, it is probably more effective to eliminate standing water and control weeds at the edges of ponds. Since 1982, it has been used successfully as a biological pest control agent to combat mosquitoes and black flies worldwide.

Mode of action

During the spore-forming stage of its life cycle, the Bti bacterium produces a protein crystal which is toxic only to mosquito and black fly larvae. These microscopic crystals are ingested by insect larvae when they are feeding. In the alkaline environment of the susceptible insect's digestive system, the crystals are dissolved and converted into toxic protein molecules that destroy the walls of the insect's stomach. The insect usually stops feeding within hours and dies within days. Not only must the insect have the correct physiology and be at a susceptible stage

Contents **Page**

of development, but the bacterium must be eaten in sufficient quantity. Spores do not usually spread to other insects or cause disease outbreaks on their own as occurs with many pathogens.

Other subspecies of Bt are registered for use in Canada and these too work only on specific species of insects. For instance, Bt subspecies *tenebrionis* (Btt) is effective against Colorado potato beetles and Bt subspecies *kurstaki* (Btk) works only against a group of insects called lepidopterans, which include destructive tree pests such as gypsy moths, spruce budworms and forest tent caterpillars.

Application of Bacillus thuringiensis israelensis

Bti is applied directly to the water where mosquito and black fly larvae are found. The bacteria are suspended in the water where the larvae will ingest it. None of the products containing Bti may be applied to treated, finished drinking water for human consumption.

Nearly all products containing Bti are restricted class products used to control black fly and mosquito larvae in aquatic situations where the flow of water is not confined to a small area. Most provinces require that applicators be certified to use restricted class products. In some provinces, Bti use may also require a permit issued by the provincial pesticide regulatory authority.

Commercial class Bti products are also available, but can only be used to control black fly and mosquito larvae in private ponds and farm dugouts where no outflow beyond the property limits exists. Bti is also used to control fungus gnat larvae in greenhouse ornamental plants.

Health concerns related to the use of Bti

Bacillus thuringiensis israelensis poses a little threat to human health through either direct handling of products or exposure to them indirectly, e.g. during a mosquito control program. To activate Bti toxins, alkaline conditions that exist only in certain insects' digestive systems must be present. The acidic stomachs of humans and animals do not activate Bti toxins. There have been no documented cases involving toxicity or of endocrine disruption potential to humans or other mammals over the many years of it's use in Canada and around the world. Studies have shown that even if Bti spores are ingested or inhaled, they are eliminated without any adverse health effects.

Prior to being permitted for sale or use in or imported into a country, generally all formulations are evaluated according to internationally-accepted scientific protocols for their potential to cause skin or eye irritation or sensitization and acute toxic effects. These tests are designed to show if the product has the ability to produce health effects or trigger allergic-type reactions.

The fact that Bti is a naturally-occurring, widely-distributed organism in the environment means that the average person would have multiple exposures to this bacterium throughout their lifetime, even if they never come in contact with a formulated product.

Exposure of the applicator during use in mosquito control programs is minimal, since the product is applied directly to the water where the larvae exist. None of the products containing Bti may be applied to treated, finished drinking water. Members of the public are unlikely to experience any symptoms if inadvertently exposed to Bti use, and in such exposure, no special precautions are necessary or required. Individuals who have concerns, however, should take reasonable precautions to avoid exposure during a spray program in the same way they would avoid pollen or other airborne materials during days when air quality advisories are issued. They can also reduce exposure by staying indoors with windows and doors shut during the spray period if spraying is taking place in their area, although this is not required to be adhered to by health officials.

Different varieties of Bt, including Bti, have been widely used in insect control programs in Canada and the USA for many years and have demonstrated a remarkable safety record. The weight of scientific evidence indicates that Bti is non-infectious and non-toxic to humans and other mammals and poses little risk at dosage levels permitted in insect control programs. While adverse effects have been observed in individuals of some non-target aquatic insect species, no lasting impact on the populations of these species has been shown from use of Bti.

Do the formulants used in Bti products pose health risks?

In addition to the active ingredient Bacillus thuringiensis israelensis, other ingredients (formulants) are used to create the final product. It is mandatory for registrants of pest control products to inform the authorities of all formulants used in a product. In canada where this bio-insecticide is used, formulant information is classified as a trade secret and the disclosure of this type of information to the general public is prohibited under the *Access to Information and Privacy Act* (ATIA). The individual formulants present in a pest control product are reviewed for any potential toxicological concerns or signs of being a potential irritant. If any human health risks are identified, steps are taken to either substitute the formulant, to address the identified health concern(s) by proper safety precautions and use restrictions on the product label or the product may not be granted registration approval in countries where this is already in use.

The effect of Bti on the environment

Bacillus thuringiensis israelensis only becomes toxic in the stomachs of mosquito and black fly larvae. Because of this, it does not affect other insects, honeybees, fish, birds or mammals. The United States Environmental Protection Agency categorizes the risks posed by Bt strains to non-target organisms as *minimal to non-existent*. The insecticidal toxin biodegrades quickly in the environment through exposure to sunlight and microorganisms.

Impact on the water supply

Registered products containing Bti are primarily intended for use by trained applicators in mosquito control programs. Label restrictions for these products permit the application only to the aquatic sites where mosquito and black fly larvae are found, and not to treated, finished drinking water. Following a review of human health risk assessments, Canada has determined that products containing Bti do not pose any health risks to humans and other mammals.

Based on the lack of human health risk and long history of safe use associated with Bti and other varieties of Bacillus thuringiensis, Canada has no human health and safety concerns with the application of registered products containing Bt to bodies of water that will be used for human consumption. The direct application of Bti to treated, finished drinking water, however, is not considered are acceptable practice.

Since the bio-insecticide, Bacillus thuringiensis israelensis is a novel strategy to Sri Lanka in preventing mosquito borne diseases, the efficacy of this method is yet to be proven. However many hopes are laid behind this introduction because an effective, rapid acting strategy to reduce the rising dengue specific deaths and disease burden is of utmost importance in the present day context.

References;

http://www.hc-sc.gc.ca/cps-spc/pubs/pest/-fact-fiche/bti/index-eng.php
http://www.nysaes.cornell.edu/ent/biocontrol/pathogens/bacteria.html
http://en.wikipedia.org/wiki/Bacillus_thuringiensis
http://en.wikipedia.org/wiki/Bacillus_thuringiensis_israelensis

This article was compiled by Dr. Upekha Seneviratne, the Research assistant , Epidemiology Unit.

Table 1: Vaccine-preventable Diseases & AFP

27th June – 03rd July 2009 (27th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2009	Number of cases during same week in 2008	Total number of cases to date in 2009	Total number of cases to date in 2008	Difference between the number of cases to date in 2009 & 2008
	W	C	S	N	E	NW	NC	U	Sab					
Acute Flaccid Paralysis	00	00	00	00	00	02	00	00	00	02	02	43	53	-10.0%
Diphtheria	00	00	00	00	00	00	00	00	00	00	00	00	00	-
Measles	00	00	00	00	00	00	00	00	00	00	01	65	61	+06.5%
Tetanus	00	00	00	00	00	00	00	00	00	00	00	15	19	-21.0%
Whooping Cough	00	00	00	00	00	00	02	00	00	02	02	31	23	+42.1%
Tuberculosis	211	57	13	00	23	36	28	08	01	377	201	5278	4543	16.2%

Table 2: Newly Introduced Notifiable Disease

27th June – 03rd July 2009 (27th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2009	Number of cases during same week in 2008	Total number of cases to date in 2009	Total number of cases to date in 2008	Difference between the number of cases to date in 2009 & 2008
	W	C	S	N	E	NW	NC	U	Sab					
Chickenpox	07	04	13	132	11	02	07	06	08	190	85	10548	3025	+248.7%
Meningitis	03 KL=3	04 KD=1 NE=3	03 MT=1 HB=2	00	01 KM=1	02 KN=1 PU=1	00	00	04 KG=2 RP=2	17	14	541	786	-31.2%
Mumps	02	01	04	03	05	00	04	06	06	31	54	1011	1388	-27.2%
Leishmaniasis	00	00	06 MT=3 HB=3	00	00	00	03 AP=3	00	00	09	Not available*	456	Not available*	-

Key to Table 1 & 2

Provinces: W: Western, C: Central, S: Southern, N: North, E: East, NC: North Central, NW: North Western, U: Uva, Sab: Sabaragamuwa.

DPDHS Divisions: CB: Colombo, GM: Gampaha, KL: Kalutara, KD: Kandy, ML: Matale, NE: Nuwara Eliya, GL: Galle, HB: Hambantota, MT: Matara, JF: Jaffna, KN: Killinochchi, MN: Mannar, VA: Vavuniya, MU: Mullaitivu, BT: Batticaloa, AM: Ampara, TR: Trincomalee, KM: Kalmunai, KR: Kurunegala, PU: Puttalam, AP: Anuradhapura, PO: Polonnaruwa, BD: Badulla, MO: Moneragala, RP: Ratnapura, KG: Kegalle.

Data Sources:

Weekly Return of Communicable Diseases: Diphtheria, Measles, Tetanus, Whooping Cough, Chickenpox, Meningitis, Mumps.

Special Surveillance: Acute Flaccid Paralysis.

Leishmaniasis is notifiable only after the General Circular No: 02/102/2008 issued on 23 September 2008.

Table 4: Surveillance of Communicable diseases among IDP's

27th June – 03rd July 2009 (27th Week)

Area / Disease	Dysentery	Enteric fever	Viral Hepatitis	Chicken Pox	Watery Diar-rhoea
Vavunia	0	0	16	57	0
Chendikulam	324	51	238	203	741
Total	**324**	**51**	**254**	**260**	**741**

Table 4: Selected notifiable diseases reported by Medical Officers of Health

27th June– 03rd July 2009 (27th Week)

DPDHS Division	Dengue Fever / DHF*		Dysentery		Encephalitis		Enteric Fever		Food Poisoning		Leptospirosis		Typhus Fever		Viral Hepatitis		Human Rabies		Returns Received Timely**
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	%
Colombo	153	2239	5	112	0	7	0	102	0	38	7	316	0	4	0	51	0	4	**85**
Gampaha	170	2040	2	97	0	17	0	29	1	10	6	168	0	7	0	47	0	2	**80**
Kalutara	35	723	13	180	0	9	1	42	4	26	1	134	0	1	2	18	0	2	**75**
Kandy	55	2276	2	182	0	5	0	17	0	54	1	134	1	104	4	35	0	0	**57**
Matale	87	773	3	64	0	2	0	23	0	6	4	241	0	3	3	11	0	2	**83**
Nuwara Eliya	18	132	17	282	0	1	4	133	0	770	0	25	5	44	1	40	0	0	**100**
Galle	34	253	8	119	1	10	0	2	0	20	1	94	0	4	0	9	0	3	**89**
Hambantota	39	569	1	53	0	6	0	5	1	8	0	49	0	44	2	17	0	0	**100**
Matara	45	654	6	174	0	4	0	4	0	15	1	94	0	74	1	18	0	1	**100**
Jaffna	0	9	0	72	0	3	2	162	0	28	0	0	0	122	0	104	0	2	**25**
Kilinochchi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mannar	0	4	2	50	0	1	1	79	0	4	0	0	0	0	0	35	0	0	**50**
Vavuniya	0	11	14	1265	0	3	2	145	0	2	0	2	0	1	111	2851	0	0	**75**
Mullaitivu	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0**
Batticaloa	12	391	3	175	0	12	0	7	0	41	0	8	0	2	1	9	1	2	**64**
Ampara	12	152	0	30	0	0	3	8	0	5	0	8	0	0	0	6	0	0	**43**
Trincomalee	16	285	2	61	0	2	0	4	0	0	0	16	0	14	10	17	0	1	**70**
Kurunegala	85	1375	1	104	0	8	0	40	0	5	2	59	1	53	4	48	0	4	**68**
Puttalam	47	320	1	84	0	7	0	56	0	0	4	48	0	26	1	9	0	1	**89**
Anuradhapura	33	388	3	72	0	4	0	4	0	3	0	74	0	26	9	38	0	1	**74**
Polonnaruwa	8	89	0	22	0	2	1	17	0	6	0	48	0	0	7	27	0	0	**57**
Badulla	9	158	7	159	0	2	0	27	0	18	0	52	2	60	2	202	0	1	**73**
Monaragala	10	83	2	36	0	0	0	15	0	7	0	12	1	44	4	39	0	0	**73**
Ratnapura	69	944	3	323	0	15	0	36	0	5	7	102	0	22	4	64	0	1	**56**
Kegalle	83	2185	2	91	0	5	0	23	0	6	0	103	2	21	6	112	0	1	**64**
Kalmunai	3	126	3	67	0	1	0	8	0	1	0	2	0	2	0	11	0	0	**85**
SRI LANKA	**1023**	**16179**	**100**	**3876**	**01**	**126**	**14**	**989**	**6**	**1078**	**34**	**1789**	**12**	**678**	**172**	**3818**	**01**	**28**	**72**

Source: Weekly Returns of Communicable Diseases (WRCD).
*Dengue Fever / DHF refers to Dengue Fever / Dengue Haemorrhagic Fever.
**Timely refers to returns received on or before 03rd July, 2009 Total number of reporting units =311. Number of reporting units data provided for the current week: 223
A = Cases reported during the current week. B = Cumulative cases for the year.

PRINTING OF THIS PUBLICATION IS FUNDED BY THE UNITED NATIONS CHILDREN'S FUND (UNICEF).

Comments and contributions for publication in the WER Sri Lanka are welcome. However, the editor reserves the right to accept or reject items for publication. All correspondence should be mailed to The Editor, WER Sri Lanka, Epidemiological Unit, P.O. Box 1567, Colombo or sent by E-mail to chepid@sltnet.lk.

ON STATE SERVICE

Dr. P. PALIHAWADANA
CHIEF EPIDEMIOLOGIST
EPIDEMIOLOGY UNIT
231, DE SARAM PLACE
COLOMBO 10