

**SAMPATH  
LANKADHEERA**  
B.Sc. (Hons), M.Sc.



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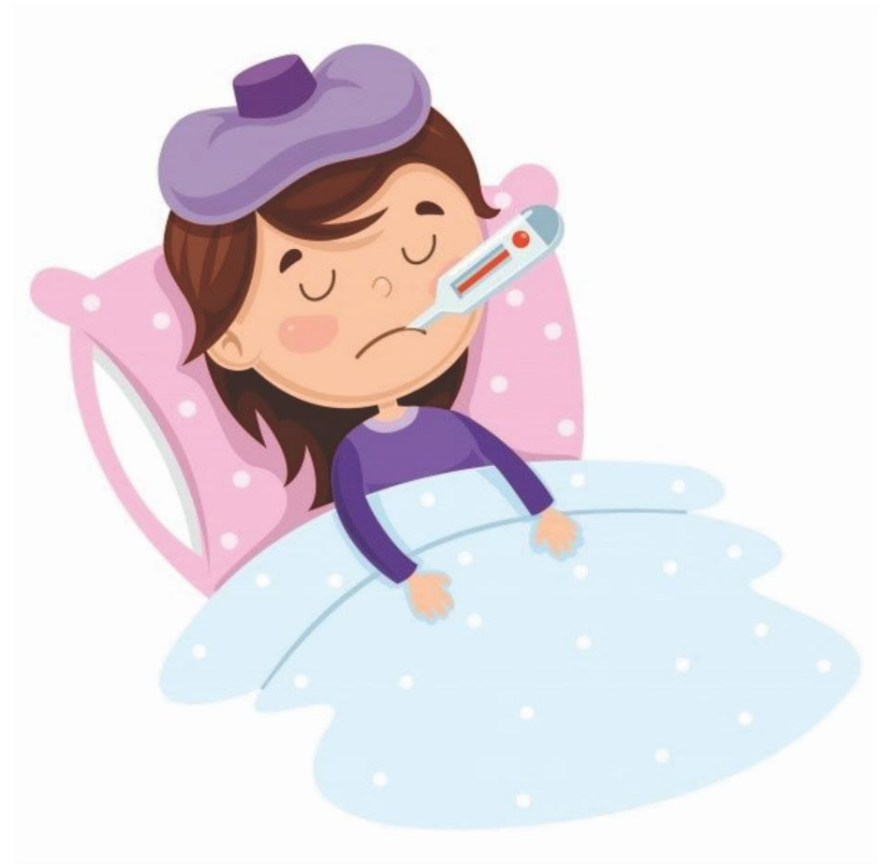
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# Applied Biology



3

## 10.3 Minimizing damage caused by vector born diseases



*Unit 10 Applied Biology*

*10.1.0 : Uses biological concepts and principles to promote the living standards*

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8. Which of the following could be used to control dengue vector as well as filaria vector?  
 (A) Construction of buildings without roof gutters (B) Mosquito proofing of domestic wells  
 (C) Preventing creation of vector breeding sites (D) Use of fish that feed on mosquito larvae  
 (E) Repairing broken septic tanks

2023/50

**Write short note on Biological control of Dengue vector**

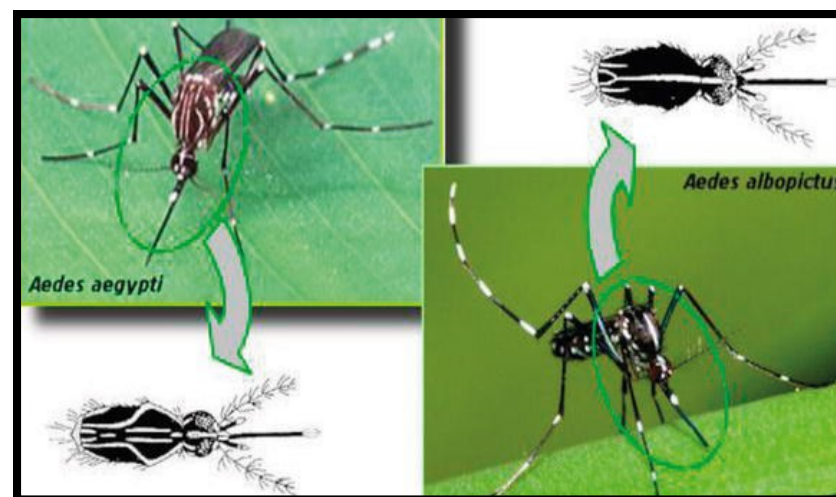
1. Using (larvivorous) fish
2. eg: Guppy, Dandi/juvenile Tilapia
3. They feed on mosquito larvae/ control mosquito larvae.
4. Using *Bacillus thuringiensis*/Bti,
5. which produces an endotoxin,
6. which is toxic to (mosquito) larvae
7. There are few limitations (of biological control)
8. Fish will die
9. due to absence of food,
10. changing water quality and
11. additions of chlorinated water.
12. Bti/*Bacillus thuringiensis* cannot be applied to some places.

**10.1.3 : Uses biological knowledge for understanding and minimizing damage caused by vector -borne diseases**

**Number of Periods : 05**

**Dengue**

- Dengue is a vector borne disease which is caused by an arbovirus which is a ..... virus. Epidemics of dengue are reported in ..... and ..... regions of the world. The virus is transmitted by two species of mosquitoes, they are ..... and ..... The transmission of the dengue virus is dependent on ..... and ..... factors. The biotic factors include the virus, the vector and the host and the abiotic factors include ....., ..... and ..... The dengue virus is transmitted to human via the biting of an infected ..... mosquito. The infected humans can be ..... as well as ..... and they are the carriers and multipliers of the virus.



- The Aedes mosquitoes are ..... to ..... sized (approximately 4-7 mm) and it is ..... in colour. These mosquitoes have ...../bands on its body and the arrangement on these bands are different in the body and the legs. They live about ..... weeks depending on the environmental conditions.
- The life cycle has four stages, they are ....., ....., ..... and ..... The adult female mosquito lays eggs ..... on the ..... surface of wet containers above the water level, preferably ..... Initially the laid eggs are ..... in colour and they become ..... colour within ..... from

3. Which one of the following is not a place for breeding *Aedes mosquito*
  - (1) discarded plastic containers» tins, clay pots, yoghurt and ice cream cups, bottles, cans,
  - (2) water storage containers such as cement tanks, barrels (3) discarded automobile tyres, and machinery parts,
  - (4) building structures such as roof gutters, concrete slabs etc (5) Drainages with polluted water.
  
4. Which of the following incorrect regarding dengi fever?
  - (1) Sudden onset of high fever (40°C/ 104°F) could be accompanied by severe headache, pain behind the eyes, muscle and joint pains, nausea, vomiting, or skin Rash.
  - (2) Symptoms usually last for 2-7 days after incubation period of 4-10 days from the bite of an infected female *Aedes mosquito*
  - (3) Warning signs occur 3—7 days after the first symptoms in conjunction with a decrease in temperature (below 38°C/100°F)
  - (4) Severe dengue (dengue haemorrhagic fever) is a potentially deadly complication due to blood plasma leaking, fluid accumulation, respiratory distress, severe bleeding, or organ impairment.
  - (5) The first 24—48 hours of the critical stage can be lethal, in which symptoms may progress to massive bleeding, very low blood pressure, shock and death.
  
5. Incorrect statement regarding *Culex mosquito*
  - (1) The *Culex mosquito* is small to medium in size (3 to 4 mm in length) and grey—black in colour.
  - (2) The nervures of Wings of adult mosquito are beset with brown or blackish scales and the posterior margin of the wings is fringed with bristle and scales.
  - (3) Female lay eggs in the form of egg rafts that floats on the surface of water.
  - (4) After hatching, larva rests keeping its body with an angle to the water surface.
  - (5) These mosquitoes have white markings/bands on its body and the arrangement on these bands are different in the body and the legs.
  
6. Which one of the following statements regarding the transmission of *Wuchereria bancrofti* is correct?
  - (1) When the mosquito suck blood from humans, larval stages of parasite is inoculated in to the body.
  - (2) microphylaria larva migrate to the lymphatic system.
  - (3) larvae within one month become matured in to adult Worms.
  - (4) Adult male and female worms nests and mate in blood vessels and produce large number of tiny, immature eggs.
  - (5) Microfilariae migrate from the lymphatic system and enter the blood stream
  
7. Incorrect regarding clinical manifestation.
  - (1) wheezing, mild fever, weight loss etc.
  - (2) Fluid accumulation in scrotum manifests as hydrocele.
  - (3) Presence of microfilariae in lungs manifest as occult filariasis.
  - (4) Occult filariasis is characterized by high basophil count with chronic cough and Wheezing which worsen at night with dyspnea, chest pain, fever and Weight loss.
  - (5) Clinical manifestations vary from asymptomatic to chronic lymphedema (elephantiasis).

13. Write the factors that influence the transmission of filaria within a community.

.....  
.....  
.....  
.....

14. How does infective stage of filaria enters in to human body

.....  
.....

15. What is the main system that filaria adult worms inhabit.

.....

16. Which stage can be found in the blood stream of an infected person?

.....

17. The behavior of the above mentioned stage is important for the entry into the vector's body, Explain this behavior

.....  
.....

18. Write the symptoms caused by microfilaria

.....  
.....

19. What are the late manifestation of the presence of adult worms for a long period of time?

.....  
.....

20. Write the controlling measures of filariasis.

.....  
.....

**MCQ**

1. Which of the following parasite causes dengi  
(1) *Ades aegypti* (2) *Aedes albopictus* (3) *Wuchereria bancrofti* (4) RNA virus (5) *Culex quinquefasciatus*
  
2. Which of the following regarding dengi vector is incorrect.  
(1) The Aedes mosquitoes are small to medium sized (approximately 4-7 mm) and it is dark in colour.  
(2) Dengue is a vector borne disease which is caused by an arbovirus which is a RNA virus.  
(3) These mosquitoes have white markings/bands on its body and the arrangement on these bands are different in the body and the legs. (4) Initially the laid eggs are shiny black in colour.  
(5) The eggs hatch within two days to become a larvae. The larvae rest with an angle to the water surface.

deposition of the eggs. These eggs are ....., and ..... in shape and about ..... long. The eggs hatch within ..... days to become a larvae. The larvae rest with ..... to the water surface. If the eggs are not hatched, they can undergo dormant for a period of about ..... months. The body of larva consists of three major parts i.e. ...., ..... and ..... After 4-5 days the larval stage becomes the ..... which is ..... shaped and ..... The pupa becomes the adult mosquito within .....

**Breeding sites**

- The female mosquitoes lay eggs in a wide variety of ..... and ..... containers. They prefer dark coloured surfaces with ..... (.....) water. The breeding sites can be found in both ..... as well as ..... They include,
- Discarded plastic containers- tins, clay pots, yoghurt and ice cream cups, bottles, cans, damaged ceramic items, coconut shells, etc.
- Water storage containers such as cement tanks, barrels, etc.
- Discarded automobile tyres, and machinery parts,
- Building structures such as roof gutters, concrete slabs etc.,
- Household/ institutional appliances including refrigerator trays, flower vases, ornamental ponds, squatting pans of wash rooms, etc.,
- Natural breeding sites such as leaf axils, tree holes, etc.

**Symptoms of disease**

- Dengue can affect infants, young children and adults.
- It starts with .....-like symptoms.
- Sudden onset of high fever (40 °C/104 °F) could be accompanied by any of the following symptoms.
- They are severe ....., pain behind the ....., ..... and ..... pains, ....., ....., or skin rash.
- These symptoms usually last for ..... after incubation period of ..... from the bite of an infected female Aedes mosquito
- Severe dengue (dengue haemorrhagic fever) is a potentially deadly complication due to blood plasma leaking, fluid accumulation, respiratory distress, severe bleeding, or organ impairment.

4. Write the identifying features of adult Aedes mosquito.  
.....  
.....  
.....  
.....
5. Write the identifying features of the eggs of Aedes.  
.....  
.....
6. What is understood by incubation period with regards to a pathogen and write the incubation period of dengue virus  
.....  
.....  
.....
7. Write the late symptoms of dengue haemorrhagic fever that is called dengue shock syndrome  
.....  
.....  
.....  
.....  
.....
8. Write the common control measures of the vector mosquito at different stages of life cycle.  
Adult - .....  
Larvae - .....  
.....  
.....
9. Write the scientific name of the filarial parasite .....
10. Who is the vector organism of filarial worm .....
11. Write the breeding sites of the vector .....
12. Write identifiable features of adult vector mosquito of filaria.  
.....  
.....  
.....



### 10.3 Understanding and minimizing damage caused by vector born diseases

#### Learning outcomes:

- describes the methods of transmission of filaria and dengue
- states the symptoms of infection
- describes the controlling measures of vectors and discusses the issues
- appreciates the importance of keeping the environment clean to prevent vector borne infections

#### Suggested Teaching Learning Process

- Introduce vector borne disease.
- Assign students to gather articles/ leaflets/ posters on dengue and filaria published by medical centers .
- Guide students to complete the following table with the help of collected materials.

	Dengue	Filaria
Name of the vector		
General characteristics of the vector		
Causal agent		
Breeding sites		
General symptoms of the disease		
How to control		

- Conduct a discussion on the above table.

#### Assessment and Evaluation

- Assess the students table using relevant criteria.

#### Structured Essay

1. Write the causative pathogen and vector organism of the disease dengue.

Pathogen — .....

Vector — .....

2. Write the biotic and abiotic factors on which transmission of dengue depends?

Biotic — .....

Abiotic — .....

3. State carriers of dengue virus?

.....  
 .....

- Warning signs occur ..... after the first symptoms in conjunction with a decrease in temperature (below 38<sup>0</sup>C/100<sup>0</sup>F) and include: severe abdominal pain, persistent vomiting, rapid breathing, bleeding from the nose and gums, fatigue, enlargement of liver, reduced number of platelets, restlessness blood in vomit.
- The next 24 - 48 hours of the critical stage can be lethal, in which symptoms may progress to massive bleeding, very low blood pressure, shock and death.
- Proper medical care is needed to avoid complications and risk of shock and death (dengue shock syndrome).

#### Controlling measures of the vector

- The dengue vector controlling methods are mainly aimed at both immature and adult stage of the Aedes mosquitoes. Integrated vector management strategy includes environmental, chemical and biological controlling methods.
  - The most cost effective way is controlling the vector by eliminating its breeding sites. Removal of open source of water through the environmental management could be done by;
  - Having continuous water supply to minimize storage of water in cement tanks, barrels, and other containers,
  - Making mosquito proofing of water storage cement tanks, domestic wells, and over head tanks,
  - Construction of buildings without roof gutters removal of unserviceable roof gutters regular cleaning with scrubbing of water storage tanks, flower pots, flower vases, ant traps, refrigerator trays
  - Proper disposal of solid wastes
  - Proper storage of used tyres, household and garden utensils.
- In addition to environmental management practices, biological controlling methods also can be used to control the vector. They include, use of fish species which feed on the larval stages of the mosquito. The following fish species could be introduced to water storage tanks, barrels, ornamental ponds, etc. to feed on the larval stages of these mosquitoes.
  1. Guppy (*Poecilia reticulata* )
  2. Dandi (*Rasbora daniconius* )
  3. Juvenile stages of *Tilapia*



2. The *Bacillus thuringiensis israelensis* (Bti) also can be used to control the dengue vectors. This is a bacterium that produces an endotoxin which is toxic to the larval stages of the mosquitoes.
3. Another method of mosquito control is thermal fogging which is a form of chemical method. When mosquitoes are exposed to sufficient dosage of this fog they are knocked down and killed.
  - There are several limitations in vector controlling methods, such as lack of sufficient knowledge in biological controlling methods.
  - When fish are used to control the vector,
    - fish could die in the absence of food in the breeding site and due to changes in water quality parameters such as pH of water in breeding site
    - When the domesticated water containers are filled with chlorinated water it may lead to the death of the fish.
  - When Bti is suggested to control the vector,
    - there could be some breeding sites that Bti can't be applied chemical methods such as fogging,
    - could affect health of both humans and animals

- When microfilaria lives in lungs patients develop dry ..... , ..... , ..... etc.
- Fluid accumulation in scrotum manifests as ..... Presence of microfilariae in lungs manifest as ..... Occult filariasis is characterized by high .....count with chronic cough and wheezing which worsen at night with dyspnea, chest pain, fever and weight loss.
  - Clinical manifestations vary from ..... to chronic lymphedema (elephantiasis). After entering the human body the filarial parasite (L3 larva) develops into an adult worm and remains silent in lymphatics for several years producing microfilaria. These patients are asymptomatic and can only be detected through active surveillance.
  - Presence of adult parasite in lymphatic system for a longer period gives rise to late manifestations. They are due to ..... of lymphatic vessels followed by their ..... , accumulation of fluid in tissues and increased risk of infection lymphoedema). With recurrent infections skin of oedematous extremities becomes thickened and later on gives rise to warty, nodular, papillomatous appearance. Lymphoedema is graded according to the state of oedema and appearance of the skin

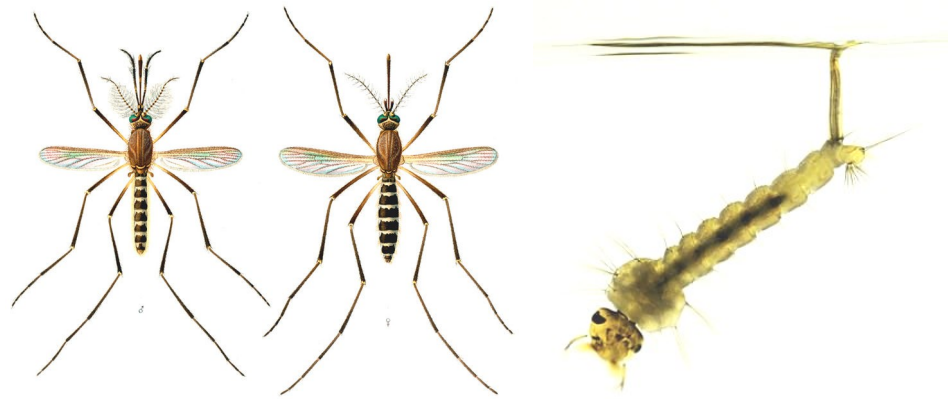
#### Controlling measures

- Personal protection from mosquito bites/ prevent mosquito bites by the use of mosquito nets, repellants, long sleeve shirts and trousers.
- Elimination of breeding sites: repair broken septic tanks, cleaning drainages, prevent dumping garbage in to drains, chemical control of aquatic plants in water reservoirs
- Prevent creation of breeding sites.
- Use of larvivorous fish such as guppy, nalahandaya in water bodies.
- Screening healthy population with night blood films and detect people who harbour the infection but do not show any symptoms and treat them.
- Monitor vector mosquito population for infectivity

#### Limitations of controlling methods

- Lack of sufficient knowledge among people about the disease, the vector, method of transmission, breeding sites and controlling measures.





## Filaria

### Lymphatic Filariasis in Sri Lanka

- Filaria is one of the oldest .....disease in the world. This is one of the major leading causes of permanent and long term ..... It does not kill people, but cause permanent disability. Filariasis is a mosquito borne disease transmitted by a thread like ....., who lives in human lymphatic system. The disease is endemic in developing countries with poor socio-economic status and is often associate with poor ..... Filaria has been categorized as a neglected tropical disease.

### Factors associated with transmission

- Transmission in a community is influenced by,
  - Number of infected persons (prevalence)
  - Density of microfilaria in blood of infected persons
  - Density of vector mosquitoes.
  - Characteristics of the vector (affects development of larvae)
  - Frequency of human vector contact.

### Methods of transmission

- Filaria parasite is introduced to human body by a bite of a female adult mosquito. When the mosquito suck blood from humans, larval stages of parasite .....on to the skin (do not inoculate in to the body as other mosquito borne disease agents). Then these larvae penetrate skin through the ..... and enter into the human vascular system. From here, the larvae migrate to the ..... system. Within one year larvae become ..... in to adult worms. Adult male and female worms ..... and ..... in lymphatic vessels and produce large number of ....., immature eggs which hatch into ..... Microfilariae migrate from the lymphatic system and enter the blood stream. Microfilariae live in ..... during day time and travel to ..... blood during night. From here they transfer to mosquito when it takes a ..... meal from human body. Ingested microfilariae transform into several larval forms and again with another bite enter into human body.
- Adult worm lives in lymphatic system for ..... years and microfilaria can lives for ..... year. When adults worms block lymphatic vessels they get distorted and lymph flow does not occur smoothly. Lymph tends to ..... independent parts of the body: legs, hands, testes, penis, and breast causing .....



### Parasite

- 90% of infections are caused by *Wuchereria bancrofti*
- Human is the exclusive host of *W. bancrofti*

### Vector

- In Sri Lanka it is transmitted solely by *Culex quinquefasciatus* mosquito.
- Culex* breeds in polluted water bodies; blocked drains, broken toilet pits, husk pits etc.
- The *Culex* mosquito is small to medium in size (3 to 4 mm in length) and ..... in colour. The ..... (hollow veins that form the framework of an insect's wing) of wings of adult mosquito are beset with ..... or ..... scales and the posterior margin of the wings is fringed with bristle and scales. Female lay eggs in the form of ..... that ..... on the surface of water. After hatching, larva rests keeping its body with ..... to the water surface.

