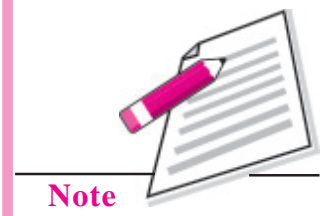


Note

13

374en13

BIOLOGICAL WARFARE

In the previous lesson we have learnt about nuclear warfare. Now, we will learn about biological warfare (BW), also known as germ warfare. It is the use of biological toxins or infectious agents such as bacteria, viruses, and fungi for war. The intent could be to kill or incapacitate humans, animals or plants by using biological agents as an act of war.

Biological weapons are living organisms that reproduce or replicate within their host victims. Biological weapons may be employed in various ways to gain a strategic or tactical advantage over the enemy. Biological weapons may also be useful as area denial weapons. These agents may be lethal or non-lethal, and may be targeted against a single individual, a group of people, or even an entire population.

Like nuclear weapons, the use of biological weapons is also prohibited under customary International Humanitarian Law and International Treaties. The use of biological agents in armed conflict is a war crime.In this lesson we will learn about the biological warfare to include the basic terms used, the types of biological warfare agents, its characteristics, selection of BW agents and delivery means.

Objectives

After studying this lesson, you will be able to:

- define the basic terms used in Biological Warfare;
- classify the types, characteristics and selection of BW agents and
- explain the meaning of delivery of BW agents and their routes of entry into human body.

13.1 Basic Terms and Definitions

(a) Biological Agent - A biological agent is a micro-organism which causes disease in man, plants or animals, or causes the deterioration of material.

(b) Biological Warfare (BW) - Biological warfare is the use of biological agents

Note

to produce casualties in man or animals and damage to plants or material and defence against such use.

(c) **Aerosol -** An aerosol is a suspension of small particles (liquid or solid) in air. Mist and smoke are examples of aerosol. The size of the particle should not exceed 5 microns (1 micron or 1 micrometre = 1×10?6 metre = 0.001 mm)

(d) **Toxins -** Toxins are metabolic products of bacteria. They cause poisoning of organisms.

Intext Questions 13.1

1. Fill in the blanks:-
   (a) An aerosol is a suspension of _____.
   (b) Biological agent is a _____ .
2. What are toxins?

13.2 Types, Essential Characteristics and Selection of BW Agents

13.2.1 Types of Biological Agents

A biological agent is one which is highly infectious, easily produced and stored. They should be stable and suitable for use in the field. They should be able to produce a disease for which there is minimal immunity in the target population. There are four primary groups of microorganisms from among which a biological warfare agent is likely to be drawn.

They are classified as

(a) Bacteria

(b) Rickettsia

(c) Virus

(d) Fungi

(a) **Bacteria:** Bacteria are small, free-living microscopic organisms. They can be grown easily in the laboratory. They are distinguished from the cells of other organisms in having primitive non- membrane-enclosed nuclei. They are therefore said to be 'prokaryotic'. Certain bacteria, under unfavourable conditions, undergo change into a state of inactiveness and are called Spores. The spores become active when suitable or favourable conditions prevail. It is considered to be a defence mechanism because such bacteria can survive under unfavourable

conditions for a long period extending to years. The bacteria, which form spores, are also known as persistent BW agents. Bacillus anthracis, cause of anthrax, is a very important BW agent, which produces spores.

(b) **Rickettsia:** These are primarily parasites of insects and appear only secondary in man and other animals. The microorganisms characteristically inhabit the cell lining of the intestines and other tissues of the insects. They are found in a certain group of blood sucking insects, such as fleas, mites, lice and ticks. The rickettsia causes no injury to the insects but is often pathogenic to men and other animals. Some rickettsia cause diseases that are severe and often fatal. They are susceptible to antibiotic treatment. They grow only within living cells like viruses.

(c) **Viruses:** A virus is a small infectious agent that replicates only inside the living cells of other organisms. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria. Viruses are not cellular and therefore do not possess typical structures of a cell. No specific treatment is available against viruses; viruses do not respond to antibiotic treatment. However vaccination is effective. e.g. Small Pox

(d) **Fungi:** A fungus (plural - fungi) is any member of the group of organisms that includes microorganisms such as yeasts and molds. The most common example is mushrooms. Fungi may be regarded as primitive plants that do not produce its own food. They draw nutrition from decaying vegetation matter. Most fungi can exist either in a yeast-like state or as resistant spores. The fungi which produce toxins (mycotoxins) are important BW agents.

13.2.2 Essential Characteristics of BW Agents

A majority of BW agents employ germs. Some of these organisms can only grow and reproduce under suitable conditions and they are regarded as non-persistent as they are extremely susceptible to variation in temperature, humidity and sunlight. Some agents, such as anthrax, are highly resistant to climatic effects and can be classified as persistent. Some important and essential characteristic BW agents are: -

- **Infectivity:** The infectivity of microorganisms is defined as its ability to cause disease. A greater infectivity means that fewer microorganisms are required. It means how fast the microorganisms can enter the body of the target.
- **Virulence:** The infective penetration of sufficient microorganism may produce diseases of different severity. The most virulent strain produces the most acute or severe effects and is a better BW agent.
- **Incubation:** The incubation period is the time between the infective penetration of sufficient microorganisms into the body and the appearance of the symptoms of the disease. It is normally not less than 24 hours.

Note

- **Transmissibility:** Some microorganisms produce disease, which may be transmitted from man to man (e.g., Plague) which may cause an epidemic. However others do not, e.g., Anthrax. The greater the transmissibility, the better the BW agent.
- **Lethality:** Some microorganism will produce diseases which are usually lethal if the target population is not immune (e.g. Small pox). Others will give rise to illness which are incapacitating rather than lethal (e.g. influenza).

13.2.3 Selection of BW Agents

The characteristics of the BW agent chosen in terms of transmissibility, incapacitation, and/or lethality will depend on the effect required in the large population. For a micro-organism to be selected as a BW agent it must meet certain requirements:

(a) **Production:** Easy to produce in required quantity.

(b) **Storage:** Easy to store while maintaining its virulence. The BW agent may be stored as resistant spores (e.g. Anthrax), in liquid growth media, or as a 'freeze-dried' powder.

(c) **Dissemination:** The microorganisms must remain viable during transit and delivery.

(d) **Immunity:** No widespread or naturally acquired immunity against the chosen microorganism should exist in the target population.

(e) **Sensitivity to Environment:** Various environmental factors affect the use of microorganisms as air-borne BW agents and thus reduce their effectiveness: -

(i) **Atmospheric Stability:** A BW agent cloud may get rapidly dispersed in unstable atmospheric conditions.

(ii) **Wind Speed:** A high wind speed will carry an agent cloud quickly past the victim who may therefore be less at risk.

(iii) **Temperature and Humidity:** The survival of BW agents is best assured by conditions of low temperatures and high humidity.

(iv) **Atmospheric Pollution:** Because of its chemical nature, atmospheric pollution has an adverse effect on BW agent.

(v) **Sunlight:** Most microorganisms are killed by exposure to ultra- violet light (sunlight); spores are an exception. BW attacks are therefore more likely at night. The appearance of sunlight could be used to limit the spread of the attack.

(vi) **Precipitation:** As the BW agents tend to have very small particle size, they are unlikely to be washed out of the atmosphere by rain and snow.

Note

Intext Questions 13.2

1. Fill in the blanks

   (a) The BW agents are drawn from four primary groups of organisms called (i) _____ (ii) _____ (iii) _____ (iv) _____.

   (b) _____ is found in a certain group of blood sucking insects, such as fleas, mites, lice and ticks.

   (c) Incubation period is normally not less than _____ hours.

   (d) Certain bacteria, under unfavourable conditions, undergo change into a state of inactiveness and are called _____.

2. List the essential characteristics for selection of any two BW agent.

13.3 Means of Delivery of BW Agents and their Routes of Entry into Human Body

13.3.1 Delivery

The BW agents may be delivered in a liquid medium called microorganism 'soup' or as an aerosol. The liquid medium protects the agent from excessive atmospheric drying, provides a degree of nutrition to the agent while being delivered to the target and protects the agent during the transition from liquid to aerosol state. The various modes of delivery of BW agents are:-

(a) **Vectors:** The use of animals or insects, known as 'vectors' is used for the delivery of microorganisms. However, in a BW attack, vectors cannot be relied upon to behave in a predictable and concerted manner.

(b) **Explosive Munitions:** Explosive munitions normally consist of a small explosive device, which is surrounded by the BW agent filled and enclosed in a thin metal or plastic case. Each munition forms a bomblet within a full sized bomb or artillery round. The bomblets are designed to disperse over a wide area when released. On impact, the device explodes and disseminates the agent in an aerosol suspension. The heat and shock of the explosion usually kills some of the micro-organisms.

(c) **Generators:** Biological agent generators normally consist of a container that has a source of pressure, which replaces the explosives charge. When the generator is activated, the pressure forces the agent through the nozzle device and creates an aerosol. The generator does not kill as many of the organisms as an explosive bomblet and is relatively quiet in operation.

Note

(d) **Spray Tanks:** Aircraft can carry spray tanks containing a large quantity of BW agent and are capable of producing effective aerosol over extremely large areas. The working of spray tanks is like generators to create the aerosol.

13.3.2 Routes of Entry

To cause disease, the BW agent has to penetrate into the human body. This can happen through the skin and eyes, by eating and drinking and/or by breathing.

(a) **Skin:** Penetration through the skin and mucous membranes may occur, particularly if the surface is damaged. The NBC IPE (Individual Protective Equipment) affords some amount of protection.

(b) **Digestive Tract:** The digestive tract provides a route of entry for contaminated food and drink. This route has some limitations like the digestive process destroys many BW agents, chlorination and water treatment destroys a majority of BW agents, cooking at high temperature kills almost all microorganisms.

(c) **Respiratory Route:** The breathing or respiratory route is the most significant and widely used. In this method, the infective dose required may be smaller and the onset of symptoms more rapid than normal.

Intext Questions 13.3

1. Fill in the blanks.

   (a) The use of animals or insects, known as _____ is used for the delivery of micro-organisms.

   (b) The _____ route is the most significant and widely used for entry of biological agents.

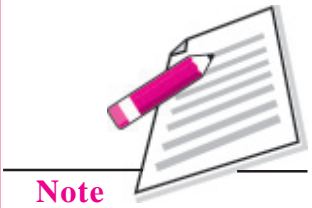
   (c) Aircraft carry _____ containing a large quantity of BW agent and are capable of producing effective aerosol over extremely large areas.

2. Name the various routes of entry of BW agent into the human body.

What You Have Learnt

The lesson on Biological warfare has taught you the basic aspects of this type of warfare. Some important highlights of the lesson are as follows:-

- The basic terms and definitions used in the study of biological warfare;
- Types, Essential Characteristics and Selection of BW Agents; The microorganisms such as virus, rickettsia that are used as agents;
- Essential Characteristics of BW Agents and their selection for use in battle;



Note

- The means of delivery of biological warfare agents and their routes of entry into human body.

Terminal Exercises

1. Explain the following:
   (a) Biological Agent
   (b) Aerosol
   (c) Bacteria as biological agents
2. What is meant by the Sensitivity to Environment of biological agents?
3. Explain the various delivery methods of BW agent.

Answers to Intext Questions

13.1

1. (a) small particles (liquid or solid) in air like mist and smoke.
   (b) Micro organism which causes disease in men, plants or animals.
2. Toxins are metabolic products of bacteria. They cause poisoning of organism.

13.2

1. (a) Bacteria, Rickettsia, Virus and Fungi.
   (b) Rickettsia
   (c) 24
   (d) Spores
2. (i) Infectivity (ii) Virulence (iii) Incubation
   (iv) Trans missibility (v) Lethality

13.3

1. (a) Vectors
   (b) Breathing or respiratory
   (c) Spray tanks
2. (i) Skin (ii) Digestive Tract (iii) Respiratory