LECTURE NOTES

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Control of Insects and Rodents

For Health Extension Workers

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In collaboration with the Ethiopia Public Health Training Initiative, The Carter Center, the Ethiopia Ministry of Health, and the Ethiopia Ministry of Education

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Acknowledgments

The development of this lecture note for training Health Extension workers is an arduous assignment for Ato Alemayehu Haddis at Jimma University.

Essentially, it required the consolidation and merging of existing in depth training materials, examination of Health Extension Package manuals and the Curriculum.

Recognizing the importance of and the need for the preparation of the lecture note for the Training of Health Extension workers THE CARTER CENTER (TCC) ETHIOPIA PUBLIC HEALTH TRAINING INITIATIVE (EPHTI) facilitated the task for Jimma University to write the lecture note in consultation with the Health Extension Coordinating Office of the Federal Ministry of Health.

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CHAPTER ONE

General Principles

1-1 Introduction

Humans have always had their trouble with insects. When humans first emerged they already had fleas, lice, mosquitoes and flies. The problem at that time, however, was not significant because people were lining in a scattered way. The attention of people was focused on getting food and protecting themselves from predatory animals. Insects were probably of great help because termites, grasshoppers, grubs and the like could be found and eaten when other foods were not available.

Today, with increased population growth, urbanization and climate change, favorable conditions have emerged for the emergence of more hostile insect pests that hamper human health and development.

Many of the communicable diseases in most developing countries are due to insect vectors. Malaria, trachoma, blindness, Leishmaniasis, Diarrhea, trypanosomiasis, Typhus, leptospirosis, skin infections etc all are transmitted by insects.

Vector borne diseases are still major health problems in Ethiopia, both among urban and rural societies. Our rural people still lack the awareness to protect themselves from the vector borne diseases. The major aim of this lecture note is therefore, to guide the teachers of health extension package the practical and theoretical aspects of vector control so that health extension workers will apply it in the community to solve the problem.

1-2 Learning Objectives

General instructional objectives

The general objective of this lecture is to equip the learner with knowledge and skills to identify common vectors of disease, learn common methods of vector borne disease transmission and apply control methods by involving the community.

Specific Objectives

At the end of this lecture, the student will be able to:

1. Define a vector and explain its association with human health.
2. Discuss the advantages and disadvantages of insects,
3. Identify the common disease vectors, their mode of disease transmission and common control methods
4. Explain common rodent types, their association to human economy and health and apply control methods
5. Differentiate some of the most common biting and stinging animals
6. Explain about the safe use of insecticides and educate the public about its use.

1-3 Definitions

A vector is defined as " the vehicle or means of transportation by which an infectious agent is transferred from an infected person or animal to a susceptible host" Based on this definition vectors may be animate (living) or inanimate (non living) things.

The living vectors are further divided into:

1. **Invertebrates** – those without backbones, which transmit infection by inoculation into or through the skin or mucus membrane by biting or depositing of infective materials on the skin, or on food or other objects. Insects belong to this group.

2. **Vertebrates** – those with backbone such as rodents, dogs, birds which are generally called zoonotic vectors and transmit what are normally animal diseases to man.

An Insect is an arthropod with 3 pairs of legs. It belongs to the phylum arthropoda and the class insecta.

1-4 Advantages and Disadvantages

Insects are both advantageous and disadvantageous to humans. We need them in our life for various reasons. Here are some of the advantages and disadvantages.

Advantages

1. They help to maintain balanced insect population – Insects eat other insects. This is called predation. Predation and parasitism helps to check insect population.
2. Insects attack plant weeds
3. They are involved in pollination of flowering plants
4. They produce honey and beeswax (Bees)
5. Insects are involved in the production of useful products such as honey, beeswax, silk, shellac, dyes, and drugs.
6. Some insects are delicious food to humans
7. They are good laboratory animals in the study of human diseases
8. They are good decomposers and hence increase the fertility of the soil.

Disadvantages

- They are nuisance to humans
- They are involved in mechanical and biological disease transmission.

- They attack crop and cause economic damage
- They destroy furniture and household appliances
- Some people have phobia to insects and are psychologically affected by them

CHAPTER TWO

Common Insect And Arachnid Vectors Of Disease And Their Control Methods

2.1. Sucking Lice (Anoplura)

Lice are one of those insects closely associated with man. They are found worldwide, and are responsible for earlier epidemics that have swept all over the face of the earth. Louse borne diseases were and still are serious problem that occur commonly among troops and the general public at large.

The body and head lice are only forms of one species and cannot be distinguished at sight from one another except by their habits. However in the Ethiopian societies; these two similar species can be differentiated by color without laboratory aids. Since the hair of Ethiopians is practically black, the head louse has adapted to it and has developed shades of black color. [The body louse usually hides itself under the seams and folds of cloths and hence it is most of the time kept away from sunshine and so it lives relatively in a hidden environment between the body of the host and clothes]. Therefore the body louse tends to have rather whitish color, probably it is trying to match its immediate surrounding, the body of the host and the white garments.

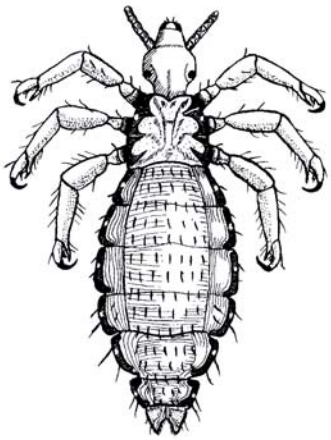

Fig. 1 a body lice

The most common types of human lice are the body louse, the head louse and the crab louse. See figure 2.

i) The Body Louse *(Pediculus humanus corporis)*

The body louse usually stays on the clothing and makes contact with the body while feeding. It has a very suitable private environment, which its host has created for it.

In heavy infestations some lice may remain on the body after all clothing has been removed. Eggs are deposited by preference in the seams of clothing.

- Eggs hatch within 7 days; it is longer at lower temperatures and eggs do not hatch above 38^0C or below 13^0c.

- The young lice are similar to the adult and immediately starts to suck blood. (Both male and female lice feed day and night)
- The newly emerging young fly (maggot) molts 3 times at intervals of 3 days and maturity is reached within 16-18 days after oviposition.
- Life span is 30-40 days.
- Adults start ovipositing within 1 or 2 days. Unfed lice soon die.
- The optimum temperature for adults is that of the temperature of the human body. Temperatures below the optimum are much less critical.

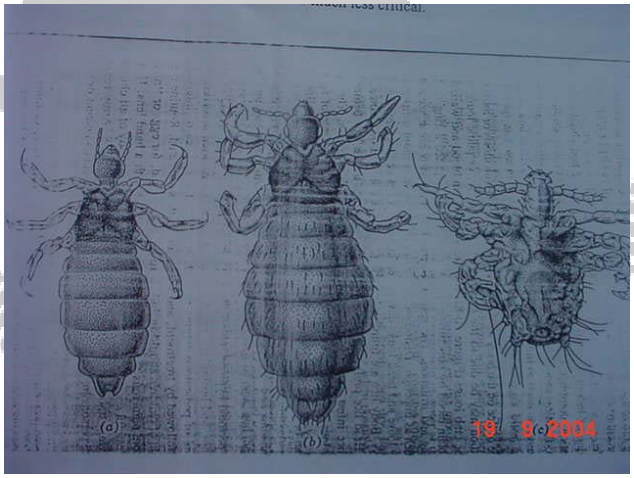

Fig. 2 Types of louse. (a) the head louse, (b) the body louse and (c) the crab louse

ii) The head louse

It tends to resemble the color of the hair of the host. In severe infestations the hair may become matted with eggs (NITS)

The number of eggs deposited by the female ranges from 50-150. These are glued to the hair and hatch in 5-10 days. The life cycle from egg to egg is 3 weeks.

iii) The crab louse

The crab louse mainly infests the pubic regions and may be found on the hairy regions of the chest, the armpits, the eyebrows, and eye lashes in cases of serious infestations. Crab lice are mainly spread through sexual or other close personal contact and are most common in young, sexually active population groups.

In general lice infestation (pediculosis) is common during times of natural and man-made disasters like famine, flooding: earth quake, tornado, fire war, imprisonment etc.

Dissemination of Lice

Some of the methods of transfer of lice are: -

- Close contact with a lousy person
- Infested bed and beddings
- Infested comb and brushes
- Sexual contact (crab louse)
- Infested toilet seats

Disease Transmission by Lice

i) Epidemic typhus (classical, louse borne typhus)

This is one of the groups of ricketical diseases (R. prowazeki), which occur only in man. This is a highly fatal disease, which kills more than 50% of its victims in epidemic situations.

Both the victim (man) and the vector (louse) die from the disease.

The louse acquires the parasites by way of the blood meal. The rickettsiae multiply enormously in the epithelial cells of he mid gut of the louse: these cells become so distended after a few days that they rupture and release enormous numbers of rickettsiae into the lumen of the digestive tract; these then appear in the lice feces. The feces plus the typhus rickttisiae are deposited upon the skin of man and clothes usually when the lice feed. Through cuts, bites, and abrasions on the human skin the typhus rickettsiae penetrate deep into the body and the host becomes infected.

Crushing of louse between the thumbs and then scratching the body with contaminated fingers, which is the custom of our community aids the transmission of Typhus. Rickttsiae do not occur in the salivary glands, that is why its bite doesn't spread the disease.

ii) Relapsing fever

Epidemics of louse borne relapsing fever occur when the normal order of the society is upset by stress, and catastrophes as a result of

war, famine, etc. Fatality of the disease depends on the standard of living of the community.

The Spirochetes- *Borrelia recurentis* do not invade the gonads salivary glands or malpighian tubes and are not found in feces. Only crushing the louse or damaging it in some way to allow the spirochetes in the louse to contaminate skin or mucous membrane of a human being acquires the disease. The disease is transmitted to human neither by bite of the louse nor by its feces. It is transmitted by when the life. It is transmitted by when the life led louse is crashed between the fingernails and the organs are released and enter the body through the abragres.

iii) Trench fever

It is a nonfatal rickettsial disease characterized in overt cases by sudden onset of fever, head aches, dizziness, pain in the muscles and bones, particularly in the legs with special tenderness in the shin and lasting 24 to 48 hrs or more followed at intervals of 5 days by other attacks of fever of diminishing severity.

Control of lice

Lice control is not difficult, provided that people will practice the necessary measures. Even if the body louse, the head louse and the crab louse have different habits, methods of control applied to one may more or less affect the others

It is of little value to delouse a person and permit him/her to return to a house to become re- infested immediately. The entire family, beddings and clothes must be deloused. Clothes, especially underwear should be washed and ironed at least once in a week. The heat of the iron kills all stages, of lice. The cloths, which have been worn during the day, should not be worn at night. A person with two suits should wear them on alternate days. In addition every one has to: -

- Take hot or cold bath as often as possible
- Shaving, cutting hair short
- Boiling clothes
- Apply DDT powder-10% DDT powder into all hairy parts of the body and to clothing
- Personal and communal hygiene

2.2 Fleas- (Siphonaptera)

Fleas are the vehicles of infection among rodents and humans. About a thousand different species of fleas are studied and described. Those that carry diseases are great concern to the public health personnel.

Fleas live upon the blood of humans, birds and other mammals.
Fleas have preferred animal hosts, for instance cats, dogs, rat, hens, bats, rabbits, moles etc., are host to specific fleas. However at times of unavailability of preferred host, the fleas jump to whomever they find in their vicinity. They have to do this in order to secure blood meals. Both sexes feed on blood. They possess the piercing sucking type of mouth parts.

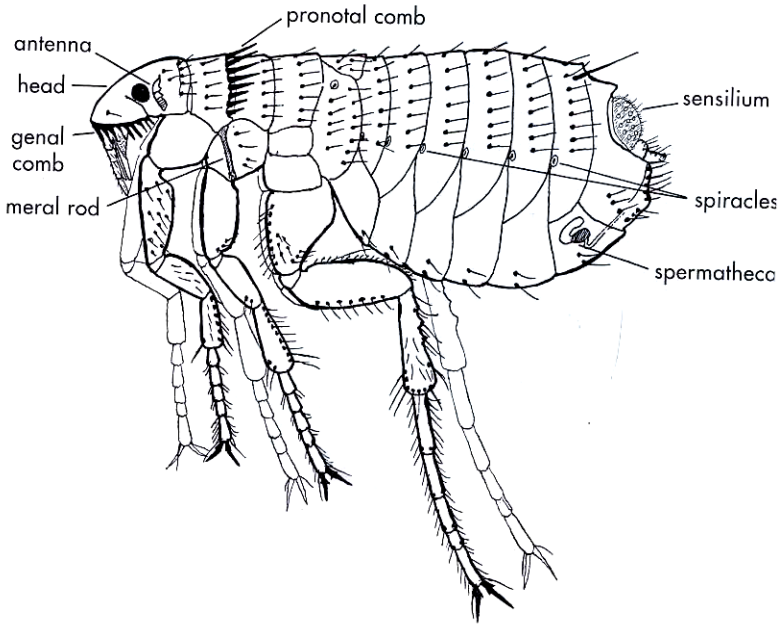

Figure 3. A flea

Adult fleas are good jumpers. It has been known that fleas jump 7-8 inches vertically and 14-16 inches horizontally. These high and broad jumps is attributed to the shape of the flea body, which is flattened from side to side, and the sturdy long legs.

Fleas pass through complete metamorphosis. Eggs are usually deposited on the host's hairs, feather, and nests. Depending upon food and climatical factors, the eggs change to the adult hood in about 2-21 days. Temperatures of 18-27^{0}C confined with a humidity of 70% or higher appear to favor egg laying.

The larva feed on organic wastes, animal droppings, animal hairs, human food crumbs etc are typical food sources. They are found in floor cracks, rugs, all types of animal nests and others. Larvae of several species will readily eat flea eggs of adequate protienateus nutrients and this may serve as insect population regulating mechanism. Under favorable conditions the larval period may be 9-15 days

The pupae are kept inside a cocoon and can stay in that form as short as a week or as long as a year in houses, which have been empty for a considerable period. The matured cocoons are triggered to emerge by vibrations, which indicate the presence of possible host nearly.

The human flea, the dog flea, the cat flea, the rat flea, the chicken flea, and others are ordinarily found in the proximity of human habitats.

The jigger flea is a pest in the tropical and subtropical areas of the world. The adult female jigger flea has a peculiar habit of burrowing in to the skin of the host, head first. Its favorite sites of boring on man are the lower extremities and thus producing deformity of the feet. Both the males and females feed on blood. The development of eggs inside the female greatly swells her abdomen. The eggs are dropped through the tiny hole she has made in entering the host, and fall one

by one on dusty earthen floors and fire places where there is plenty of cold ash. The eggs that have fallen to the ground, hatch and proceed to form the adults.

In the lowlands of rural Ethiopia, jigger fleas are common, and their problems of entering into the skin of humans cause inflammation, and pain, and ultimately deformity of the feet, tetanus, gangrene, amputation.

Disease transmitted by fleas.

i) Bubonic plague

In case of bubonic plague, the fleas of infected rats, in sucking the blood take in plague bacilli into their system. The bacilli multiply in the flea's gullets and block them.

Though the organisms in the throat choke them, and yet the fleas repeatedly endeavor to suck blood from the host. A certain amount of blood is drawn in, but it cannot pass into the stomach. The drawn blood mixes with the blocking gullet and at the same time regurgitating into the host and hence some of the bacilli are transferred to the hosts body and infection starts. Plague is essentially a disease of rodents transmitted by rodent fleas, but it may under certain conditions cause serious outbreaks among humans.

ii) Murine typhus (endemic flea-borne typhus)

The disease is not communicable directly from man to man it is transmitted from an infected rat to the flea through blood meals and humans get it by the feces and crushed fleas, contaminating abraded skin and at the site of flea bites.

Fleas serve as intermediate hosts for several species of tapeworms that occasionally catch them. The eggs of the tapeworms are ingested by flea larvae along with dog droppings, and when accidentally or with flea-contaminated food is swallowed infestation of dwarf tapeworm occurs.

Control of fleas

Flea control is a little bit challenging. It involves the control of a wide range of flea reservoirs including household pets. Here are some of the methods to control fleas.

1. Take care of their hosts

- Avoid rats from the residential environment by application of rat control methods.
- Keep Dogs clean and avoid stray dogs
- Keep cats clean by regular washing and combing, or otherwise don't allow cats to live with you.

2. Treat the fur of pets with proper dose of insecticides.
(Consult an expert before doing it)

3. Attack fleas

- 10% DDT dust
- 5% DDT oil sol

4. House and compound sanitation- Because flea larvae feed on debris found at ground level, beneath old carpets, or in floor cracks, keeping such debris to a minimum indoors helps to reduce their numbers.

5. **Application of domestic and personal hygiene**
6. **Health education**

2.3. Bed Bugs (Cimicidae)

Bed bugs are reddish-brow, wingless insects. Their wings have been reduced to inconspicuous pads. The bodies are broad and flat enabling them to creep into narrow crevices. Their mouth parts are piercing sucking type; the thoracic scent glands produce a characteristic odor. They gain access to the house in traveling bags, on laundry clothes, furniture and person-to-person contacts in buses or at home. Infestation in public places such as theatres, offices, hotels, etc, is usually due to low personal and community hygiene.

Bed bug infestation at home may be detected by

1. Their bite,
2. Their characteristic buggy odor
3. Blood and fecal stains on sheets, along cracks in the wall etc..

Bed bugs are nocturnal in their feeding habits, hiding in crevices during the day.

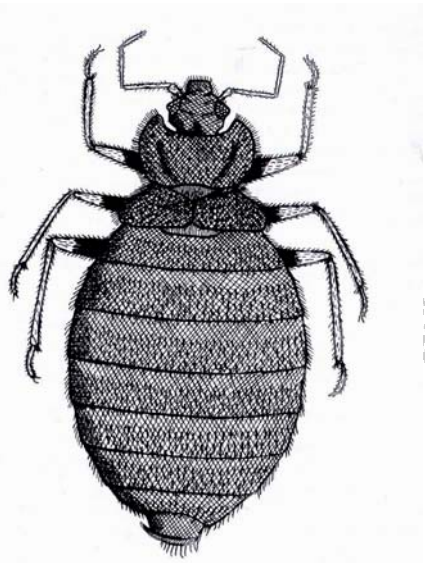

Fig.4 a Bedbug

Breeding places for bedbugs are:-

Wooden bedstead, seams in mattresses, furniture cracks in plastered wall, nails holes etc. Bad bugs pass through gradual metamorphosis.

Both sexes of bed bugs feed on mammal's blood; particularly man but may survive for a long time without food. These pests have not yet been proven to be important bearers of disease organisms. However their habit of feeding together with the isolation of pathogens in their body in the laboratory makes them risky vectors.

Control of bed bugs

- Search for all the crevices
    - Plaster
    - Use hot water to kill bed bugs
- Search for all furniture and bedding
    - Place infested bedding and clothing in sunlight (ventilate)
    - Repair / Maintain furniture
    - Apply hot water repeatedly (for 10 days)
- Apply insecticides
    - Keep all premises in good repair and condition before applying insecticides. Many liquid insecticides and dusts are effective in killing bedbugs. Malathion, pyrethrum and ronnel sprays are some of the insecticides commonly available
- Check for furniture infestation before transferring from house to house.

2.4. The black flies- <u>Simullidae</u>

The species of simulium are small and black, though some of them may be gray or even pre-dominatly tannish yellow. The mouthparts include blade like piercing stylets in the female but reduced in the male. A prominent hump is produced on the thorax.

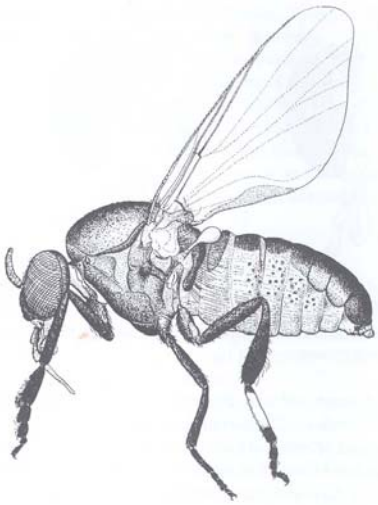

Fig 5. A black fly

The stages of development of black flies are the same as in mosquitoes (complete metamorphosis), demanding the existence of water for the eggs, larva and pupa. Eggs cling to aquatic and emergent vegetation. They are also found attached to the sides of canals in irrigation schemes, concrete dams, and on aquatic animals. They feed on small aquatic organic matter like protozoa, bacteria, algae, fungal spores, pollen etc. Life cycle ranges from 60 days to 15 weeks or over.

The most important species in Africa are:-

S- damnosum

S- naevei

Both of them appear to like rapidly flowing rivers and streams with many cascades and water falls. In additions *S. naevie* likes streams

deeply shaded by forest. The pupae are contained in cocoons, which are fastened to a rock and do not swim about.

The females have particularly irritating bite, but the m ales do not bite. The females bite by the day especially in shady places near rivers and streams. Black flies have a very considerable flight range. They can cover a distance of 50 miles at ease. Biting extends to horses, cattle, and other animals besides man.

The bite of black flies can result in:

- Local reactions – reddened itching wheals
- Generalized conditions
- Black fly fever – The signs and symptoms for a black fly fever include:
    - Headache
    - Fever
    - Nausea
    - Adenitis
- Dermatitis
- Allergic asthma

The most important disease transmission by black flies is **Onchocerciasis.** It is also called river blindness. Onchocerciasis is a dangerous disease of tropical Africa with blindening, visceral

involvement and fatal effects and other disorders. The cause of this disease is a filarial nematode *O.volvulus.*

Onchocerciasis is reported in southwestern part of Ethiopia. Endemic foci probably are centered around Jimma, Bonga, Shebe, Gore, Lekemte and Gardulla. A person with onchocerciasis may show subcutaneous nodules or tumors, skin eruptions, and blindness

Control of black flies

1. **Damming** – damming of streams to slow down the flow of water and reduce the dissolving rate of Oxygen will kill both the larvae and the pupa.
2. **Clearing of vegetation along the river coast**
3. **Personal protection measures against the bite of black flies**
    - Repellents
    - Bed nets
    - Protective clothing
4. **Chemical control**
    a) Larviciding – an emulsion of DDT into the infested rivers and streams. Two parts of DDT per million parts water are sufficient under suitable conditions to kill the larvae and pupae for at least a distance of 15 miles downstream.

However it is impractical for large rivers. Oils can also be used as larvicides.

b) Adulticiding – spraying of benzene hexachloride (BHC) on vegetation and around river banks

5. **Proper sitting of residential or settlement areas (away form river banks)**

2.5. Mosquitoes- Cullicidae

There are 31000 species of mosquitoes belonging to 34 genera arranged in three subfamilies namely:

- Toxorhynchitinae
- Anophelinae
- Cullicinae

The most important man biting mosquitoes belong to the genera anopheles

Distribution

Mosquitoes have a worldwide distribution. Some genera have a restricted distribution and may be confined to certain areas of the world.

- Heamagogus and Sabathes are found in only South America
- Others like culex quinquefasciatus and aedes aegipty are widespread in the tropical regions of the world.

The body of the malarial mosquito is divided into head, thorax and abdomen. The head consists of 2 compound eyes, a pair of antennae, a pair of palps and a proboscis. The 6 legs and a pair of wings are located on the thorax. The abdomen has eight segments, the 9^{th} and 10^{th} being modified to form male and female genitalia.

Life history

Mosquitoes have 4 distinct stages in their life history, the egg- larva-pupa and the adult. The first 3 stages are present in water. Therefore the presence of water is essential for the development and existence of all mosquitoes.

The life cycle of mosquitoes is shown in the fig below.

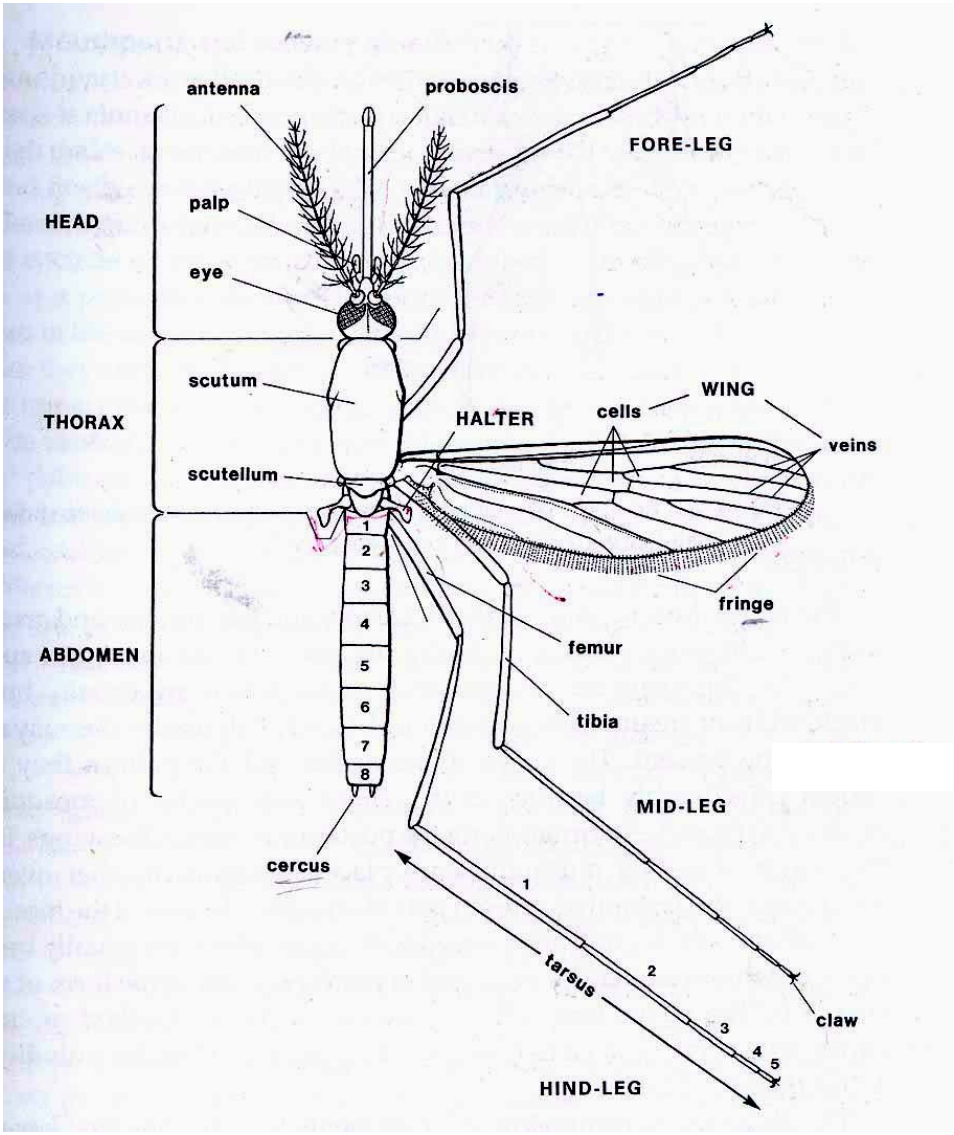

Figure 6. A mosquito

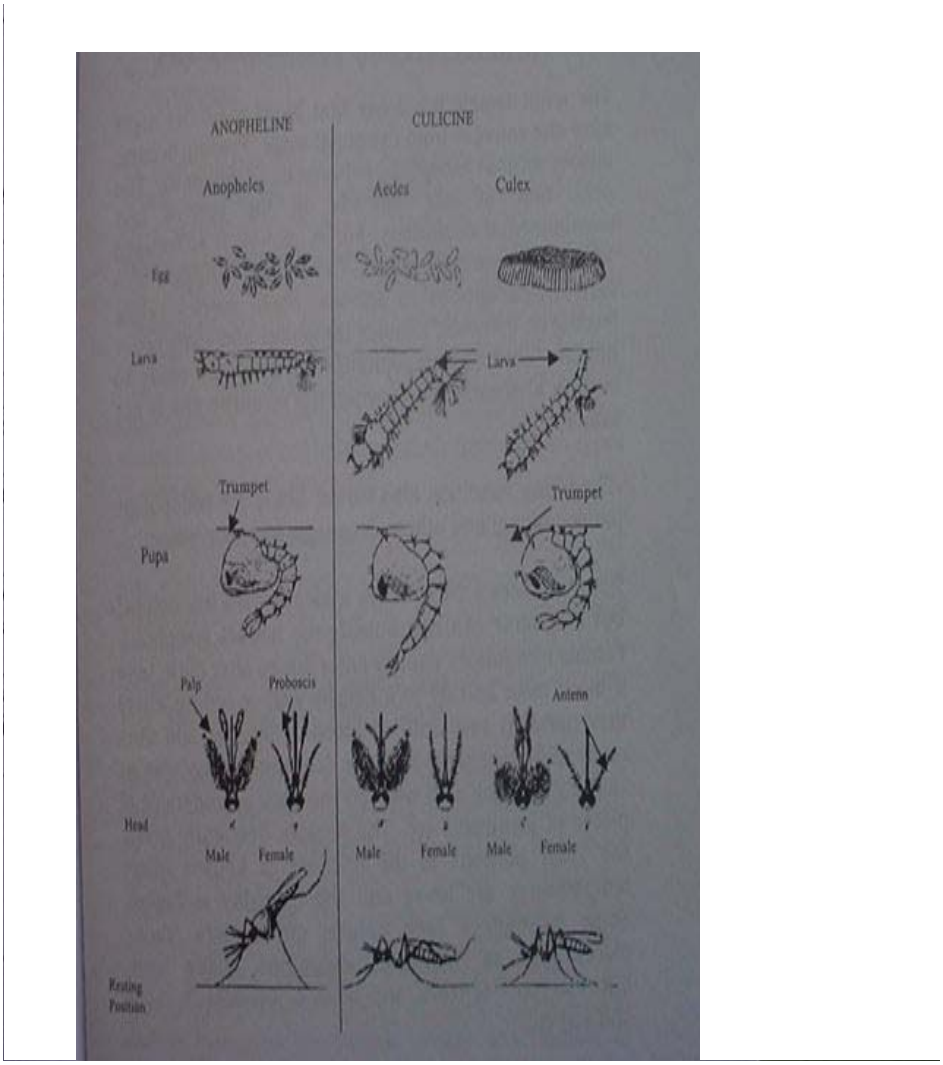

Fig.7 Life cycle of mosquitoes

1. The egg

The fertilized female mosquito lays its eggs in or near water, depending upon the species generally in a situation proper for hatching and capable of providing food for the emerging larvae. The eggs are white when first deposited, changing to dark color within an hour or two. Many eggs, perhaps as many as 100 of them, are deposited at once. Under favorable conditions of temperature eggs hatch in 2-3 days, but may take longer in cold weather. Eggs of all the major groups of mosquitoes are deposited singly (Anopheles and Aedes) or in rafts (culex and culiseta).

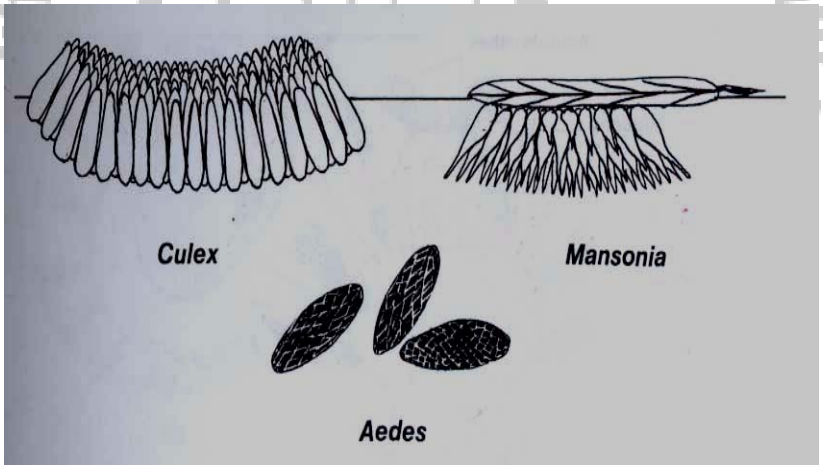

Fig.8 A mosquito egg

2. The larva

The larva on emerging from the egg is an aquatic animal about one millimeter in length. It swims actively in the water in which it is hatched and feeds greedily. Its growth is interrupted by three molts. When fully grown, the larva stops feeding and develops into a pupa.

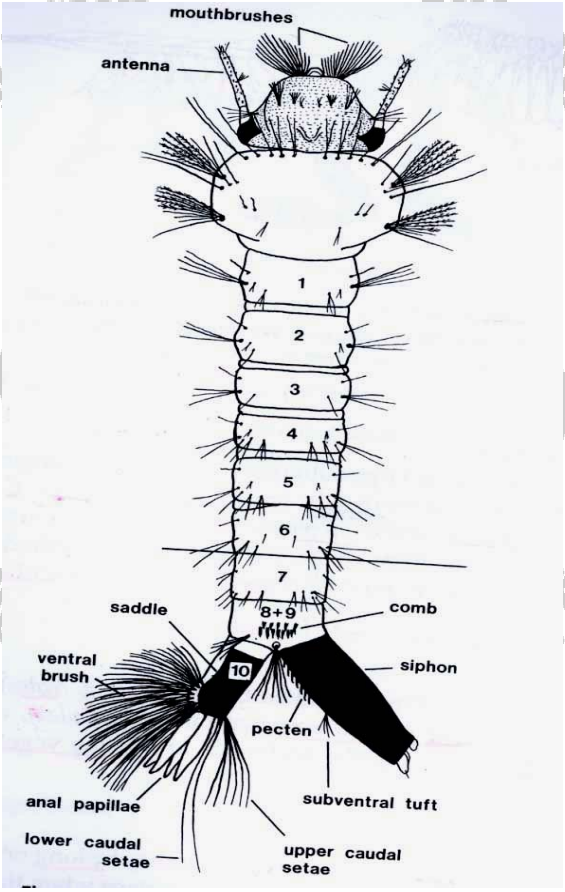

Fig. 9 The larva of a mosquito

3. The pupa

As in other insects takes no food, but unlike other insects it swims actively in the water seeking safety in sheltered positions when disturbed. After a few number of days and depending upon temperature, the pupae becomes immobilized on the surface of the water, its skin splits and liberates the fully matured, perfect adult mosquito.

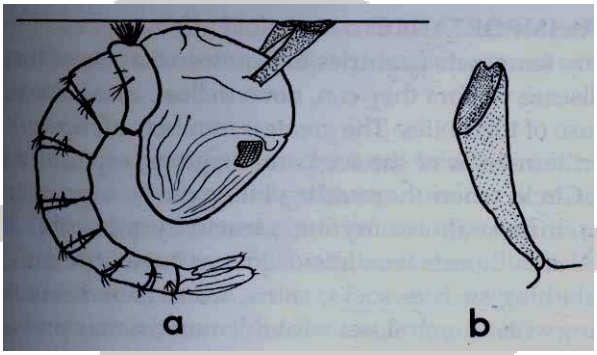

Fig. 10 the pupal stage of a mosquito

4. The Adult

The adult mosquito is a sensitive fragile and small insect 3-6mm length.

Feeding – It is only the female mosquito that bites and takes blood meal. The males feed on nectar

Flight – It is only the female that travels long distances.

Longevity – It is only the female that lives longer.

- Female – 4-5 weeks
- Male – 1week

Host preference – Some species tend to bite only humans. Others bite animals

Resting places - most species are active during the night. During daytime they hide in cool dry places under vegetation, walls, pit latrines, bridges, etc…

DISTINGUISHING ADULT MOSQUITOES FROM OTHER INSECTS

The adult is the easiest stage to identify the life cycle of the mosquito. Fig 6. shows the main parts of the adult mosquito, and you should learn the names of these. The body as in all insects is divided into head, thorax and abdomen.

Three characteristics can be used to distinguish adult mosquitoes from other insects

- There is only one pair of wings
- There is a long proboscis (the tubular mouthparts)
- The body is covered with scales

DISTINGUISHING FEMALE ANOPHELINE MOSQUITOES FROM OTHER MOSQUITOES

When alive, you can distinguish between anopheline mosquitoes by observing their resting postures. Anophelines rest at an angle between 50^0 and 90^0 to the surface whereas culicines rest more or less parallel to the surface. These resting postures are shown in fig. 11.

MEDICAL IMPORTANCE

- Anopheles mosquitoes are vectors of diseases called malaria and filariasis
- Aedes mosquitoes transmit yellow fever and dengue fever
- Cullex mosquitoes transmit filariasis

Now we will look more detail into the most common vector borne disease in Ethiopia called Malaria

Malaria is a serious disease and a significant health problem in most tropical countries. It is caused by a protozoan organism called plasmodium which exists in the blood of people suffering from the disease. These parasites are transmitted from one person to another by the bite of female anopheline mosquitoes.

Global malaria situation

- There are 400 – 500 million cases of malaria which occurs annually
- There are over 2 million deaths annually

- Over 90% of the cases and deaths are registered in sub-Saharan Africa

Ethiopia

- 75% of the land below 2000 meters is malarious
- Over 40 million people are at risk of malaria
- Malaria is among the top leading cause of death and illness
- Greater than 400,000 microscopically confirmed cases are registered annually
- It is estimated that there could be 4-5 million cases every year

The malaria parasite

The parasites that cause malaria belong to the genus plasmodium. Four species of plasmodia can live in the blood of humans and cause malaria. These are:

1. Plasmodium falciparum
2. Plasmodium vivax
3. Plasmodium malariae
4. Plasmodium ovale

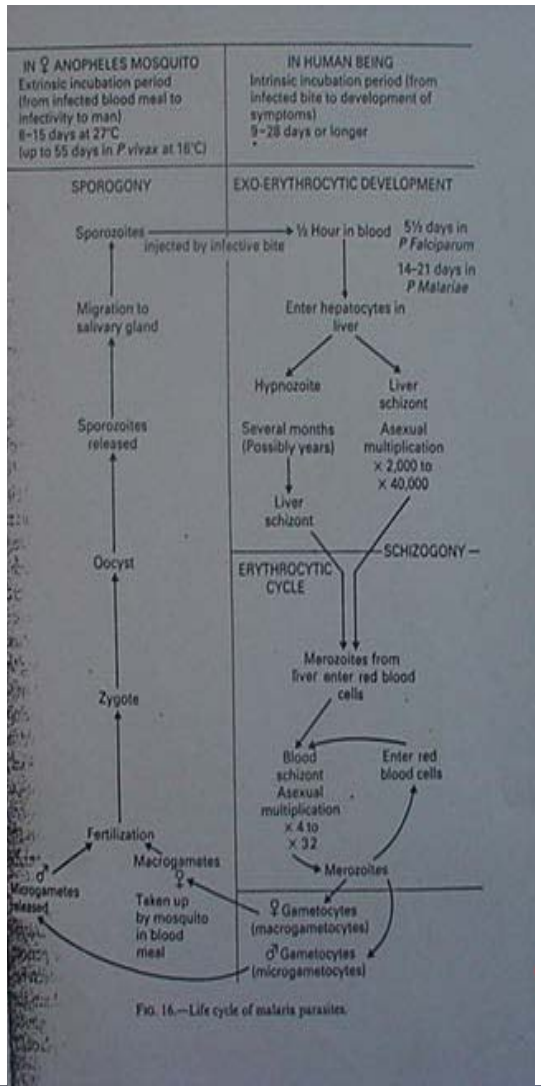

FIG. 16.—Life cycle of malaria parasites.

Fig. 11- Life cycle of malaria

Malaria Control

The control of malaria requires a combination of some or all of the followings

- Chemotherapy and chemoprophylaxis to destroy or prevent the expression of infection in man
- Attacks on the vector, including insecticides against adult mosquitoes
- Larvicides
- Removal or modification of breeding sites
- Biological control against mosquito larvae.

1. Chemoprophylaxis-

Chemoprophylaxis is used to prevent or suppress malaria infection in individuals and groups making temporary visits to malarious areas. Antimalaria tablets are usually taken daily or weekly from arrival in the area until one moth after departure. Travelers should be advised to take the drugs according to the prescription of the medical officer.

2. Actions against the vectors

a. Application of Insecticides

Environmental measures to prevent mosquito breeding are preferable, where practicable, but insecticides play a larger role in mosquito control.

Insecticides may be used for an immediate or knock-down, as external space sprays or most used in malaria control, as residual insecticides on the inner surface of dwellings. Insecticide impregnated bed nets combine a residual insecticide effect with insect repellent and medical barrier action .

In the absence of resistance DDT is the insecticide of choice and this is usually sprayed as water dispersible powder at the rate of 2g/m^2. If mosquitoes are resistant to DDT, the organophosphates malathion and fenithrothion can be used, but they are less persistent and repeated spraying at 3-4 months interval is required. They are also more expensive than DDT.

Use of pyrethroid impregnated benders is also an efficient way of killing mosquitoes. Impregnation can be done every 6 months.

b. Larviciding- should be aimed at breeding places of vector mosquitoes, where these can't be readily be removed or modified to prevent breeding.

- Tempehos (Abate) has a large margin or safety-used at 1% (10g/kg) on sand granules.
- Refined fuel oils, with a spreading agent added can be applied at 19 to 47 1t/ha. (whithout a spreading agent 142-1901/ha)
- Paris green (coper acetoarsenate) 1kg/ha.

3. **Physical methods of preventing mosquito breeding**

a. Drainage

The objective of drainage is to remove water so that mosquito breeding sites will be eliminated or reduced and the value of the land improved or at least in no way lessened. The best type of drain for any particular scheme will depend on local conditions. Some of the types include:

- Surface drains
- Subsoil drains
- Flushing of streams
- Intermittent drying

b. Filling

Where drainage is not feasible it is often possible to eliminate low-lying mosquito breeding areas or small depressions by filling with earth from neighboring higher land.

c. Naturalistic methods of control

These methods initiate natural conditions which limit breeding and involve altering the character of a breeding place in such a way to render it unattractive to the ovipositing mosquito

Examples:

- For mosquitoes, which love heavily shaded breeding place- remove the shade.

- For a species which oviposit in sunlight pools- Grow vegetation around it
- Change the salinity of water by either introducing sea or fresh water.
- For species which oviposit in sun light pools- Grow vegetation around it

Please note that:- Altered conditions which are unfavorable to one species may be attractive to another.

4. **Measures to reduce Man- mosquito contact**

a. Sitting of houses

When choosing where to build houses or erect temporary living quarters, attention should be paid to distance from mosquito breeding places.

Houses should preferably be built

- Up wind of water where mosquitoes breed.
- 0.8-1.6 km away from breeding places

b. Screening

The windows, doors and other openings of houses, hospitals, restaurants and other buildings need be screened with mesh gauze of wire, nylon, polyester or other plastic to exclude mosquitoes.

c. Bed nets

Nowadays Bed nets are becoming more and more popular among the community and are also good barriers of man-mosquito contact. When the bednets are impregnated, ie. treated with insecticides, they provide dual functions.

1. Protect humans from mosquito contact
2. Kill mosquitoes.

However care must be taken to use the impregnated bed nets as the insecticide is poisonous to none target organisms including man.

d. Zooprophylaxis

Where vectors are zoophilic, the presence of cattle or other domestic animals in or near human dwellings may divert vectors away from humans.

e. Protective clothing and repellents

- Clothing- wear long trousers and long sleeved shirts
- Chemical repellents – DEET, DIMP
- Burning of (smoking) – mosquito coils
  - sticks containing pyrethrum

2.6. Houseflies (muscidae)

Carriers of diarrhoeal diseases and skin and eye infections. The common housefly, Musca domestica, lives in close association with people all over the world. The insects feed on human foodstuffs and wastes where they can pick up and transport various disease agents. In addition to the housefly, a number of other fly species have adapted to live in human settlements, where they present similar problems. In warmer climates, the filth fly, M. sorbens is of particular interest in this regard. It is closely related to the housefly and considered important in the spread of eye infections. Blowflies (Calliphoridae) and other flies have been associated with the transmission of enteric infections.

Biology

Life cycle

There are four distanct stages in the life of a fly: egg, larva or maggot, pupa and adult (Fig.13) Depending on the temperature, it takes from 6 to 42 days for the egg to develop into the adult fly. The length of life is usually 2-3 weeks but in cooler conditions it may be as long as three months.

Eggs are usually laid in masses on organic material such as manure and garbage. Hatching occurs within a few hours. The young larvae burrow into the breeding material; they must obtain oxygen from the

atmosphere and can, there fore, survive only where sufficient fresh air is available. When the breeding medium is very wet they can live on its surface only, where as in drier materials they may penetrate to a depth of several centimeters.

The larva of most species are slender, white, legless maggots that develop rapidly, taking time from a minimum of three days to several weeks, depending on the species the temperature type and quantity of food available. After the feeding stage is complete the larvae migrate to a drier place and burrow into the soil or hide under objects offering protection. They form a capsule-like case, the puparium, within which the transformation from larva to adult takes place. This usually takes 2-10 days. At the end of which the fly pushes open the top of the case and walks its way out and up to the surface. Soon after emergence the fly spreads its wings and the body dries and hardens. The adult fly is grey, 6-9 mm long and has four dark stripes running lengthwise on the back. A few days elapse before the adult is capable of reproduction. Under natural conditions an adult female rarely lays eggs more than five times, and seldom lays more than 120-130 eggs on each occasion.

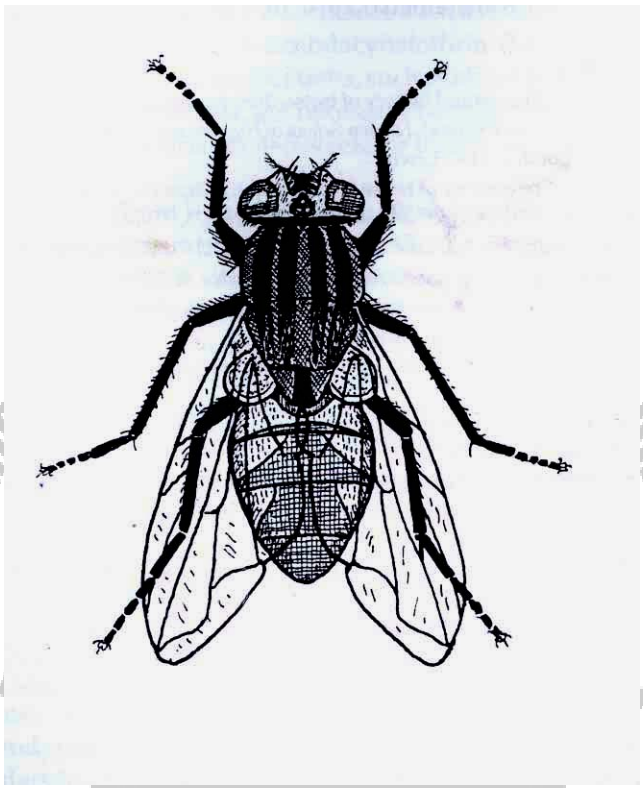

Fig. 12 The housefly (Musca domestica)

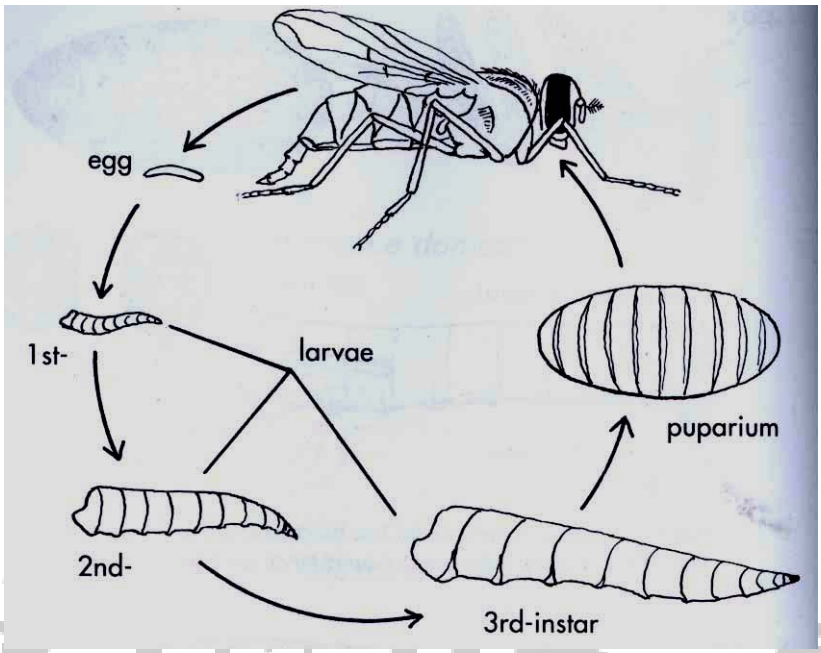

Fig.13 The life cycle of a fly

Feeding habits

Both male and female flies feed on all kinds of human food, garbage and excreta, including sweet, and on animal dung. Under natural conditions flies seek a wide variety of food substances. Because of the structure of their mouthparts, food must be either in the liquid state or readily soluble in the salivary gland secretions or in the crop. Liquid food is sucked up and solid food is wetted with saliva, to be dissolved before ingestion. Water is an essential part of a fly's diet

and flies do not ordinarily live more than 48 hours without access to it. Other common sources of food are milk, sugar, syrup

Blood, meat broth and many other materials found in human settlements. The flies evidently need to feed at least two or three times a day.

Breeding sites

Female flies deposit their eggs on decayed, fermenting or rotting organic material of either animal or vegetable origin. Unlike blowflies and fleshflies, houseflies rarely breed in meat or carrion.

Dung

Heaps of accumulated animal faeces are among the most important breeding sites for houseflies. The suitability of dung for breeding depends on its moisture (not too wet), texture not too solid) and freshness (normally within a week after deposition)

Garbage and waste from food processing

Garbage provides the main medium for breeding (Fig. 11) It includes waste associated with the preparation, cooking and serving of food at home and in public places, and with the handling, storage and sale of food, including fruits and vegetables, in markets.

Fig. 14 Garbage is a breeding site for flies

Organic manure

Fields that have high organic matter such as dung, excrement, garbage and fish-meal may provide suitable breeding places for flies. Garbage is the main medium for fly breeding in urban areas.

Sewage

Houseflies also breed in sewage sludge and solid organic waste in open drains, cesspools (underground pools for household sewage) and cesspits.

Accumulated plant materials

An understanding of the ecology of flies helps to explain their roles as carriers of disease and allows the planning of control measures. Adult flies are mainly active during the day when they feed and mate. At

night they normally rest, although they adapt to some extent to artificial light.

Resting places

During the daytime, when not actively feeding, flies may be found resting on floors, walls, ceilings and other interior surfaces as well as out doors on the ground, fences, walls, steps, simple pit latrines, garbage cans, clothes lines, grasses and weeks.

At night, flies are normally inactive, Their favorite resting places at this time are ceilings and other overhead structures. When temperatures remain high during the night, houseflies frequently rest out of doors on fences, clothes lines, electric wires, cords, weeds, grades, hedges, bushes and trees. These resting places are generally near favored daytime feeding and breeding areas and sheltered from the wind. They are usually above ground level, but rarely more than five meters high.

Fluctuations in fly numbers

Fly numbers in a given locality vary with availability of breeding places, sunshine hours, temperature and humidity. Fly densities are highest at mean temperatures of 20-25^{0}c; they decrease at temperatures above and below this range and become undetectable at temperature above 45^0 C and below 10 ^{0}C : At very low

temperatures, the species can stay alive in a dormant state in the adult or pupa stage.

Behavior and distribution

During the day, flies are mainly gathered on or around feeding and breeding places, where mating and resting also take place. Their distribution is greatly influenced by their reactions to light, temperature, humidity, and surface colour and texture. The preferred temperature for resting is between 35^0c and 40^0c Ovipostion, mating, feeding and flying all stop at temperatures below 15^0c.

Flies are most active at low air humidities. At high temperatures (above 20^c), most houseflies spend the time outdoors or in covered areas near the open air.

Fig.15 – The food market and flies.

(During the day adult flies can be found in large numbers on food tables, garbage and the ground)

When not eating, flies rest on horizontal surfaces and on hanging wires and vertically suspended articles and ceilings indoors, especially at night. A detailed study of local resting places is essential for successful control.

Public health importance

Nuisance

In large numbers flies can be an important nuisance by disturbing people during work and at leisure. Flies soil the inside and outside of houses with their faeces. They can also have a negative psychological impact because their presence is considered as a sign of unhygienic conditions.

Diseases

Flies can spread diseases because they feed freely on human food and filthy matter. The fly picks up disease- causing organisms while crawling and feeding. Those that stick to the outside surfaces of the fly may survive for only a few hours, but those that are ingested with the food may survive in the fly's crop or gut for several days. Transmission takes place when the fly makes contact with people or their food Most of the diseases can also be contracted more directly through contaminated food, water, air hands and person-to person contact.

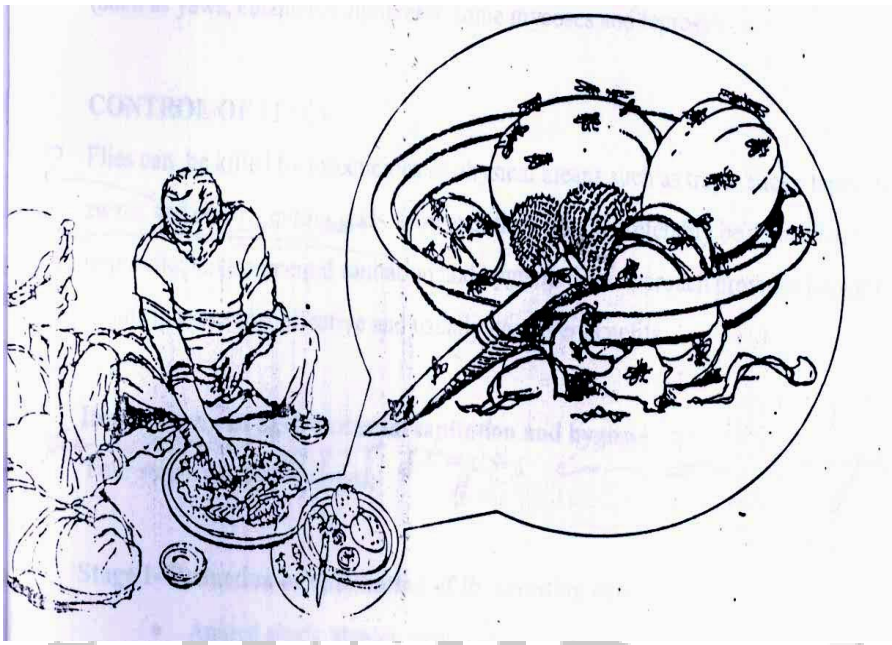

Fig 16 - Humans can be infected by eating food contaminated by flies.

Fig.17 People who keep cattle are usually surrounded by large numbers of filth files (musca sorbens) which are important vectors of certain eye infections.

The diseases that flies can transmit include enteric infections (such as dysentery, diarrhoea, typhoid, cholera and certain helminth infections), eye infections (such as trachoma and epidemic conjunctivitis) poliomyelitis and certain skin infections (such as yaws, cutaneous diphtheria, some mycoses and leprosy).

Control of flies

Flies can be killed by insecticides or physical means such as traps, sticky tapes, and fly swats. However they should preferably be controlled by improving environmental sanitation and hygiene. This approach provides longer lasting results in more cost effective and usually has other benefits.

Four Stages in the Improvement of environmental sanitation and hygiene

Stage 1- Reduction or elimination of fly breeding sites

- Animal sheds, stables, pens and feed lots of construct solid concrete floors with drains, clean during and fleyh floor daily.
- Dung heaps- stack it to reduce the surface area of contact with flies and cover it with plastic sheets.
- Human excreta- do not defeacate in the open fold or durt are latrines which are already filled, use ventilated unproved pit latrines.
- Use appropriate containers until they are picked to be disposed.

Stage 2- Reduction of sources that attract flies from other areas.

Manage odour emanating breeding sites such as fish and bone meals, molasses and malt from breweries, Milk and ripe fruits etc.

Stage 3. Prevention of contact between flies and disease causing germs.

The sources of germs include:-

- Human and animal excrement
- Garbage and sewage
- Infected eyes and wounds

Measures to eliminate fly breeding also reduce contact between fly's germs.

Stage 4. Protection of food, eating utensils, and people from contact with flies.

- Put food and utensils in fly proof containers
- Use nets and screens on widows and other openings
- Doors – anti-fly curtains
- Use electric fans.

2.7. Tsetse flies (Glossinidae)

The different species of tsetse flies occur in West, central, East and South Africa. They live both in dry and wet savannah regions. Their breeding sites and habitats are located close to rivers, streams and other bodies of water, mostly in trees, bushes, and scrub, where cattle rest or pass by.

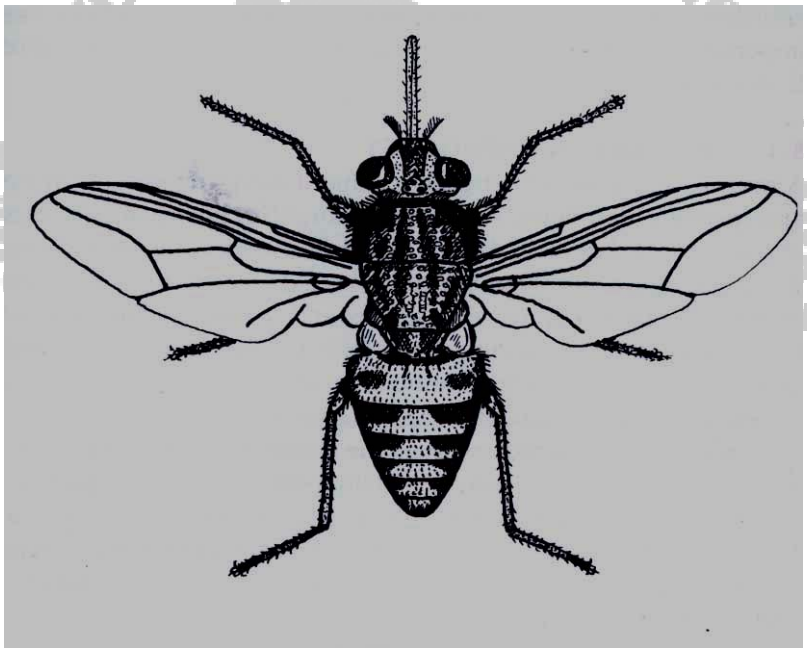

Fig.18. A Tsetse fly

Reproduction in tsetse flies is of particular form known as adenotrophic viviparity, because the eggs contain enough yolk for the

embryo to complete its development and the larva is nourished in the uterus by nutrients derived from the mother. Larval development is completed in the uterus and the fully developed third instar larvae are then deposited by the mother, burrow into the soil and pupate close to the surface

Tsetse flies transmit the causal organisms of sleeping sickness *(trypanosoma stpecies)* to man and of nagana disease to cattle. Antelopes and other wild animals are reservoirs of the trypanosomes. The disease called trypanosomiasis is transmitted to humans and cattle by the bite of a tsetse fly.

Control of tsetse flies

Control of tsetse flies is conducted during the dry period. It is mainly targeted at the adults. Some of the major control methods include:

1. Destruction of animal reservoirs like antelopes and other wild animals (an out dated strategy)
2. Clearing away vegetation near rivers and lake shores (still there is an ecological and economical question about this method)
3. Application of insecticides – There is a very less problem of resistance about the use of insecticides in tsetse fly control. However, there is no doubt that the large scale aerial application of insecticides disrupts the local fauna. no problem

4. Use of targets and traps – This method is considered as an effective and environmentally friendly method. It is aimed at screening and trapping tsetse flies.

2.8. Ticks

There are two quite different types of ticks, the *Argasidae* or soft ticks and the *Ixodidae* or the hard ticks. Ticks, mites, spiders, and scorpions belong to the class arachnida.

Ticks may be distinguished by their specific anatomical characteristics. A large number of hard and soft tick species are of worldwide importance as vectors of a broad spectrum of pathogenic viruses, rickettsiae, bacteria, spirochaets and protozoa, which they transmits during their parasitic phase to man and domestic animals.

Fig. 19 A hard tick

Control of ticks

1. Removal of ticks from their animal hosts
2. Application of Vaseline, medicinal paraffin or nail varnish on the skin of humans and animals
3. Application of chloroform, ether or benzene or other anesthetic on the skin of animals facilitates their removal
4. Application of other accaricides such as 5% malathion, 0.1% dichlorvos (DDVP) or 1% carbaryl

2.9. Other stinging animals

10 – 1 Spiders

Fig. 20 A spider

There are many types of spiders that live all over the earth in every type of habitat. 30 000 species of venomous spiders, but luckily for humans only 200 species have fangs long and strong enough to penetrate the human skin. Most spiders live for about a year, but the tarantula can live for fifteen years. Young spiders are cannibals (they will eat each other) and females often eat males after mating. Spiders are carnivorous (meat eaters). Most eat insects. Spiders produce silk in abdominal glands. They use silk to make webs and traps, shelter lifelines.

Because spiders are predators, they have poison gland and are capable of biting, but the vast majority is not health risk to humans. Spider bite accounts for not more than 200 deaths a year worldwide. The fangs of spiders inject substances to subdue and digest prey, the juice of which is then sucked into the stomach by the spider

Of all venomous spiders, the most known are tarantula, and black widow spiders. They do not bite unless they are severely provoked. Those in greatest risk from the bite are children or the elderly, particularly those with high blood pressure or heart diseases. Some symptoms of spider bites are; pain in the affected part or extremity, muscle cramps, sweating is common and patient complains of weakness, pain in the regional lymph nodes, pain in low back thighs, or abdomen.

Treatment

- Bite should be encouraged to bleed freely
- Wash with hot water and soap and treat with antiseptic, (hot water relieves the pain and encourages bleeding from the punctures
- Consult physician or poison control center for advice or assistance

Precautions and control

- Avoid handling spiders
- Conduct a night time reconnaissance with a flashlight around the house or barracks
- When working in potentially spider infested areas, wear gloves and a long sleeved shirt or coat
- Avoid dense vegetation and debris

2.9.2. Scorpions

Scorpions are the oldest terrestrial arthropods. There are 500 species and all are venomous, although only a small number are sufficiently dangerous to be of a problem to humans. All scorpions spend the light hours under a cover or in a burrow. At night they emerge within their individual defended territories and wait ambush prey, which consists of insects, other arthropods, and occasionally small reptiles and young rodents. Scorpions are active only in nighttime low temperatures about 250 ^{0}C. They are inactive and rarely winter months

Body consists of a cephalothorax broadly joined to an elongated abdomen that narrows towards its rear end to form a tail with a segment called the vesicle. The vesicle is equipped with stout sting

Fig. 21 A scorpion

Scorpions are not aggressive towards none prey, and only sting when handled or otherwise molested. When defending themselves, they usually hold the victim with their pincers and sting repeatedly by thrusting the tail over the body and the stinger into the victim's flesh. Obviously a person who has been clasped by a scorpion should quickly remove it to avoid multiple stings. Children and older people, especially those with respiratory problems and heart diseases are particularly vulnerable to the venom.

The venom causes a stinging or burning sensation at the injection site, often with very little swelling or inflammation. Extreme pain when the sting site is tapped with finger. Systemic reactions include progressive hyperactivity (restlessness) progressing to convulsions. Roving eye, staggering, slurred speech, excessive sensitivity of skin, abdominal pain and cramps, and respiratory depression may also manifest Scorpion stings. These symptoms usually subside within 48hours; systemic reactions to scorpion stings are rare

Extent of the problem

- Annually millions of scorpion stings occurred world wide, causing tens of thousands of deaths in humans each year
- Between 30 000 and 45 000 cases of scorpion stings are reported annually in Tunisia, causing between 35 and 100 deaths, mostly among children

- In Mediterranean region, South America and Mexico, the scorpion is responsible for more death than the poisonous snakes

Treatment

Any one stung by a scorpion should contact a physician or poison control center for advice and medical intervention. If available, an ice cube may be applied directly to sing site. The victim should remain calm. He / She should never consume alcoholic beverages or take over sedatives

Prevention and control

- Remove rock and debris from areas immediately surrounding homes, barracks
- Wear leather gloves and exercise caution when moving objects in a yard or at campsite
- When camping, invert and shake out sleeping bags, clothes, and other items that have been in contact with ground
- Shake out shoes before putting them on in the morning
- Always wear shoes when walking at night
- Conduct a night reconnaissance of a house or a barrack with camp light
- Apply insecticides at dusk to maximize their effectiveness

2.9.3. Snakes

Snakes have been used in mans worship, magic, entertainment, science, food, sport, medicine, commerce, witchcraft, and war. They have even been used in human torture. They have been the symbol of love, hate, health, disease, sin, death, temptation, etc. Of the more than 3500 species of snakes, approximately 375 are considered sufficiently venomous and dangerous to humans.

Venom is modified saliva. Its primary function is to capture / kill the victim and then it also helps to digest the prey. Some venom is considered as haematoxic, that means that primarily it affects the blood. A hematoxic venom destroys tissue and is very painful. Neurotoxin venoms attack the nervous system and the brain. These may cause almost no pain, but shut down the respiratory system and interfere with heart functions.

The severity of snakebite is dependent on a number of factors:

- Size and type of snake
- The amount venom is injected
- The location of the bite on the body and
- The health of the victim

Snakebites

1. According to the world health organization, (WHO 1995) snakebites are estimated to cause 30 000 deaths in Asia.
2. In Brazil about 20 000 snake bites with case fatality rate of 1.5%
3. In Burkina Faso, there are 7.5 snakebites per 100 000 population in peri urban areas and 69 per 100 000 deaths in more remote areas
4. In USA 45 000 snakebites and the availability of healthcare reduced the number of deaths to 9-19% per year
5. In Australia annual number of snakebites is estimated 300 to 500 with average of 2 deaths

The earliest symptoms directly attribute to the bite are local pain and bleeding from the fang punctures, followed by pain, tenderness, swelling, enlargement of lymph nodes, vomiting, diarrhea.

Prevention

- Wear foot and leg protection
- Provide anti venom
- A person walking in dangerous area at a distance of over half an hours travel from the nearest first aid post should carry an anti venom kit

Treatment

- First aid: The patient should be moved to the nearest medical facility as quickly as possible, avoiding movement of the bitten limb, which should be immobilized with a splint.
- Local incision and suction may introduce infection, damage tissues, and cause persistent bleeding. The vacuum extractor method is of unproved benefit in human patients and could damage soft tissues
- Tourniquets and compression bands can cause gangrene
- Patient being transported to hospital should be laid in their side to prevent aspiration of vomit, and persistent vomiting is treated with chlorpromazine, by intravenous injection

CHAPTER THREE

Rodents And Their Control

3. 1 Taxonomy and characteristics

Rodents are mammals. They belong to:

Class - *Mammalia*,

Order – *Rodentia*

Family – *Muridae* and

Genus - *Ratus*

The most common species are:

R.rattus – known as the roof rat or black rat

R. norvegicus – known as the Norway rat, or brown rat and

Mus musculus – known as the house rat

Look at fig 22 and the table 2 to differentiate these rats.

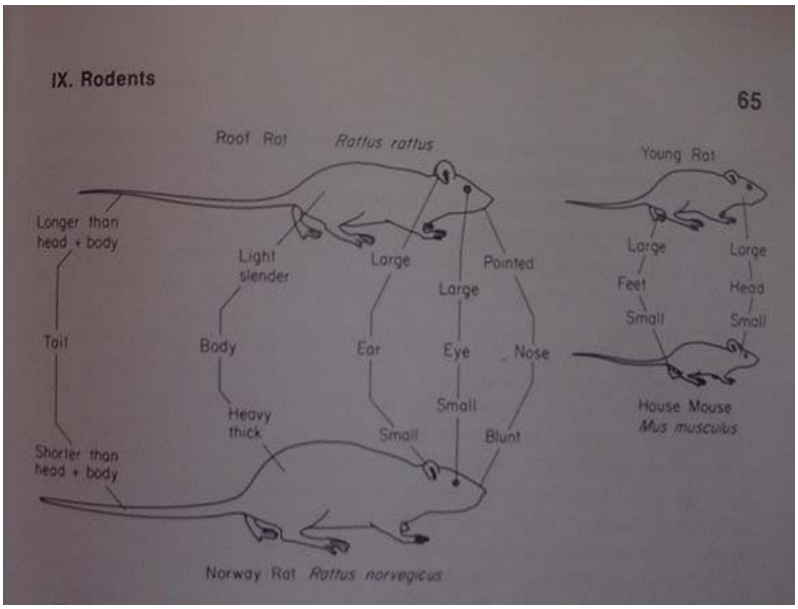

Fig. 22 different types of rats

Table 2. Identification and differentiation of the 3 rodent types

S.No	Character	Norway rat	Roof rat	House mouse
1.	Adult weight	280 – 480 gm	110 – 340 gm	14 –21 gm
2.	Length from nose tip to tail end	325 – 460 mm	350 –450 mm	150 –190 mm
3.	Body	Heavy and stout Slut muzzle	Slender Sharply pointed muzzle	Small Muzzle is very sharp
4.	Tail	Shorter than head plus body Underside light colored	Longer than head plus body Uniformly black	Same as the size of the body Colored– necked
5.	Ears	Small in size Closely set on head	Large and prominent	Large compared with

		Half buried in the fur		the body
6.	Droppings (feces)	Capsule shaped	Spindle shaped	Rod shaped
7.	Sexual maturity	Needs a period of 3-5 months	Same	½ a month
8.	Gestation period	22 days	22 days	19 days
9.	Number of young borne at a time	8 –12	6 –8	5 -6
10.	Number of gestations	4 –7 per year	4 –6 per year	8 per year
11.	Life span	About 1 year	About 1 year	About 1 year
12.	Home range	Not more than 25 – 50 mt	Same	3 –10 mt
13.	Food	Omnivorous	Omnivorous	Omnivorous

S.No	Character	Norway rat	Roof rat	House mouse
14	Habitat (Harborage)	Outdoors Ground burrows under foundations of buildings Open dumps Indoors Between floors and walls in enclosed spaces of furniture, piles of refuse, and in any hidden spaces	Outdoors In trees and bushes Indoors Above ground level in roof area, between walls and enclosed spaces	They make nests and burrows in any convenient spaces on the ground and above ground level

Source: Lecture note of Shiferaw gezahegn, Gondar college of medical sciences.

3.2 Rodents and disease

Rats and mice are most destructive animals. They are responsible for the transmission of such diseases as:

1. Salmonellosis – It is a food poisoning disease that causes diarrhea and dysentery. The disease is spread in several ways, one being the feces of rats containing the infective bacteria
2. Leptospirosis – (Hemorrhagic jaundice) – This disease is transmitted to man by contaminated water supplies with infected urine of rodents. Direct contact with the infected rodents can also produce the disease. The spirochetes may enter through mucous membranes, cuts, and abrasions of the skin.
3. Murine typhus fever – It is transmitted from rat, the reservoir of the disease, to man by the rat flea. The rickettsial organisms that cause murine typhus fever enter the human blood stream when feces of infected fleas are rubbed or scratched into the flea bite wound or broken skin.
4. Plague (Black death) – This is the disease which once killed millions of people in Europe, Asia, and Africa. It is transmitted from rodent to rodent and from rodent to man. The disease is usually fatal to the rat, the flea and man.

5. Trichinosis – The rat serves as a reservoir of the disease. Man gets the disease indirectly by eating raw pig that, in turn, have eaten infected carcasses of rats
6. Rickettsial pox – The infection is transmitted from the house mouse to man by the bite of the mite, which the house mouse harbors. The rickettsial pox is a mild non-fatal diseas, which resembles chickenpox.
7. Rat bites – Rats have a painful bite. It leaves an ugly scar when it heals. Secondary infections are also common after a rat bite. People may develop rate bite fever. Death due to rate bites occurs very rarely.
8. Economic damage – Since rats and mice live everywhere and eat every thing their destructiveness is unlimited.
    - Merchandize in stores and in transits is destroyed by rates and mice
    - Seeds and stored food are heavily destroyed.
    - Furniture, clothing, they will even try to gnaw stones and iron.

3.3 - Rodent control

Controlling rat population is preferable than killing individual rats in a house. The key for a successful rodent control program in a community is to control the rodent population. At any given time each village, farm or mill has a certain capacity to support rats. This

capacity is related to the availability of food, harborage, living space and other vital rodent requirements.

Limiting factors for rodent population

The factors that regulate the balance between reproduction, morbidity and movement of rodents are:

- Physical environment
- Predation
- Competition

The physical environment is comprised of three main elements, which are:

- Food and water
- Harborage
- Climate

Improperly handled foods, garbage, and field crops are often major sources of rodent food.

Control methods.

I. Rodent trapping

Traps have a definite place in rodent control activities. Traps are useful in connection with the following key points.

1. To kill the rats where the use of poisoned baits is too dangerous for use in common.
2. To avoid dead rat order
3. To eliminate bait shy rats

4. When live rats are needed for the recovery of ectoparasites or other research or survey needs, like bloods for use in rodent disease studies

The most commonly used traps are:

Use of traps

1. Snap traps (Killer traps) – an attractive bait should be placed on it.
2. Cage traps (holder types)

Remember these points when you use traps

- Use traps in rat runways, burrows, etc.
- Fasten traps
- Block runways with boards, boxes, or other objects after traps are set
- Set two traps at each end of runway
- Camouflage traps with dust, paper, board etc.
- Rats are suspicious, use as many traps as possible

Remember the following rules for effective rodent control

- To prevent mass movement and spread of rodents, killing must be done before sanitation campaign
- To reduce rodent expatriates, which are the reservoirs of plague, murine typhus, etc., killing must be done after dusting with 10% DDT or other insecticide

- Killing must be done during and after or together with rat proofing work

II. Rat proofing

Rat proofing is applied to structures and is designed to prevent rats from doing economic damage and disease transmission. Rats enter buildings through drainpipes, doors, windows, roofs, and foundations. Therefore, such places should be screened for built properly to avoid rats

III. Starving of rodents

This is the best method of controlling rodents. If you starve rats by eliminating all food material through basic sanitation, then they will soon vanish, or migrate away. Mobilize the community for basic sanitation movement so that rodents are deprived of food and shelter.

IV. Killing of rodents

- Use stick to kill rodents
- Fill their harborage and suffocate them
- Flood their holes
- Burn fire on their harborage or holes
- Use rodenticides to kill them

There are two kinds of poisons or rodenticides currently in use.

1. Single dose or knock down poisons

These are the poisons that can kill rats through a single feeding. Examples include: ANTU, Red squill, Strychnine, Sodium flouroaccetate (1080), Zinc phosphide and Arsenic trioxide (white arsenic)

2. Anticoagulans (Multiple dose poisons)

These poisons need to be repeatedly given to be effective. This is considered as a good safety factor for children who might have one contact. Anticoagulants kill the rat by causing internal hemorrhage. Examples are warfarine, pival and fumarine.

CHAPTER FOUR

Safety Measures For Use Of Pesticides

4.1 What are pesticides?

Pesticides are substances, which kill pests. They are divided into groups as follows according to target organism.

1. Insecticides are pesticides which kill insects
2. Herbicides kill weeds
3. Rodenticides kill rats and mice
4. Nematicides kill nematods, and so forth.

Within each of these groups there may be further subdivisions based on such characteristics as route of intake of the poison or physiological effects on the target organism.

In this chapter we will concentrate on insecticides and its safe handling methods.

Fig. 23 Types of Pesticide containers.

4.2 Insecticides

According to the mode of attack insecticides can be grouped into:

1. Stomach poisons – which can kill the insect when taken through the mouth
2. Contact poisons – which kill the insect by penetrating the body wall, and
3. Fumigants – which enter the body of the insect through the breathing pores

Representative types of insecticides include:

1. **Inorganic insecticides** – Lead arsenate, Paris green, compounds of copper, Zinc, mercury, chlorine and sulfur. They act as stomach poisons.

2. **Botanicals** – Plant extracts such as pyrethrums. They act as contact poisons

3. **Chlorinated hydrocarbons** – This group includes DDT and its derivatives like chlordane, heptachlor, lindane, BHE, etc. These groups of insecticides act primarily on the central nervous system. Members of this group are broad-spectrum insecticides. A broad-spectrum insecticide is able to kill a wide range of insects. Another peculiar characteristic of this group

of insecticides especially DDT is that they are persistent in the environment. A persistent insecticide is able to stay in the environment for a long period of time without being broken down. Hence they can effectively kill the insect for a long time, but at the same time, they have an adverse effect because they can damage other fauna and flora when they accumulate in the environment.

4. **Organophosphates** – These are the most toxic group of insecticides, which once were manufactured to serve as nerve gases during the 2nd world war. Examples are parathion and phosdrine. The least toxic in this group is Malathion. They act as contact poisons.

5. **Carbamates** – Are contact poisons. This group of insecticides is widely used in public health and agriculture because they act as rapid knock down poisons to insects and have less toxicity to mammals. Example is Savin, which is widely used as a garden dust and for mosquito control.

4.3 How to safely use pesticides

Fig.21. Look for warning symbols on labels

1. The label

Pesticides should be packed and labeled. The label must be in English and in the local language. So before using any pesticide or household chemical, read the label carefully. Make sure you have understood the directions for use, the precautions and 1st aid instructions.

Fig. 24. Keep pesticides out of reach of children

2. Storage and transport

- Store pesticides in a place that can easily be located, but away from unauthorized people and children
- Make sure that they are stored in places where they can't be mistakenly taken with food or drink
- Keep them dry but away from fire or direct sunlight.
- Do not hold them with items used to hold food

3. Disposal

Left over insecticides can be disposed of by pouring into a pit latrine or a specially dug hole in the ground. However you must be make sure that ground or surface water and soil is not polluted.

Contaminated Cardboard, paper or plastics can be incinerated.

Fig.25 Dispose pesticides into a Specially dug pit

Fig. 26. Packages to be buried must be made unusable

4. Wear protective clothing if you are engaged in spraying

Fig.27. Protective equipment

5. Furniture and food must be covered with a plastic sheet or placed outdoors before a house is sprayed

6. Wash the hands and face before eating or drinking

Fig. 28. Washing hands and the face after contact with insecticides

Summary

Insects and rodents have lived with man since ancient times. The presence of insects and other arthropods have been both an advantage and a threat to mankind. The advantage of insects is that they can be a good source of food for man himself and also are sources of food and clothing. Insects are also used to control other insects, which are a danger to the environment and a threat to human health. Under natural conditions insects can control / check / one another like other creatures.

But there are some species of insects that cant be left for this natural check to proceed as they claim the lives of millions of people all over the world. Man has experienced severe epidemics like plague of Europe. It is not only epidemics like plague and typhus that insects transmit, but also other debilitating diseases such as skin infections, eye diseases, and even allergies and death due to toxic stings.

The problem of insects is tremendous in Ethiopia. If we think one vector borne disease alone- Malaria it affects thousands millions of people every year causing loss of life and having a negative impact on the national economy. To tackle the problem every one must be aware about the way it is transmitted and the methods of control. Infact most vector borne disease in Ethiopia can be prevented by

basic environmental sanitation. Health extension workers are therefore expected to teach the public to solve its own problem.

Glossary

1. **Biological control** (Biocontrol) – deliberate introduction, or augmentation, of biological agents such as pathogens, parasites and predators (especially fish) to control arthropod populations mainly mosquito larvae.
2. **Biological transmission** – transmission of disease organisms with biological involvement between the vector and parasite.
3. **Carbamates** – Synthetic insecticides which are derivatives of carbamic acid, e.g. cararyl (Sevin) and Propoxur (Baygon)
4. **Epidemic** - Occurrence of a disease in the human population where the numbers of cases exceed the normal expected numbers of cases
5. **Genetic control** – special type of biological control that uses genetical techniques to control pest populations.
6. **Habitat** – usually means of the physical environment in which an animal lives, e.g. the skin in the case of scabies mites, streams or simuliid larvae and animal nests in the case of Ixodid ticks.
7. **Hibernation** – period of inactivity and /or altered behavior caused by cold conditions such as winter

8. **Insecticide resistance** – ability of arthropods to tolerate doses of insecticide which would prove lethal to the majority of normal (susceptible) individuals of the same species
9. **Instar** – one of a series of life cycle stages in metamorphosis that is separated by a molt, e.g. the first, second and larval instars of house flies and the five nymphal stages of bedbugs
10. **Larviparous** – reproduction in which the eggs hatch within the femal and larvae are deposited. E.g. tse-tse flies
11. **Life cycle** (life history) – in entomology and parasitology, this usually means the series of morphological stages an organism passes through to reach maturity.
12. **Mechanical transmission** – transmission where there is no multiplication or cyclical development of the etiological agent
13. **Metamorphosis** – changes in form from the first stage (egg) in the life cycle of an arthropod to the adult form.
14. **Morphology** – the external structure of an organism
15. **Molting** – process of shading the cuticle between developmental stages
16. **Nocturnal** – refers to the activity during the night
17. **Organochlorines** – (chlorinated hydrocarbons) synthetic insecticides containing carbon, chlorine and hydrogen, e.g. DDT, Dieldrin, HCH, and Mehoxychlor.
18. **Organophosphates** – synthethic insecticides which are derivatives of phosphoric acid, hence all contain phosphorus. E.g. diazinone, dichlorvos and malathion.

19. **Pyrethroids** (synthethic pyrethroids) - synthetic insecticides containing different pyrethrine like chemicals, e.g. permethrin, deltamethrin.
20. **Reservoir** – host animals in which populations of disease organisms persist indefinitely and which pass the disease to other species of hosts, often by vectors.
21. **Source reduction** – simple measures that either prevent breeding of arthropods or eliminate their breeding sites. Mainly applicable to mosquito control, e.g. covering water tanks, filling in puddles or removing discarded water retaining receptacles
22. **Vector** – organism that conveys an etiological agent from one host to another.

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