Principles of pest control- cultural, physical, mechanical and biological control of pests.

Cultural methods are simple agricultural or farm practices that man has learnt by his long experience as a farmer in order to keep the pest population down. However the methods at best are prophylaxis rather than a complete cure and control suitable when used alone for low unit value crops. Nevertheless, they cost nothing except labour is convenient and without hazards. the methods include under these are given below-

a.Crop rotation- Changing of crops,- if the crops are rotated that is the same crop is not drawn successively on the same field it acts as the control of pests. This is because the pest of the preceding crop would not affect those of the following one. Crop rotation affects those insects which have a limited host range and are relatively immobile in some stage of their development .

b. crop location- crops of adjacent fields should be chosen. The pest of one crop may not be attracted by those of the other. Mixed crops would produce the same effect.

c.Trap crops- small plantings of a susceptible crop may be grown near a major crop to act as a trap. best accumulated on this trip may then be killed by suitable means- insecticides for ploughing.

d.Tillage-Tillage tends to reduce soil insects and those which pass any of their developmental stages under the soil by mechanically damaging the pest and the stages, by burying or exposing a developmental stage of the pest by changing physical condition PH, moisture oxygen content of the soil by eliminating the main plant or alternating host plant etc.

e. Alternate timing- Incase, where the susceptible stage is in crop life,the infecting stage in the pest life is brief, alternating timing of sowing and harvesting can be effective as a control measure. This keeps the susceptible stage of the host and infecting stage of the pest separated resulting in the death of the latter.

f.Clean culture- Keeping the fields clean of weeds, which may act as temporary alternative host plants and the removal and burning of crop residue tend to kill pests like beetles and caterpillars that hibernate in plant debris. This method is specifically useful against vegetables and field crop pests.

g. Soil manuring and fertilization -Proper manuring and fertilization of soil produces healthier plants which are better adapted to withstand pest attack.

h. Pruning and thinning- Occasional pruning of the old damaged and weak portions of plants and encourages growth of new shoots which are healthy and pest resistant.

i.Crop refuge destruction- After the harvest, the crop waste should be burnt so as to destroy infesting pests, borers in particular of the preceding crop in order to protect the new one.

j.Management control- Most cultural methods could be regarded as a management control, but methods which aid in the control of livestock pests are preferably referred to as management control. This involves the destruction of breeding places of pests, the clean up of barns and shelter and isolation of infested animals.

Biological control of pest

The term biological control means control of insects by several biological agencies such as parasites, predators and pathogens. the introduction of sterile males in a normal population and use of sex attractant. have been reported to bring about effective biological control.

The theoretical basis of biological control depends on the existence of a natural enemy. The essential principles of biological control Is to maintain a state of biological equilibrium of Living Organism. This biological equilibrium is normally maintained by a set of forces called environmental resistance.

Often the biological aquarium equilibrium of a living organism is distributed is disturbed I do due to environmental biotic factors and consequently a particular organism multiplies and spreads in an unlimited manner so as to assume the status of a pest. This inherent ability of an organism to survive and to reproduce within a given time under optimal environmental conditions is known as biotic potential. Biotic potential is a force opposed to environmental resistance.

Types of biological control

1. Introduction of parasites
2. Introduction of Predator
3. Introduction of pathogenic organisms purchase bacteria fungi and Virus
4. Removal of fertile males in creating sterility in males by Gamma radiation and introducing the sterile males in a normal population
5. In addition to the four main types there is a type of biological control where indigenous parasites of the locality are being utilised for the purpose.

Factors governing parasites- one of the most important factors governing parasites introduction for biological control is the geographical location of the area, under experiment introduced parasites meet with relatively little competition from indigenous parasites.

Utilisation of indigenous parasites

Biological control is also brought about through the agencies of indigenous parasites of a locality search operations consist idea of conserving or increasing the number of parasites in a given area or attending to colonize such parasites by artificial culture methods under laboratory experimental conditions in a area of a country where did not previously existed. One of the important features of this type of biological control is the alternation of host parasite ratio any given locality.

Pathogens: Pathogenic microorganisms attack insects and have life cycles more or less characteristic or similar microorganisms developing in other groups of animals. Insects are probably subjected to a wide variety of diseases as in vertebrates except for the fungi, Disease organisms gain entry in the host via mouth or a digestive tract. i.e the insect host must eat plants or other contaminated with pathogens. In case of fungi entrance is gained through the insect integument virtually no insect disease organisms occur in males online have been recorded from men .The most common diseases of insects are caused by bacteria,fungi, virus and protozoa.

Use of Pheromones:The ability of an insect to locate mate and to copulate has been found to often be directed by natural specific chemicals produced by the insect pheromones. Natural chemical attractants and mating simultaneously have been shown to occur in many pest insects.They are often effective in incredibly small concentrations, one virgin female of the introduced pine sawfly attracted over ten thousand male, some have been chemically identified and even synthesized. use of pheromones offer highly specific control methods with little or no side effects. Eg:One of the best uses of pheromones is eradication of the Oriental fruit fly on Rota island, where an artificial Pheromones or attractants namely Methyl eugenol the male fly to the poison coated surface.

Physical and Mechanical Control-

Direct physical manipulation of the environment can be used as a pest control tactic. The mode of action is to kill or incapacitate the pests by creating environmental stress that the pest cannot tolerate. Physical and mechanical methods are sometimes considered part of cultural management tactics. But it should be kept in mind that ecological principles underlying the approaches are different.

The primary ways that physical and mechanical methods can be used for pests management include:

a) environmental modification by altering temperature, atmosphere,

b) physical exclusion by traps and barriers,

C) Direct physical means e.g. hand picking, burning etc. Pests have been controlled using physical and mechanical methods since the origin of agriculture.

PHYSICAL METHODS

The physical methods are those which are used for pest control to reduce pest populations by using devices, which affect them physically or alter their physical environment. Temperature, sound, atmospheres and radiations are employed as important methods of physical control.

1.**Temperature**: Insects develop within a limited temperature range and increasing or decreasing this range will cause insects to die fast. This behaviour of insects is exploited for insect control. Storage of foodstuff and other commodities continues to be used in India, Egypt and Kenya. For most stored grain insects the temperature of 25-33'~ is optimal for development and at 13-25'~ or 33-35'~ the insects can complete development and produce young. Stored grain insects will die at less than 13'~ or higher than 35°C. For the majority of stored grain pests, an exposure of 14°C will cause complete elimination of the pest.

2. **Application of heat**: Insects exposed to high temperature require less exposure time to be lethal than cold temperature.

a**) Dry heat**: Application of dry heat including exposure to sun rays during hot summer months helps in killing a number of pests in seeds and stored commodities. Exposure of cotton seeds to sun in thin layers for 2-3 days helps in killing the diapausing (suspended metamorphosis during winters) larvae of pink bollworm.

b) Exposure to sun: Exposing infested grain to the sun on a pucca floor in June also kills stored grain insects in the adult stage.

.**c) Superheating**: Super heating empty godowns to a temperature above 50'~ for 10 - 12 hours kills the hibernating stored grain pests.

d) Steaming: Fruits and vegetables may be heated to disinfect insects by exposure to hot water, hot dry air, infrared radiation and microwave radiation. Fruit flies and scale insects were controlled successfully by steaming. By steaming woolen clothes, the wooly bear is killed.

e) Radio-frequency energy: The radio-frequency portion of the electromagnetic spectrum, generally accepted between 1 and 100 MHz, causes heating of biological materials specially wood, stored grain and food stuff. This aspect has been found to have potential for insect control.

3) Application of cold: The first use of cold temperatures was in 1889 to control apple maggots. All eggs and larvae of apple maggots were killed within 35 days at 0 degrees celsius.

. **a) Cold storage of fresh and dry fruits** and vegetables is often resorted for escaping fruit fly, potato tuber moth and pathogen damage. A temperature of 0 degree celsius for several days kills fruit fly maggots.

b) Stored grains pests are killed when stored grains are exposed to sub zero temperatures by opening doors and windows of godowns.

4) Manipulation of moisture: Raising or lowering the moisture content of food and other creates unfavorable conditions for insect pests.

a) Drying: Insects are highly sensitive to reduction in air moisture content but manipulation of humidity is generally not feasible. This method is however very useful in case of stored grain pests and under greenhouse conditions. Well- dried, grains (moisture content < 8-10%) stored in a cool dry place can escape insect damage.

5) Draining stagnant water kills the breeding ~mosquitoes.

6) Soaking logs in water over extended periods for drowning the boring weevils, and larvae of the wood wasps.

7.Sound: Low frequency sound waves cause adverse effects on the development of insects. Sound produced by male and the response of females of a species to the sound can be utilized for their control.

8. Use of controlled atmospheres (CA) to manage insect pests has gained momentum in recent years. Carbon dioxide is toxic to insects, but its action is low. Eggs and adults of pulse beetle die when exposed to 100% CO? at 32"~ and relative humidity of 70%. Carbon dioxide under high pressure is found to be effective against stored grain pests. Carbon dioxide and nitrogen treatment have been found effective for grain beetles. A nitrogen atmosphere effectively controls all stages of fruit fly.

9.Irradiation:. Micro Radiation (usc of microwaves) and gamma radiation are being used against stored grain pests effectively. Infrared radiation can be used dually to the insects or to the stored grain infested with insects. Ionising radiation (X-rays. A-rays) are sterilizing at lower doses but lethal at higher doses. Although irradiation can disinfect various food stuffs but major obstacle of this control measure is the acceptability of irradiated food by consumers.

MECHANICAL CONTROL METHODS

The reduction or suppression of insect populations by means of manual devices is referred to as mechanical control. The mechanical control involves the use of the following tactics: 11 1**.Hand Picking**: Handpicking and destruction of large sized, conspicuous, immature or mature stages of insects is the most ancient method. It can prove fairly effective under certain conditions. This is still being used for picking out lice from human hair (at home). In the field, insects can be handpicked if they are:

a) easily accessible to the picker,
b) large and conspicuous, and
C) present in large numbers.

Collection and destruction of egg masses of top borer of first and second brood during March and May in ratoon (sprouted from roots) and autumn-planted sugarcane crops, reduces top borer damage in endemic pockets. Destruction of infested cane stocks harboring larvae of borers is useful for reducing the incidence of these borers. Handpicking is also generally useful for the management of hairy caterpillars, leaf rollers, tobacco caterpillars, cabbage butterflies, mustard sawfly, Epilachnn beetle, white grubs etc.

Collection and destruction of fallen infested fruits is effective against fruit flies and Physical and Mechanical Control Methods fruit bc;ers. Manual removal of pink boll worm attacked flowers, withered and drooped terminals infested by spotted bollworms, shed floral bodies attacked by bollworms, leaves with egg masses or younger instars of tobacco caterpillars can reduce the incidence of these pests in cotton crop.

Exclusion by Screens and Barriers: Mechanical exclusion consists of the use of devices by which barriers can stop the pest from reaching crops and agricultural produce.

a) The application of a fluffy cotton band 6" wide, or a band of a sticky material or a band of slippery sheets like alkathene around the tree trunk of a Mango tree to prevent the upward movement of the mango mealy bug.

b.Screening windows, doors and ventilators of the house to keep away house flies and mosquitoes, bugs etc. Screening placed over cavities and windows serves to exclude termites. Packaging is a barrier to prevent insect infestation. Polymer films, and laminations can protect packages from insect infestation, whereas polyester, polyurethane resist insect penetration.

Wrapping individual fruits of pomegranate and citrus with a butter paper envelope to save them from attack of the anaar butterfly and fruit-sucking moths respectively. fruits wrapped in paper bags or cloth or straw remain protected to the extent of nearly 95 per cent against fruit flies.

Digging trenches: Digging of 30 to 60 cm deep trenches or erecting 30 cm high tin sheet barriers around fields is useful for protecting them from moving bands of locusts and hairy caterpillars.

Traditional methods of protecting maize cobs for seed storage.

Use of ant pans to prevent ants from ascending.

Lighting: Using red light in the monsoons to keep away most of insects, and to keep the field well lit with white light at night to protect it against certain insects. Light reflection by aluminum foil is effective against aphids. Similarly, light reflected by plastic ribbon bands or plastic flags hung in the ripening rice fields will protect the crop from bird attack.

Scaring birds by creating noise with explosives; An automatic device is available in which an explosive gas catches fire intermittently and a loud noise produces.

Trenches: Plastic lined trenches were found to restrict the movement of beetles in potato fields.

Particle barriers: Materials such as sand, granite, glass splinters can act as termite barriers.

Inert dusts are used to protect the grain from stored grain insects. These dusts are non-silica dusts, sand or silica aerogel. Though these dusts act slowly, mammalian toxicity is low and develops negligible resistance.

Trapping and Suction Devices : Several types of mechanical devices are used for collecting insect pests. Insects are attracted by suitable baits into cages, from which their exit is difficult. Traps have been in use since long as an effective control measure for insects. Traps also provide valuable information for estimating pest intensity crop loss assessment.,monitoring initial infestation.

monitoring the periodicity of pest activity.

Various types of traps have been devised for collecting and killing different types of insects:

i) The cricket trap: A deep cylindrical vessel containing beer as a bait and having wooden splinters to aid crickets to reach the bottom.

ii) House-fly trap: A box , containing a piece of stale cake, with a side opening for the insects to get in only to be trapped in a wire gauze cage on the top .

iii) Light traps: Light traps for attracting and mass killing of several species of moths and beetles were used as a control measure before the advent of synthetic organic insecticides. The traps could still be useful for monitoring the population of important pests in an area. Trapping of adults through light traps has proved encouraging in controlling top borer, root borer and white grub damage in sugarcane, red hairy caterpillar and ber beetle.

i**v) Air suction traps:** These traps are fixed in godowns against stored grain pests. Suction light traps are very effective for those insects which form a group.

v) Electrocuting trap: Live metal screens on which insects are electrocuted. These traps have been efficiently used to reduce housefly populations as you must have seen their placement in restaurants.

vi) Plant materials as traps: Compacted plant materials such as sprouts or milkweed placed in fields are used to control cutworms

. **vii) Fermentation traps**: Pheromone baits used in traps are being used for reducing lepidopteran (moths and butterfly) pests. Moths are naturally attracted to molasses, fermenting fruit, tree sap, honeydew and flower nectar.

viii)Colored traps: Different insects respond to different colours The selection of the colours depend upon the position of traps, physiological stage of insect and quality of the incident wavelengths hitting the traps.

Clipping, Pruning and Crushing Pruning and destruction of infested shoots and floral parts is effective in checking the multiplication of scales, mealy bugs and gall midges attacking fruit trees like grapes, citrus, ber, fig, custard apple etc.

Pruning of infested material. A useful approach for the management of mustard aphid infesting Brassicu (mustard) crops involves clipping and destruction of aphid-infested twigs.

Beating and Hooking Killing house flies with fly wrappers and locusts with brooms or thorny bushes is effective. On coconut palms, the borer can be picked out of ihe holes with the help of crooked hooks made of iron.

Shaking or Jarring: Shaking small trees and shrubs, particularly early in the morning in the cold season when the insects are benumbed, and collecting them in open tubes containing kerosinized water or simply burying them in pits is effective against locust and the defoliating beetles.

Hopperdozer : Hopperdozer is a physical technique used to control grasshoppers by catching them.

Sieving and Winnowing: These are commonly employed against insect pests of stored grains.