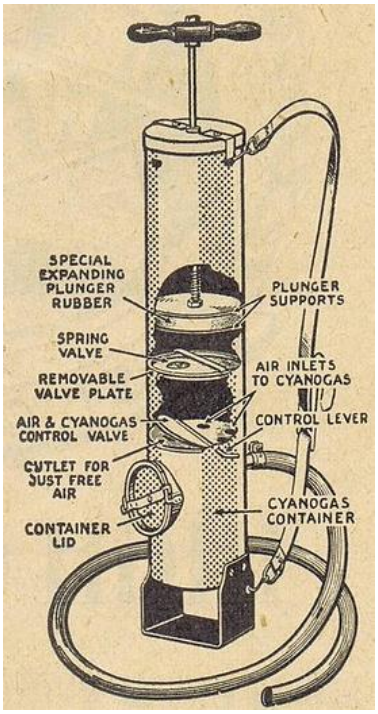
Rayat Shikshan Sanstha's
Annasaheb Awate College, Manchar
Department of Zoology

Class: S.Y.B.Sc. **Semester: III**

Paper: Applied Zoology I (ZO-232)

Topic: Agricultural Pests and Their Control

1.	**Describe in brief – Cyanogas Pump**
	• The cyanogas pump is and a special pest control appliance designed for fumigation of suitable pesticides likes calcium cyanide against subterranean pests. • Fumigation is a very effective method of pest control and is employed usually in closed chambers to fumigate stored products. • Cyanogas pump consist of Pump itself with a long foot rest. • In between a foot rest and pump, a glass container is suspended which holds the calcium cyanide. • A pump is provided at the top handle and is used for pumping the air through the glass into the delivery hose. • The glass container is filled with dust or gas of calcium cyanide. • It is suited for small scale operations like fumigating the rodents like rat burrows, kitchen, gardens, poultry houses, sheds etc. with calcium cyanide or sodium cyanide. The mask should be used during operation for protection.  **Fig. Cyanogas Pump**
2.	**Describe in brief – Knapsack Sprayer**
	• Sprayer is a machine used to apply liquid chemicals on plants to control pest and diseases. • It can also be used to apply herbicides to control weeds and to spray micronutrients to enhance plant growth. • This sprayer is suitable for applying chemicals to several field crops.

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- The operator carries the sprayer on his back and hence the name knapsack sprayer.
- It has a flat or bean-shaped tank of 10-15 litres capacity., a hydraulic pump fitted inside the tank, a handle to operate the pump, agitator, filter, delivery hose, and spray gun with nozzle and flow control lever.
- The tank is made of either brass or PVC material.
- The tank is filled with chemical solution.
- When the pump is operated, it draws the fluid through the suction hole and delivers it to the spray gun.
- When the cut off lever is pressed spraying is done through the nozzle as fine droplets.
- The pressure developed in these sprayers depends on the pump and varies from 3 to 12 kg/cm2
- The application rate is 500 lit/ha.
- The coverage is 0.5-1.0 ha/day.

Salient features of knapsack sprayers:

1. Useful to develop high pressure with less effort.
2. Light in weight and easy to carry on the back of the operator..
3. High work rate and economical.
4. Robust and simple to maintain.
5. Both left and right hand operation
6. 10-15 lit. capacity
7. Easy to spray chemicals.

The main functions of a sprayer are:

- Breaking the chemical solution in to fine droplets of effective size.
- Distributing the droplets uniformly over the plants.
- Applying the chemicals with sufficient pressure for positive reaching the plants.
- Regulating the amount of liquid applied on plants to avoid excessive application.

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	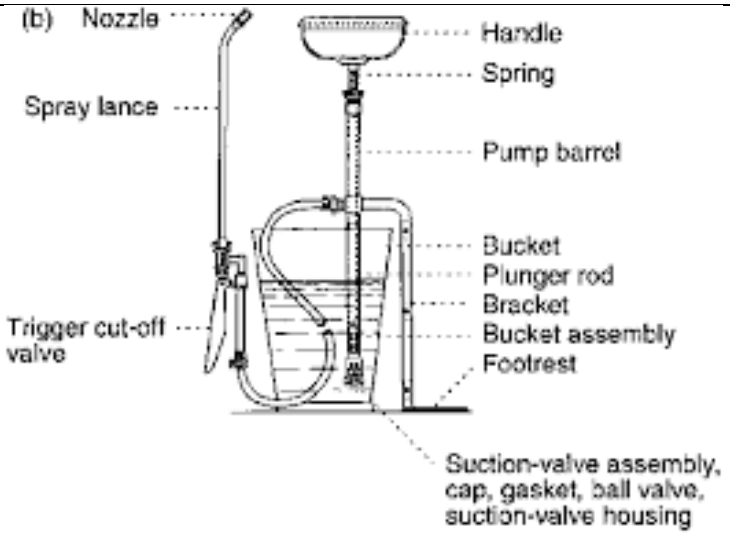 **Fig. Knapsack Sprayer**
3.	**Describe in brief – Rotary duster**
	• Duster is a machine used to apply chemicals in dust form. • Dusters make use of air stream to carry pesticides in finely divided form on the plants. • A duster essentially consists of 1. Hopper 2. Agitator 3. Feed control 4. fan or blower 5. Delivery nozzle • Hand rotary dusters are useful to apply chemicals which are in powder form. • It consists of a hopper, a fan, gear box, handle, delivery hose and a deflector plate. • When the handle is rotates the fan rotates at high speed and draws air from outside. • The chemical from hopper is fed in to the air stream in the suction side of the fan. • The chemical mixes with the air, passes through the delivery line and is applied on the plants. • The rate of delivery can be regulated It is used to apply powdery chemicals to vegetables, sorghum crops.

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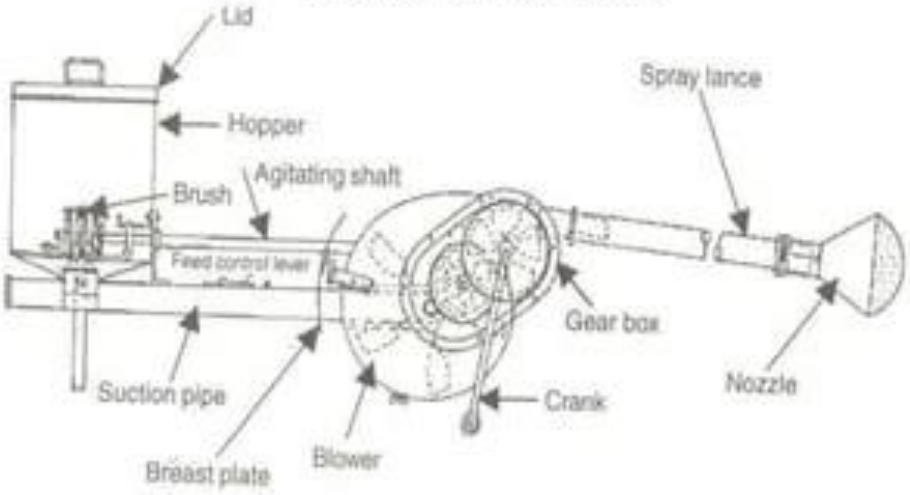
	Line diagram of rotary duster 
4.	**Describe Marks of Identification, nature of damage and control measures of Jowar Stem Borer**
	Scientific Name: *Chilo partellus* S. **Class:** Pyralidae **Order:** Lepidoptera **Marks of Identification:** **1. Eggs:** • The eggs are laid on the underside of a leaf near the midrib in 3-5 rows, in groups of 10-100. • They are flattened, oval, and about 0.8 mm long. **2. Larva:** • They are creamy pink with groups of dark spots along the back. • The head capsule is brown. • When mature they are about 25 mm long. **3. Adult:** • Adult moths have a wingspan of 20-30 mm. • Males are smaller and darker than females. • It has straw or light brown forewings with numerous shining brown spots on the margin, and white and papery hindwings. **Nature of Damage:** • Withering and drying of central shoot - "dead heart". • Red mining in the midrib. • Bore holes visible on the stem near the nodes.

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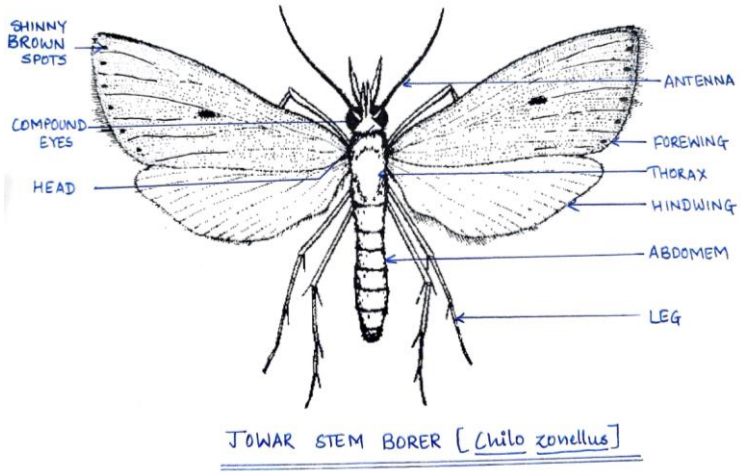
	• Tender folded leaves have parallel "shot hole" • Affected parts of stem may show internally tunneling of caterpillars **Control Measures:** **1. Preventive:** • Collection and destruction of stubbles after the harvest of crop to kill hibernating larvae • Increase the seed rate to compensate the loss. • Follow proper crop rotation (with non host crop). • Use of light traps. **2. Curative:** • Removal & destruction of affected shoots along with the larvae. • Spraying with 0.05% endosulfan or 0.2%carbaryl OR whorl application of endosulfan 4G @ 10kg/ha, when 10% plants are infested.  JOWAR STEM BORER [Chilo zonellus]
4.	**Describe Marks of Identification, nature of damage and control measures of Red Cotton Bug**
	Scientific Name: *Dysdercus cingulatus* **Family:** Pyrrhocoridae **Order:** Hemiptera **Marks of Identification:** **1. Eggs:** • The small, pale eggs are laid singly on the food plant or dropped on the ground near the food plant. • They are spherical and bright yellow in colour.

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2. **Nymph:**
    - Nymphs are red coloured with black median dorsal spots on the inter-tergal membrane of and abdominal segments.
    - There is a pair of white dorsal spot on each of the third, fourth and fifth tergal plates on the abdomen

3. **Adult:**

- Adults are 12-13 mm in length and have deep red legs and antennae.
- The membranous portion of the forewings and the eyes are black in colour.
- There is also a black spot in each forewing.
- The transverse bands along the posterior margins of each thoracic and abdominal sterna, the collar behind the head and the spots at the base of the head are white in colour.

Nature of damage:

- Red stained lint and rotting bolls
- Inner boll wall with warty growth or water-soaked spots
- Young bolls abort and turn dark brown
- The bacterium Nematospora gossypii enters the site of injury and stains the fibre

Control Measures:

- Plough the field to expose the eggs
- Spraying of Malathion 0.05%, Spraying of 1-litre endosulfan 35% EC, 0.25 litre phosphamidon= 100% EC or 1-litre Fenitrothion 100% EC
- Use of trap crops

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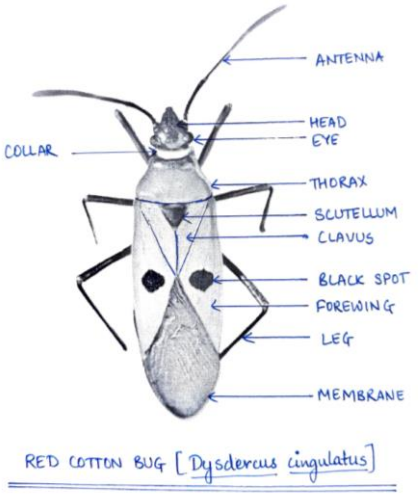
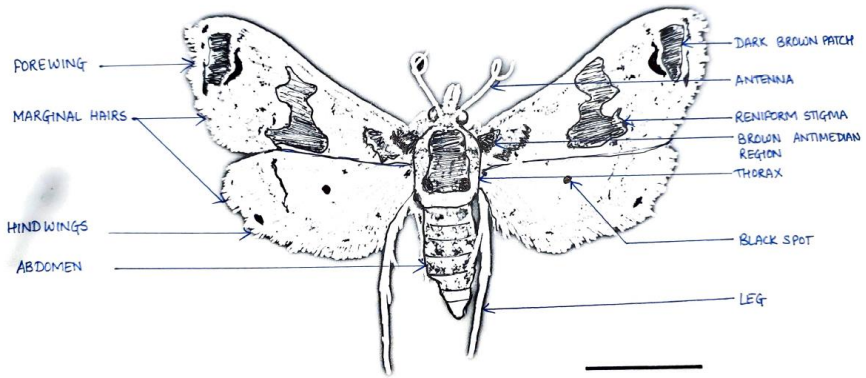
	 RED COTTON BUG [Dysdercus cingulatus]
5.	**Describe Marks of Identification, nature of damage and control measures of Brinjal Fruit Borer**
	Scientific Name – *Leucinodes orbonalis* Order – Lepidoptera Family – Crambidae **Marks of Identification:** **1. Egg:** • The eggs are white and flat in appearance. • The adult female, after copulation, lay about 250 eggs within two to five days of their emergence. • The eggs are laid singly on the surface of the tender leaves, shoot or fruits of the host plant during March-April. **2. Larva:** • They are 20-22mm long. • They are pinkish in color with brown head. • The body bears wart all over the body through which hairs protrudes out. **3. Adult:** • The adult is greyish-brown moth with white wings, wingspan 18-24 mm, • Forewing - antemedian region brown, median region with large brown patch near inner margin, reniform stigma is brown. • Hindwing - black patch on cross-vein of cell. • The fore and hind wings are provided with marginal hairs and bears pinkish-brown spots **Nature of Damage:** • Withering of terminal shoots/dead hearts

- Bore holes on shoots and fruits plugged with excreta
- Shedding of flower buds
- Withering and drying of leaves

Control Measures:

- Remove the affected terminal shoot showing boreholes.
- Remove the affected fruits and destroy.
- Avoid continuous cropping of brinjal crop
- Grow the varieties with long and narrow fruits in endemic areas
- Install pheromone trap@12/ha
- Encourage the activity of larval parasitoids: Pristomerus testaceus, Cremastus avoorbitalis
- Avoid use of synthetic pyrethroids
- Avoid using insecticides at the time of fruit maturation and harvest
- Neem seed kernel extract (NSKE) 5 % or
- Spray any one of the following chemicals starting from one month after planting at 15 days interval



BRINJAL FRUIT BORER [*Leucinodes orbonalis*]

6. Describe Marks of Identification, nature of damage and control measures of Mango stem borer

Scientific Name – *Batocera rubus*
Order – Coleoptera
Family – Cerambycidae

Marks of identification:

1. **Egg:**

- The eggs are brownish-white, cylindrical, and 6 x 2 mm, with narrowly rounded ends with flattened appearance.
- They are normally placed into an incision.

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2. Larva/ Grub:

- Newly-hatched, first-instar larvae are about 10 mm long.
- Fully grown larvae may reach 100 mm long, but more commonly reach about 60-80 mm long.
- The grub is subcylindrical, weakly flattened dorsoventrally, and yellowish-white, with the head dark brown and sclerotized, without obvious legs.

3. Adult:

- Typical cerambycid beetles, recognized by the long antennae reaching to atleast the end of the body and the tarsi.
- Legs, with apparently four segments excluding the claws, but with the third segment strongly bilobed and almost concealing the very small fourth segment at the base of the true fifth, claw-bearing segment.
- Length is 25-55 mm. Covered with grey to yellowish pubescence on a dark brown to pitchy surface.
- Head held vertically downwards, maxillary palpi tapering apically. Antennae inserted on distinct prominences forming a shallow V-shape on the top of the head.

Nature of damage:

- Grub tunnels in the sapwood on the trunk or branches
- Grub bore into the sap wood and macking irregular tunnels.
- Feeding the vascular tissues interruption of nutrient and water transport on the tissue
- Drying of terminal shoot in early stage
- Frass comes out from several points and some times sap oozes out of the holes
- Wilting of branches or entire tree

Control measures:

- Remove and destroy dead and severely affected branches of the tree
- Remove alternate host, silk cotton and other hosts
- Grow tolerant mango varieties viz., Neelam, Humayudin.
- Swab Coal tar + Kerosene @ 1:2 or Carbaryl 50 WP 20 g / l (basal portion of the trunk - 3 feet height) after scraping the loose bark to prevent oviposition by adult beetles.
- If infestations are severe then apply the copper oxychloride paste on the trunk of the tree.
- One celphos tablet (3 g aluminum phosphide) per hole
- Apply carbofuran 3G 5 g per hole and plug with mud.

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	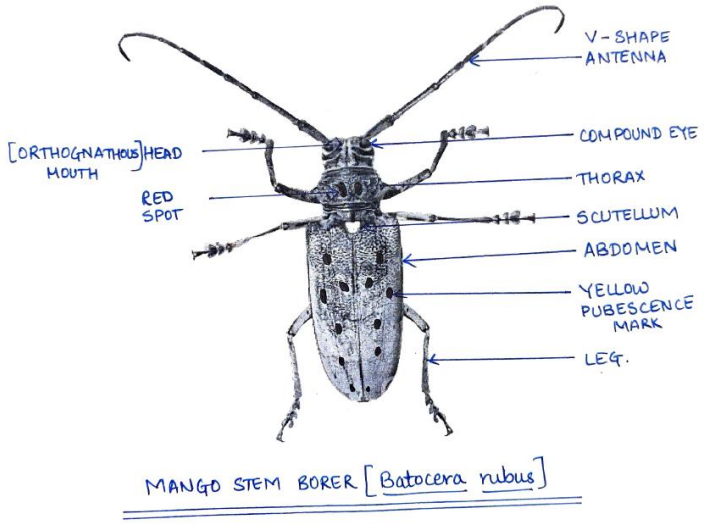
7.	**Describe Marks of Identification, nature of damage and control measures of blister beetle**
	Scientific name: *Mylabris pustulata* **Order:** Coleoptera **Family:** Meloidae **Marks of identification:** **1. Egg:** • Eggs are light yellowish in colour and cylindrical in shape. • They are laid in clusters. **2. Larva/ grub:** • First instar larvae found in flowers or attached to the hairs of bees. • The body is navicular (boat-shaped) and heavily sclerotized and there is a definite pattern of setation. • These are distinctive in having one to two stemmata (ocelli) on each side of the head, an ecdysial line on the thorax, and no pulvilli (bladderlike appendages). • In the larval stage, they prey on the immature stages of solitary bees or on the eggs of grasshoppers. **3. Adult:** • They are often brightly coloured, the need for camouflage being eliminated by their ability to secrete cantharidin.

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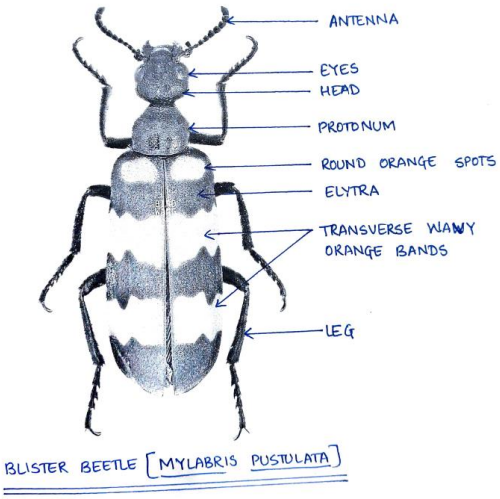
	• They range between 3 and 20 mm (0.1 to 0.8 inch) in length, with the majority between 10 and 15 mm (0.4 and 0.6 inch). • Their long, slender, leathery bodies are covered by metallic green or blue wing covers, often marked with bands or stripes. • Elytra are black in colour with a round orange spot and two transverse wavy orange bands across the wings. • They feed on broadleaf plants. **Nature of damage:** • They attack the inflorescence and feed on pollens and petals of flowers. • This affects the grain setting. • In severe cases ear heads without grains are seen. • This hinders fertilization. **Control measures:** • Collection of bettles by hand insect nets. • Using light traps, and killing with kerosene water. • Chemicals: 10 % BHC, Chlorpyriphos, Quinalphos, Phosalone  BLISTER BEETLE [MYLABRIS PUSTULATA]
8.	**Describe Marks of Identification, nature of damage and control measures of Sitophilus oryzae/ rice weevil**
	Scientific name: *Sitophilus oryzae* **Order:** Coleoptera **Family:** Curculionidae

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Marks of identification:

1. **Larva/ grub:**

- They are tiny, white, fleshy, legless grubs
- They have yellowish- brown head and biting jaws.

2. **Adult:**

- The rice weevil is small, 1/10 inch (2 to 3 mm) and stout in appearance.
- Rice weevil is reddish-brown to black in color with four light yellow or reddish spots on the corners of the elytra (the hard protective forewings).
- The snout is long (1 mm), almost 1/3 of the total length.
- The head with snout is as long as the prothorax or the elytra.
- The prothorax (the body region behind the head) is strongly pitted and the elytra have rows of pits within longitudinal grooves.

Nature of damage:

- The larvae are more destructive as they feed voraciously on the content of the grain but leave the shell of the grain intact.
- They exit by making a circular hole on the surface.
- Adults can damage several seeds by cutting an irregularly lined circular hole, through which they feed on the kernel.

Control measures:

- Locating the source of infestation and quickly get rid of it
- Disposing off heavily infested foods in wrapped, heavy plastic bags or in sealed containers for garbage removal, or bury deep in the soil
- Ventilate the storage area to discourage these moisture-loving stored product pests
- Use of neem, mercury, ash, sweet flag rhizome powder
- Sun drying
- Sieving and cleaning
- Fumigation using EDBR [Ethylene dibromide]
- 5% BHC
- Malathion
- Pyrethrum

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	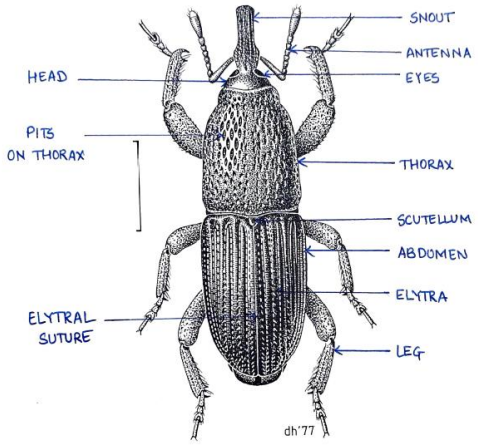 RICE WEEVIL [Sitophilus oryzae]
9.	**Describe Marks of Identification, nature of damage and control measures of pulse beetle**
	Scientific name: *Callosobruchus chinensis* **Order:** Coleoptera **Family:** Chrysomeloidea **Marks of identification:** 1. **Egg -** Laid singly, glued to the surface of the pod (in fields) or on grains (in stores). Fresh eggs are translucent, orange cream in colour, changing to greyish white with age. 2. **Grub -** Fleshy, curved, creamy white in colour with black mouth parts. 3. **Pupa -** Pupation takes place in a pupal cell prepared beneath the seed coat. 4. **Adult:** • Brownish grey beetle with characteristic elevated ivory like spots near the middle of the dorsal side. • It is small, short, and active with long conspicuous serrate antenna. • Elytra do not cover the abdomen completely, which is called as pygidium. • Adults are short lived, it is harmless. **Nature of damage:** • Grubs eat up the grain kernel and make a cavity. • Adults come out making exit holes.

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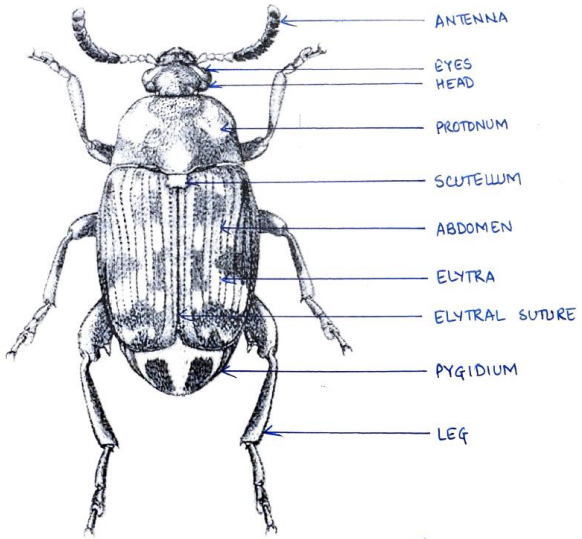
	Control measures: • All the stages of pulse beetle in seeds could be killed by exposing them to temperatures of up to 45°C for varying periods, or by exposing them to sunlight for 4 to 6 hours with the diurnal temperature varying from 37 - 45°C. • Viability of the treated grains not will be adversely affected. • Clean the warehouses and storage places with brushes, scrapers or a vacuum cleaner, then destroy any collected insect • Mix ash with grains • Use neem leaves at @ 1 kg / 100g of grains • Apply neem oil @ 8-10ml / kg seed, fenvalerate 0.4% @ 4 gm/kg seed, malathion 50EC @ 0.06ml/kg seed or deltamethrin 2.8 EC (0.04ml)/ kg for seed treatment • Dust with 5% malathion  PULSE BEETLE [Callosobruchs chinesis]
10.	**Describe in brief – biological pest control**
	• Biological control is the use of living organisms to maintain pest populations below damaging levels. • Natural enemies of arthropods fall into three major categories: predators, parasitoids, and pathogens. **1. Predators:** • Predators catch and eat their prey.

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	• Some common predatory arthropods include ladybird beetles, carabid (ground) beetles, staphylinid (rove) beetles, syrphid (hover) flies, lacewings, minute pirate bugs, nabid bugs, big-eyed bugs, and spiders. **2. Parasitoids:** • Parasitoids (sometimes called parasites) do not usually eat their hosts directly. • Adult parasitoids lay their eggs in, on, or near their host insect. • When the eggs hatch, the immature parasitoids use the host as food. • Many parasitoids are very small wasps and are not easily noticed. Tachinid flies are another group of parasitoids. **3. Pathogens:** • Pathogens are disease-causing organisms. • The main groups of insect disease-causing organisms are insect-parasitic bacteria, fungi, protozoa, viruses, and nematodes. • Biological control using pathogens is often called microbial control. **Approaches to biological pest control:** 1. **Classical control or importation:** a natural enemy from another geographical area, often the area in which the pest originated from, is introduced to contain the pest below the economic injury level. 2. **Inoculation:** the periodic release of a control agent is required so that it is available throughout the year. 3. **Augmentation:** involves the release of an indigenous natural enemy in order to supplement an existing population, and is therefore carried out repeatedly usually to coincide with a period of rapid growth of pest population. 4. **Inundation:** the release of large numbers of natural enemy, with the aim of killing those pests present at the time.
11.	**Describe in brief – chemical pest control**
	• Different types of chemicals are used for the control of insect pests. • Insecticides can be grouped in various ways, such as their chemical composition, mode of entry, and formulations in which they are to be applied. • Chemically, the types of insecticides are: 1. Elements

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	2. Inorganic chemicals 3. Organic chemicals • According to their mode of entry, insecticides can be grouped into- **1. Stomach poison:** • They are generally applied against insects with chewing-type mouthpart. • These are also mixed with food to kill higher animals like rodents and birds. Stomach poisons are applied as spray dust on baits. **2. Contact poison:** • A toxicants-which kills the insect by contact and enters the insects through vulnerable sites, is said as contact poison applied as dust spray directly to the insects' body or the places frequented by them. • This type of poison is particularly effective for the control of sucking insects. **3. Systemic poison:** • A systemic insecticide, when applied to seeds, roots, stems, or leaves of plants, is absorbed and translocated to various parts of the plants in amounts lethal to insects that feed on them. • Most systemic insecticides act both as stomach & contact poisons. Granular systemic insecticides are most effective and favorable to our farmers. **4. Fumigants:** • Poisonous gases are used as fumigants to kill insect pests of stored grain and products in warehouses, elevators, godawns, etc. • The toxicant enters the trachea of the insets through the spiracles in the form of gas and brings about its kill. Since all fumigants are deadly poisonous, great care is in their use. • All phosphide, CH3Br. **Examples:** Barium carbonate, Endrin, Phosacetim, Strychnine, Nitrophenols
12.	**Describe in brief – physical pest control**
	• Physical pest control relies on the use of equipment and pest proofing. • Most physical pest control methods should be carried out by an experienced and qualified pest controller. • Some physical methods exterminate pests or remove them; other methods focus more on prevention. Examples of physical pest control include: **1. Pest proofing:**

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	– Pest proofing which involves keeping pests out of your home, business or garden by creating a barrier to entry. – It can also include eliminating their nests. – By taking away a pest's breeding ground, it can stop infestations from developing. – It will also stop any current infestation from getting worse. **2. Traps and baits:** – Traps and bait stations are the most common of all the physical pest control methods. – Traps are a great method for capturing small animals like rodents and insects. **3. Temperature control:** – Extremes of temperature, both hot and cold, can control pests. For example, heat treatment will kill bedbug adults, eggs and larvae at certain temperatures. At the other end of the scale, placing grown produce in cold storage containers slows down or eliminates the growth of insects.
13.	**Describe in brief – cultural pest control**
	• Cultural controls are the oldest methods that have been used to manage pest populations. • Cultural controls are practices that reduce pest establishment, reproduction, dispersal, and survival. • For example, crop rotation - replacing a susceptible crop with a less susceptible crop; and changing irrigation practices - less watering can reduce root disease and weeds. **1. Crop rotation:** • Crop rotation interrupts normal life cycle of insect pests by placing the insects in a non-host habitat. • Rotation is generally most successful against arthropod pest species with long generation cycles and with limited dispersal capabilities. **2. Tillage:** • Tillage operations used to produce a crop include soil turning and residue-burying practices, seedbed preparation, and cultivation.

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	• Some forms of tillage can reduce pest populations indirectly by destroying wild vegetation (weeds) and volunteer crop plants in and around crop-production habitats. **3. Timing of planting and harvest:** • Alterations in planting date and harvest date can frequently result in plants escaping from damaging pest infestations. • This can be achieved by delayed planting and early harvest. **4. Trap crops:** • Crop monocultures are often damaged more severely by pests than is the same crop located in an area with crop diversity. • However, there are cases where such diversity can aggravate pest problems. • It is in these situations where trap crops can be important. • A trap crop is a small planting of the susceptible crop made earlier than the main crop for the purpose of diverting the insects from the main crop. • Eg. Okra **5. Sanitation:** • Destroying culled potatoes by turning them under, so that they decompose is important in reducing inoculum sources of the late blight fungus, and as an early season host for aphids and other pests. • Destroying slash in logging operations can reduce the buildup of bark beetles. 6. **Destruction or provision of breeding:** • Many natural enemy species require food sources in the form of pollen, nectar, or innocuous arthropods that are not present in particular crop habitats. • These food requirements may be provided to support natural enemy populations by encouraging or deliberate development of certain wild vegetation habitats near plantings of the crop.
14.	**Describe in brief – pheromonal pest control**
	• A pheromone is a specific chemical that insects and other organisms use to communicate with others of the same species – usually those of the opposite sex. • Once released, the pheromone travels through the air or water before reaching the second organism, which will often alter its behavior in response. • The ability to lure insects into traps is used for pest control. • **There are 2 types:**

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	1. Aggregation pheromones: • Produced by male • Attract both males, females, adults and larvae of same species • Act over short distances • High concentrations may be repellent, spacing phenomena • Used by species with long lived adults **2. Sex pheromones:** • Produced by the female • Attracts adult males of same species • Act over long distances • Used by highly mobile, dispersed species • Used by species with short lived adults
15.	**Describe in brief – autocidal pest control**
	• The use of sterile male pestiferous insects has been the primary emphasis in autocidal control, although there has been considerable research in genetic methods, involving the incorporation of lethal traits into a pest's population. • The sterile male approach continues to be most widely used, there having been no practical demonstrations with other methods. • As none of these methods interfere directly with the natural enemy component, they are generally considered completely compatible with classical and other natural controls. • However, the cost of the sterile male approach is generally too high for individual growers, and is usually applied in conjunction with eradication efforts by government agencies. • Autocidal control is considered by some to be out of the realm of biological control. • Its deployment does not involve natural self-perpetuating balances, but rather is aimed at complete destruction of the target pest. • Host mass production is one of the principal goals for the successful deployment of autocidal methods, and, therefore, a great amount of research effort and financial support is given to rearing improvement. • As the controls are never permanent, it is believed by many thoughtful scientists that this encumbers the discovery of potentially successful classical biological controls by diverting the scientific work force and funds away from traditional biological control research.

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16.	**Describe - IPM**
	• IPM is a managed pest management system that: eliminates or mitigates economic and health damage caused by pests; minimizes the use of pesticides and the risk to human health and the environment associated with pesticide applications. • Integrated Pest Management (IPM) is a process consisting of the balanced use of cultural, biological, and chemical procedures that are environmentally compatible, economically feasible, and socially acceptable to reduce pest populations to tolerable levels. • Elements/ principles of any IPM program include: 1. **Prevention:** Organisms are kept from becoming problems by planning and managing ecosystems. 2. **Identification:** Pests and beneficial organisms are identified. 3. **Monitoring:** Pest and beneficial organism's populations are watched, as well as pest damage, and the environment. 4. **Injury and Action Decision:** Injury and action thresholds are used to know when to treat pests. 5. **Treatments:** Treatments (or a combination) are used, including cultural, biological, physical, mechanical, behavioural, or chemical methods. The goal is to control pests with little impact on the environment. 6. **Evaluation:** The effectiveness of pest management plans are considered.
17.	**Describe hazards of pesticides to humans in brief**
	• Pesticides are chemical substances that are meant to kill pests. • In general, a pesticide is a chemical or a biological agent such as a virus, bacterium, antimicrobial, or disinfectant that deters, incapacitates, kills, pests. • Pesticides can cause short-term adverse health effects, called acute effects, as well as chronic adverse effects that can occur months or years after exposure. **1. Acute effects:** • Immediate health effects from pesticide exposure includes irritation of the nose, throat, and skin causing burning, stinging and itching as well as rashes and blisters. • Nausea, dizziness and diarrhea are also common. • People with asthma may have very severe reactions to some pesticides, particularly pyrethrin/pyrethroid, organophosphate and carbamate pesticides. • Symptoms of pesticide poisoning mimic symptoms of colds or the flu. Since pesticide-related illnesses appear similar or identical to other illnesses, pesticide poisonings are often misdiagnosed and under-reported.

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	2. Chronic effects: • Chronic health effects include cancer and other tumors; brain and nervous system damage; birth defects; infertility and other reproductive problems; and damage to the liver, kidneys, lungs and other body organs. • Chronic effects may not appear for weeks, months or even years after exposure, making it difficult to link health impacts to pesticides. • Reproductive harm from pesticides includes birth defects, still birth, spontaneous abortion, sterility and infertility.
18.	**Describe hazards of pesticides to environment in brief**
	• Pesticides are chemical substances that are meant to kill pests. • In general, a pesticide is a chemical or a biological agent such as a virus, bacterium, antimicrobial, or disinfectant that deters, incapacitates, kills, pests. • Pesticides easily contaminate the air, ground and water when they run off from fields, escape storage tanks, are not discarded properly, and especially when they are sprayed aerially. • Pesticides can be found in rain, ground water, streams, rivers, lakes and oceans. • The use of pesticides decreases the general biodiversity in the soil. • Soil quality is higher without chemicals and this allows for higher water retention, necessary for plants to grow. • Nitrogen fixation, which is necessary for the growth of many large plants, is hindered by pesticides that can be found in soil. • This can lead to a large decline in crop yields. • Animals may be poisoned by pesticide residues that remain on food after spraying. • An application of pesticides in an area can eliminate food sources that certain types of animals need, causing the animals to relocate, change their diet, or starve. • Fish and other aquatic biota may be harmed by pesticide-contaminated water. • Application of herbicides to bodies of water can cause plants to die, diminishing the water's oxygen and suffocating the fish.
19.	**Describe hazards of pesticides to agriculture in brief**
	• Pesticides are chemical substances that are meant to kill pests. • In general, a pesticide is a chemical or a biological agent such as a virus, bacterium, antimicrobial, or disinfectant that deters, incapacitates, kills, pests. • Pesticides degrade the quality of soil and further the quality of the food and yield.

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	• Chemical pesticides deplete the nutritional value of the food and contaminate it. • When we eat any food such as apple, lettuce, potatoes or strawberries, these pesticides enter our body and may lead to many health issues. • While these chemical pesticides are developed to kill organisms found on the crop, these are also harmful to other living things.
20.	Non-insect pests
	1. CRABS: • Crabs are arthropods which belong to group crustacea. • They are aquatic animals. • The rice field crab, Parutelphusa hydrodrumus has oval body tucked beneath the thoracic region. • It lives in holes made in the sides of field bunds, irrigation channels etc., where water does not stand. • Holes are protected by heaping soil around their openings. • About 300-700 crabs are seen over a ha of infested field. • A female can lay about 200 eggs inside her pouch-like abdominal flaps. **Nature of Damage** • Seedlings at ground level are cut into bits and carried to the holes for feeding. • In addition to crop damage, crab holes made into bunds lead to breaches and water loss. **Management:** • Manual collection and disposal. Place 4-5 gunny bags on the ground adjacent to field. • Poison baits with warfarin (0.025%). • Spray with 0.025% parathion over a thin sheet of water in the field and draining after 3 days. • Encouragement of natural biological control exerted by pond heron, Ardeola grayi and rats depending on the gravity of crab-menace. **2. RATS:** • Rodents comprise nearly 40% of all mammal species. • They are characterized by two pairs of razor sharp incisors (teeth of the front of mouth for cutting) used for gnawing through the toughest pods and shells for food. • Rodents include mouse, domestic rats, molerats /field rats, gerbils, porcupines and squirrels.

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Nature of damage:

- The nature and extent of damage vary from crop to crop.
- Rats prefer cereals to dicot seeds and grains.
- In the wheat crop, little damage is done to the seedlings and most of the damage is caused at the ripening stage.
- The rats uproot paddy nurseries to eat the seeds and they also cut down the plants.
- Damage by rats to coconut fruits is characteristic in that they make one or two holes near the stalk and feed on carpel.

Management:

- Rodent proofing using plastic walls around crop/metallic/cement sheets for storage facilities.
- Trapping through multi-capture rat traps hamboo shelters.
- Repellent like "Pestgo" a sticky gel or supersonic sound based electronic devices.
- Elimination of harbourages and proper disposal of wasteslcrop residues.
- Poison baiting with zinc phosphide
- Fumigation

3. SNAILS:

Snails and slugs are among the most destructive pests found in gardens and landscapes.

Both snails and slugs are members of the mollusk phylum and are similar in structure and biology, except that slugs lack the snail's external spiral shell. These mollusks move by gliding along on a muscular "foot."

Nature of damage:

- Snails and slugs feed on a variety of living plants and on decaying plant matter.
- They create irregular holes with smooth edges on leaves and flowers by scraping with their rasp-like tongues.
- Small succulent plant parts are easily clipped by snail and slug feeding.
- Because they prefer succulent foliage or flowers, snails and slugs are primarily pests of seedlings and herbaceous plants

Management:

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- Boards, stones, debris, weedy areas around tree trunks, leafy branches growing close to the ground, and dense ground covers, such as ivy, are ideal sheltering spots. Eliminate their hiding place
- Baits can be used.

4. SQUIRRELS:

- Squirrels are generally small rodents with slender bodies, bushy tails and large eyes.
- In general, their fur is short, soft and silky, and ranges in thickness from species to species.
- The color of their fur is also highly variable and can be whitish, gray, yellow, red, brown, or even black.

Nature of damage:

- Squirrels damage many food-bearing and ornamental plants.
- Particularly vulnerable are grains, as well as nut and fruit trees such as almond, apple, apricot, avocado, orange, peach, pistachio, prune, and walnut.
- The squirrels gnaw the pods in the center.
- They also make burrow in the fields.

Management:

- Baiting
- Fumigation
- Sealing of all possible points of entry