OPINION BASED ANSWERS, FOR EACH SUBJECTS!

KAVERI'S IAS - INSTITUTE FOR IAS EXMAINATION

UPSC ANSWER BOOKLET: GENERAL STUDIES

UPSC MAINS OPTIONAL

PLANT PATHOLOGY

Opinion Based Answers:

PLANT PATHOLOGY

Q1. How would you distinguish between virues and physiological disorders? Write a short account of mosaic disease of vegetables.

Ans. Viral plant diseases are caused by viruses or viroid's whereas physiological disorders are caused by abiotic factors. Viruses are non-living when outside but become active inside the host plant and therefore viral disease are called as meso-biotic.

Viral	Physiological
• Often affect one species or cultivar of same age	• Affect several species of different ages
• Symptoms appear unevenly among plant population	• Symptoms are relatively uniform
• Insects, pest may act as vector	• No vectors
• Diagnosis by Plant Samples	• Diagnosis by soil samples
• Spreads by infection	• Not infections but spreads if environment is not suitable
• Recurrence due to cultivation of susceptible cultivar or favourable condition for pathogen	• Recurrence depends on current environment condition, cultural practices
Example: Yellow mosaic of black gram	Example: Chlorosis of leaves due to nitrogen deficiency.

Mosaic disease of vegetables

Mosaic disease of vegetables are caused by mosaic viruses. They are transmitted by aphids (*Myzus physicae,* and *Aphis gossypii*)

- Symptoms are yellow mottling on leaves, white, green, circular spots on leaves
- Leaves may be crinkled, deformed
- Prevention by growing resistant varieties
- Control by controlling insect vectors (aphids)
- Eliminate weeds that may act as alternate hosts for pathogen.
- Selection of healthy seedlings for transplanting as a part of cultural method of control.
- Infected plants should be isolated to avoid further infection
- Mosaic disease due to virus occurs in many vegetables like Tomato, Cucumber, Snake gourd, Bitter gourd etc.
- In case virus is seed borne – seed treatment is also an effective method of control and prevention.

Q2. What are broad principles for disease control in crop plants? Describe biological disease control in any crop. 15 marks.

Following are the principles for disease control in crop plants.

1. Avoidance: Avoiding disease by planting at a time when inoculum is absent or ineffective due to environmental conditions
    - ✓ Adjusting time of sowing
    - ✓ Disease escaping varieties early
    - ✓ Maturing varieties of pea
    - ✓ Proper selection of seed, planting material
    - ✓ In case of panama wilt, bunchy top disease of banana, planting material free from pathogen is used by tissue culture.
2. Exclusion – Preventing entry of inoculum into an area where it doesn't exist, methods are:-
    - ✓ Seed treatment
    - ✓ Seed inspection and certification
    - ✓ Plat quarantine regulations
    - ✓ For eg. Transport of planting material (Banana) from Kerala, Assam, Bihar, Bengal in prohibited due to Bunchy top disease
    - ✓ Phytosanitary requirements
3. Eradication – Process of reducing inactivating, eliminating or destroying inoculum at source, from a region or an individual plant part where it is already established.

    Eradication methods aim at breaking the infection chain (elimination of source of primary, secondary inoculum) methods are:-

a. Roguing – Removal of diseased plant / parts
b. Eradication of alternate/ collated hosts.
c. Crop rotation – in soil borne diseases
d. Crop sanitation – collection and distribution of plant debris.
e. Manures and fertilizers – Excessive nitrogen predisposes a plant to diseases like stem rot, rice blast
f. Mixed cropping
g. Soil solarisation, sterilization

4. Protection – Prevention of infection by creating a toxic barrier between plant surface and the inoculums, methods are:-
   - ✓ Chemical sprays, dusts
   - ✓ Modification of environment
5. Host Plant Resistance – Immunization
   - ✓ Improvement in host plant resistance by breeding or chemical methods. It can also be induced by certain biotic abiotic factors.
   - ✓ Types are – vertical resistance – resistance against certain races of pathogen
   - ✓ Horizontal – uniform resistance against all races
   - ✓ Monogenic, Oligogenic and Polygenic are depending on number of genes controlling it.
6. Therapy – curing a disease or reducing the severity of disease in an infected plant.
   - ✓ Chemicals used are called therapeutants
   - ✓ Other approaches are prophylactic while therapy is an curative approach. Also it helps to recover an economically important part of plant to a certain extent.

Biological control

It is a method of disease control by reducing disease causing activity of a pathogen with another living organism.

Biological control of disease in rice

Seed treatment with antagonistic bacteria is an effective method for biological disease control in rice:

- ✓ Pseudomonas fluorescens against rice blast, stem rot and rice tungro virus (vector nephotettix sp.)
- ✓ Bacillus subtilis – against bacterial flight, sheath rot, stem rot, bakanae disease.

Q3. What are the common modes of transmission of viral diseases? Name any diseases that is caused by virus in a crop and suggest methods of controlling it. 15 marks.

Transfer of spores, infections bodies acting as inoculum from one host to another resulting in spread of diseases is called dispersal or transmission of diseases.

Following are the common modes of transmission of viral diseases

1. Pests/ Insects – Aphids, leaf hopper, mites and other such insects/pests act as carriers of virus (either mechanical or biological). For example aphid myzus persicae as carrier for mosaic virus diseases in vegetables.
    - Leaf hopper Nephotettix sp. For Rice tungro virus
    - White fly Bemisia tabaci for Bhendi yellow vain mosaic virus
    - Thrips tabaci for Tomar spotted wilt virus
    - Mites Aceria cajani transmit pigeon pea mosaic virus
2. Nematodes – Some soil borne viruses can be transmitted by nematodes grouped into 2 categories.

    NEPO Viruses – Nematode transmitted viruses. Eg. Tobacco rinspsis / spot virus with polyhedral particles

    NETU viruses – with tabular particles. For example: Tobacco rattle virus, Pea early browning virus.
3. Fungi – Tobacco necrosis virus and cucumber mosaic virus are transmitted by fungi by their spores.
4. Dispersal by parasites like cuscuta
    - In case of cucumber mosaic virus, Tobacco mosaic virus
    - Act as a bridge between diseased and healthy plants
5. Dispersal by human beings
    - By transportation diseased seed, planting material. For eg. Banana, Potato
    - By use of contaminated implements
    - By routine activities like weeding, thinning etc. in the field, soil borne viruses may be transported from one field to another certain viruses spread by budding and grafting operations.
    - Yellow vein mosaic disease of Bhendi
    - It is a viral disease that is spread by whitefly – Bemisia tabaci
    - Interveinal chlorosis results in yellowing of entire leaf
    - Fruits are dwarfed, malformed and yellow green

    Causal agent is single stranded DNA. Bhendi Yellow vein mosaic virus.

    Management
    - Isolation and destruction of infected plants
    - Use of resistant cultivars Ex; Kranti
    - Insecticides can be sprayed for control of whitefly.

Q4. Write a short note on Disease escape, Diseases tolerant, diseases Immune and Diseases protection. 15 marks.

The inherent ability of a plant to resist a pathogen in called as host plant resistance

- There are certain mechanisms of disease resistance. They are disease escape, disease endurance or tolerance and true resistance.

Disease escape (Pseudo resistance)

Disease escape is prevention mechanism that causes the host escape infection.

- ✓ Early or late maturity crops avoid physical contact with pathogen. Example: Early maturing varieties of wheat escape rust and loose smut infection and early maturity varieties of groundnut escape early leaf spot infection (Cercospora arachidicola).
- ✓ Certain mechanical barriers like thick cuticle, waxy bloom on leaves may prevent penetration of fungal **senses**.

Another example of wheat that escapes ergot disease (claviceps purpurea) because in wheat flowers remain closed until pollination.

Disease endurance / tolerance

When host after infection tolerates and suffers less damage which doesn't lead to a significant yield loss. For example Potash and Phosphatic fertilizers increase disease tolerance. And in paddy silicate fertilizer are tolerant to blast disease.

Wheat crop fertilized by Potash and Phosphates is tolerant to mildew and rust.

These fertilizers arrest vegetative growth and promote early maturity and also strengthen the tissues to resist pathogenic invasion.

True resistance is ability of host plant to withstand attack of a pathogen, such resistance to heritable and less subject to environmental influence.

Protection

Prevention of pathogen from entering the host or checking further development of disease in already infected plants by application of chemicals is called as protection and chemical are called as protectants.

Protectants are non-systemic, that is they can't enter the plant system. Such chemicals are applied to soil, seeds, plant surfaces. For example: Zineb, Sulphur, Thira, Laptan.

Immunization

Improving resistance of host plant by either genetic manipulation of chemical therapy is known as immunization. For example: Bordeaux mixture (copper sulphate + lime) is useful for improving resistance against downy mildew in grapes, rust in coffee, citrus scale canker etc.

BT cotton contains genetically altered genes for resistance against Boll worm.

Q5. What is virus? How does it differ from bacteria and mycoplsama? State the important virus diseases of the following crops, their modes of spread, resistant verities and control measures 20 marks.

Viruses are ultramicroscopic, nucleoprotein entities that are obligate parasitic pathogens and can't reproduce without a host. They are devoid of enzymes and depend on the hosts protein synthesis machinery (ribosomes). Most of the plant viruses have RNA eg. TMV some contain DNA for eg. cauliflower, mosaic virus, bunchy top virus of banana.

Virus	Bacteria	Mycoplasma
Viruses are non-living when outside host and become active inside the host.	These are unicellular prokaryotes that lack chlorophyll	They are somewhere between bacteria and viruses in shape, size and function
Most primitive of the three	Primitive nucleus	They cause yellows types of diseases and transmitted by leaf hoppers
Cause Tobacco mosaic vein disease	For. Eg. Yellow ear rot of wheat by corynebacterium tritici	Sesamum phyllody
No nucleus only naked nucleoprotein		Little leaf Brinjal

BACTERIA	VIRUSES	FUNGI
Need Microscope to see them	Smaller then Bacteria	Single Cells (Yeast) or threads (Mushrooms)
Need warmth, moisture, nutrients	Depend on living hosts	Need warmth, moisture, nutrients
Divided into Aerobes and Anaerobes	'Non' Living	Aerobes or Anaerobes
Saprophytes or Parasites	Always Parasites	Saprophytes or Parasites
Can be harmful of Useful	Always Harmful	Can be Harmful or Useful
Harmful: cause diseases, eg tetanus, TB, pneumonia, sore throats, food poison-ing, Cholera etc	Cause diseases, eg Measles, Mumps, Poli, Flu, Cold Sores, Aids...	Cause diseases, may be poisonous, decay food
Uses: antibiotics, rot things		Uses: eaten, beer and bread making, antibiotics

Viral Diseases:

A). Banana- Banana bunchy top disease by single stranded virus.

- ✓ Infected plants are stunted and have bunchy leaves at the top.
- ✓ Transmission by banana aphid and by use of infected planting material
- ✓ There are no resistant varieties

- ✓ So only control is by using insecticides to kill aphids and destroy the planting material of plant quarantine laws.

B.) Rice – Rice Tungro disease caused by disease complex RTBV (Rice Tungro Bacilliform Virus)

RTSV (Rice Tungro Bacilliform Virus)

- ✓ RTBV can't be transmitted by leaf hopper (Nephotettix sp.) unless RTVS is present.
- ✓ Leafhopper transmit the disease after sucking the sap from infected plant and then from other plants
- ✓ Resistant varieties are IR36, IR50, ADT 37, Ponmani, White Ponni, Co48.
- ✓ Control of Leafhopper by spray of insecticides like Fenthion, Phorate, Carbofuran – Light trap to capture leafhopper.

C.) Tobacco – Tobacco mosaic vein disease caused by single stranded RNA TMV virus.

- ✓ Leaf shows mosaic like mottling and discolouration
- ✓ Transmission is by mechanical means by man during field operations, contact by implements.
- ✓ Control by removal and burning o infected plants.
- ✓ Resistant varieties are Jayasree (MR), VT-1158.

D.) Sugarcane mosaic disease by sugarcane mosaic virus.

Interveinal chlorosis in leaves, streaks, stripes.

- ✓ Transmitted by infected setts, mechanical means and by aphid – Aphis gossypii
- ✓ Also perpetuated by rationing
- ✓ Management – use of disease free planting material – tissue culture seedlings (meristem culture)

Sugarcane yellow leaf disease is also caused by virus and transmitted by aphid.

Control of aphid by Monocrotophos, Carbofuran application.

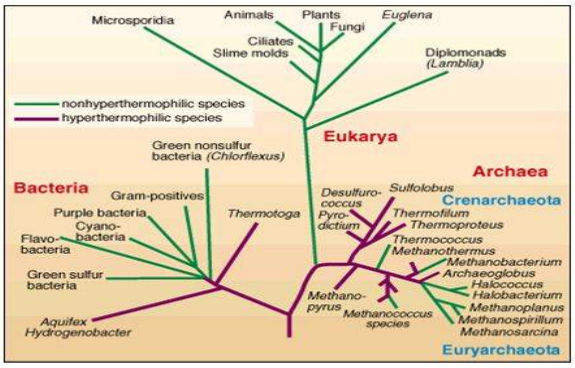
Q6. What you understand by Antibiotics? State few examples. Discuss Mode of Action and mechanisms that are producing by Antibiotics. And bring out the imp Pros and cons of using antibiotics in plant diseases control. 15 marks.

Antibiotics are compounds secreted by bio-control agents that supress growth of pathogen. For eg. Phenoxy carboxylic acid secreted by *Pseudomonas fluorescence* is used to supress all diseases of wheat..

- Streptomyces produces streptomycin that is an antibiotic (antibacterial)
- It is a broad range antibiotic against wilt, rot, blight causing bacteria.
- It can control Blight of apple, pear caused by *Erwinia amylovora*, citrus canker caused by *Xanthomonas* campestris and soft rot of vegetables caused by *Erwinia carotovora.*
- Tetracyclines like Oxymicin / Oxytetracyclins are bacteriostatic, bactericidal and mycoplasma static. Effective in controlling MLO diseases in many crops.
- Antifungal antibiotics like Aureofungin it can control diseases by Phytophthora, downy mildew, Powdery mildew of grapes and groundnut tikka leaf spot.

Definition of antibiotics

Antibiotics are compounds of natural, semi-synthetic, or synthetic origin which inhibit growth of microorganisms without significant toxicity to the human or animal host.



The key concept of antibiotic therapy is selectivity.
The independent evolutionary history of bacterial (prokaryotic) and host (eukaryotic) cells led to a significant difference in cell organization, biochemical pathways and structures of proteins and RNA.
These differences form the basis for drug selectivity.

Mode of Action

Antibiotics suppress the growth of pathogen either by killing them or just controlling their growth.

Killing action – Cidal – bacteriocidal

Controlling action – static – bacteriostatic

Streptomycin is a bacteriocidal antibiotic. They are also classified as

Antibacterial and Antifungal antibiotics

Antibacterial – Streptomycin, Tetracyclines

Antifungal – Aureofungin, Griseofulvin, cycloheximide, Blasticidin, antimycin, Kasugamycin, Indomethacin, Nystatin, Urocidin, etc.

Pros	Cons
Control a broad spectrum of diseases effectively	Chances of resistant pathogenic races developing is there due to excessive use of antibiotics
Cost effective method of disease control especially in many commercial horticultural crops.	Excessive use may lead to transfer to animals and further into human food chain
Systemic action	

Q7. What is meant by Chemotherapy? And discuss its Classification in detail? 10 marks.

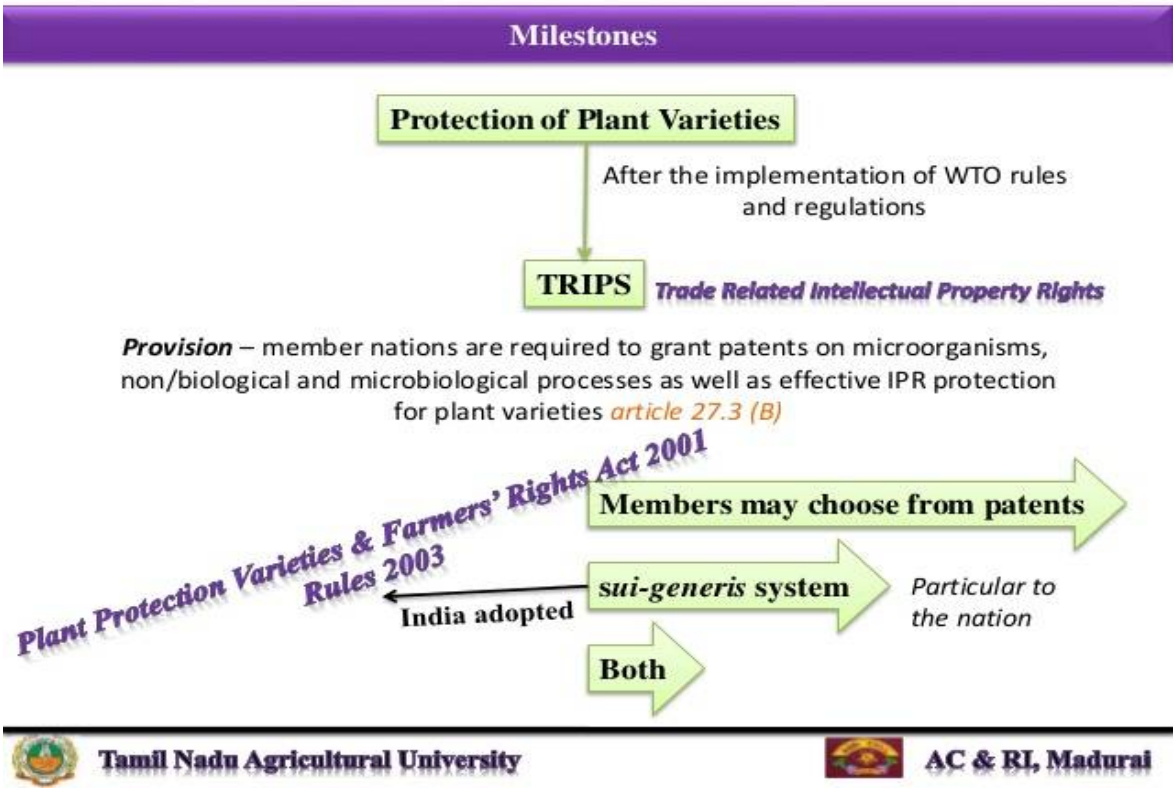
It is a method of disease control by use of chemicals to use or rejuvenate an infected plant/parts. It is a curative approach of disease control and is adopted after the infection has occurred.

- Therapy inhibits development of disease in an infected part
- Successful chemotherapy is possible with help of antibiotics in case of certain bacterial diseases such as blight of apple, pear and fungal diseases caused by Phytophthora, fusarium and botrytis.

Q8. Write a note on Quarantines? And discuss the imp features of PPV & RV Act 2003? 10 marks.

Plant quarantine can be defined as legal restriction on movement of agricultural commodities for the purpose of exclusion, prevention or delaying the spread of plant pests and diseases in uninfected areas.

In India plant quarantine rules and regulations were issued under DIPA (Destructive Insects and Pests Act) in 1914. There are 16 quarantine station in operation under Ministry of Agriculture (Directorate of Plant Protection and Quarantine).



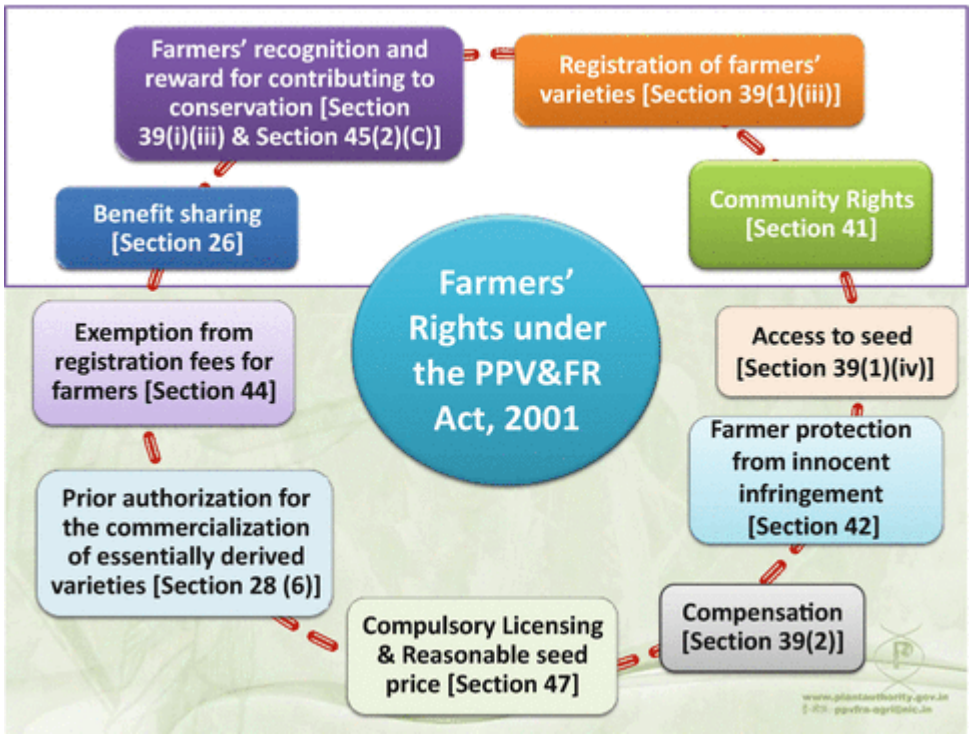
Plant quarantine measures are of 3 types

1. Domestic quarantine – that regulate movement between two or more states. For example Potato wart disease endemic in Darjeeling, West Bengal and is banned for transport to other areas.
2. Foreign quarantine – rules that prohibit / regulate movement from foreign countries. They may be general as well as for specific pests and diseases plant materials can be imported only through prescribed ports.
3. Total embargo – total restriction on export / import of agricultural commodities.

Phytosanitary certificate is obtained from country of origin before granting entry.

Protection of Plant varieties and former Right Act 2001

- ✓ Plant variety protection gives breeder's rights to local farmer's breeders.
- ✓ To make quality planting material avoidable and encourage development of new varieties
- ✓ Also encourage commercial breeders to invest in research and development
- ✓ It is in accordance with TRIPS agreement of WTO
- ✓ Farmers are given right to save seeds exchange and sell seeds / planting material, to register varieties, get benefit right to get information about performance of a variety and get compensation in case of failure.
- ✓ Certain varieties are excluded from legal protection under the act.



Q12. What is meant by Mycoplasma? Discuss the important features of Mycoplasma diseases in crop plant with examples. 12.5 marks.

Mycoplasma are a genus of bacteria that lack cell wall around their cell membrane. They are between virus and bacteria in size.

They can be either saprotrophic or parasitic and reproduce by budding and binary fission process.

They are resistant to antibiotics like Penicillin, Cephaloridine that act on cell wall but they are sensitive to tetracycline.

They are unicellular and cell contains cytoplasm, ribosomes and nucleic acid avoid of nuclear membrane (Both DNA and RNA)

- ✓ Mycoplasma present in plants as pathogen are not true mycoplasma and are further differentiated as Phytoplasma (round to elongate prokaryotes) and Spiroplasma (motile, helical prokaryotes)

- ✓ Phytoplasma are transmitted through vegetative propagation material, **lodder**, grafting/budding and also by insect vectors like leaf hoppers, psyllids, aphids plant hoppers.
- ✓ They cause yellowing of leaves, stunting of plants, sterility of flower, excessive dormant buds giving rise to witches broom appearance, dieback, Phyllody, reduced size of leaves.

1. Sesamum Phyllody – Yellowing of leaf conversion of floral parts into green leafy structures is called phyllody. Thus diseased plants become sterile other symptoms are win clearing, profuse branching, shortening of internodes. Disease is spread by leaf hopper.
2. Brinjal little leaf
    - ✓ Reduced size leaves, shortening of sterility – Bushy pants due to stimulation of axillary buds.
    - ✓ Spread by leaf hopper
3. Rice yellow Dwarf – Narrow yellow leaves and dwarfing in plants. Transmitted by *Nephotettix virescens*, Green leaf hopper

Q13. Differentiate the Symptom Vs Sign. And Preventive Vs Curatives measures in plant diseases management. 10 marks.

Signs are physical evidence of pathogen in form of primary or secondary, vegetative or reproductive structures for eg. Mildews, mycelium, ooze, rhizomorphs.

Symptoms on other hand are plant's expressions of being diseased for eg. Blights, canker, rots, necrosis, spots, galls etc.

- Symptoms may appear locally at point of infection or systemically i.e. all over the plant body.
- They reflect an abnormality in plant's physiological, structural systems.
- Both signs and symptoms are used for diagnosis of plant diseases.

Preventive is curative

Measures of plant disease control are classified as either preventive or curative.

Measures that aim at prevention of disease from occurring are called preventive. These methods are avoidance, exclusion, eradiation, protection. All these aim at somehow preventing contact between pathogen and host plants (before infection prophylactic). Whereas curative measures are therapy methods that are used after infection has taken place. In case of use of chemicals it is called as chemotherapy, physical methods are also utilized in therapy like hot water treatment, aerated steam treatment.

Q14. What is meant by Biocide. Why Biocide is need in Plant Protection? Discuss Its Classification in detail with examples. 20 marks.

A biocide is a living organism that is used to restrict activity of other target organism. Viral particles, fungal spores, their metabolites, plant extracts are used in management of pest, diseases and weeds are called biocides. A natural biocide is penicillin. An ideal biocide must be environmentally safe, biodegradable and renewable.

Why Biocides?

Chemical like fungicides, antibiotics have various harmful effect on the environment and also other human food chain. But in case of biocides their activity is mostly restricted to target organism and also they are more environment friendly. They are also more cost effective.

- No risk of bio-magnification, in food chain.
- No risk of resistance in pathogen
- Also due to narrow spectrum action on target organism alone, beneficial micro-organisms are not harmed.

Types of Biocides

Main classes of biocides are

- Microbial Biocides (derived from Micro-organism)
- Botanical Biocides (derived from Plant)

Microbial Biocides

- Viral insecticides Baculovirus NVP (Nuclear polyhedrosis virus) on cotton boll worm
- Bacterial-insecticides (fungal) – Bacillus Thuringiensis on cotton boll worm
- Mycofungicides (fungal) – Trichoderma, Gliocladium – against roseum grey mould.
- Myco-insecticides (fungal) – Beauveria bassiana Metarhizium
- Fungal – nematicides – Paecilomyces, Nematophagous fungi
- Myco herbicides – Phytophthora palmivora, Colletotrichum gloeosporioides

Botanicals

- Insecticides: From extracts of Neem, Pyrethrum, Nicotine (tobacco), Karanj oil Mahua oil
- AVP- Antiviral principles-against viruses from extracts of Phyllanthus niruri, against TMV

  AVP used in groundnut and Tobacco mosaic virus diseases.

Q15. What is meant by Pathology? And mention the Objectives of plant Pathology? Note on Scope and Significance of Plant Pathology. 12.5 marks.

Term pathology is derived from Greek term "Pathos" and "logos" meaning suffering and study. So, Plant Pathology is the study of suffering of plants, when a plant is suffering and not functioning normally it is said to be diseased. Due to this productivity of plant is reduced.

Objectives of Plant Pathology

1. To study living, non-living and environmental causes of plant diseases
2. To study mechanism of disease development by Pathogens
3. To study interactions between plants and pathogens
4. To develop methods of controlling diseases and reducing losses caused by them.

Scope and significance of plant pathology

Based on these objectives the scope of Plant Pathology is very wide and covers study a disease causing pathogens as well as their management strategies. As newer diseases are coming up or older pathogens

are becoming more resistant, the research for new, more innovative chemicals, technologies is being done.

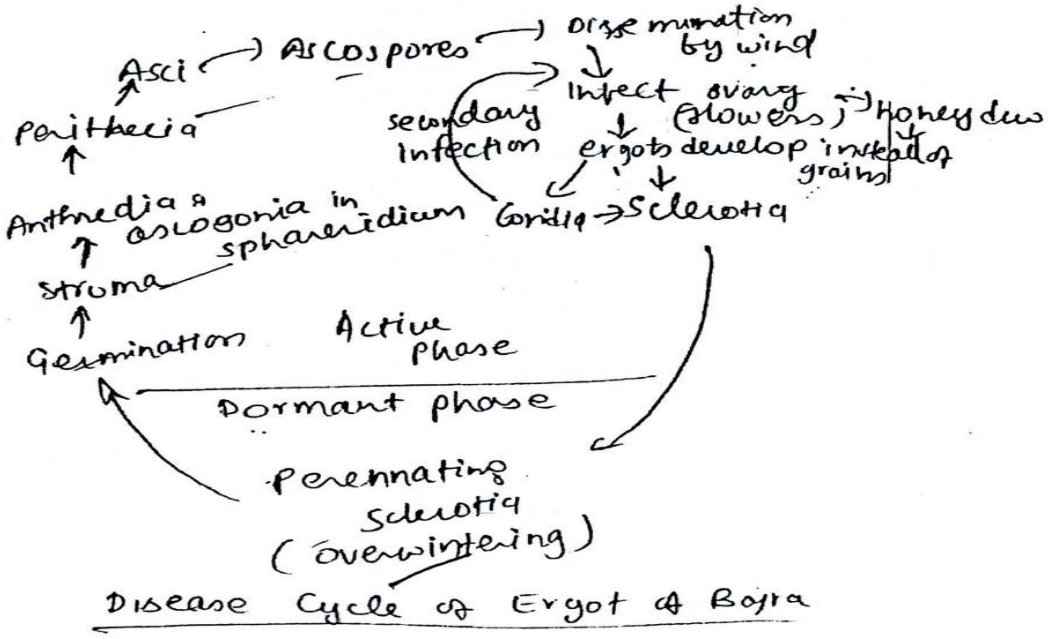
As far as significance of phytopathology is concerned, various historical famines like Irish famine or Bengal famine were caused by various diseases. Thus to ensure food security, we need to be well versed with science as well as management strategies in plant pathology.

To put food on our tables as well as to give a decent return to farmers we need to develop efficient, cost effective disease management strategies for which we need to stem on plant pathology.

Q16. Write the Diseases cycle for Ergot of Bajara? And list the imp control measures for its. 10 marks.

Ergot is a disease of cereals crops caused by fungus *Claviceps purpurea*

- It reduces yield and quality of grans
- Toxins by the fungus cause ergotism in animals a humans.
- The fungus is an ascomycetes that form sclerotium ascospores and condia.
- Sclerotia is also used economically for production of LSD – Lysergic Acid Diethylamide which is a hallucinogenic drug.



Disease can be controlled by:

Cultural Methods

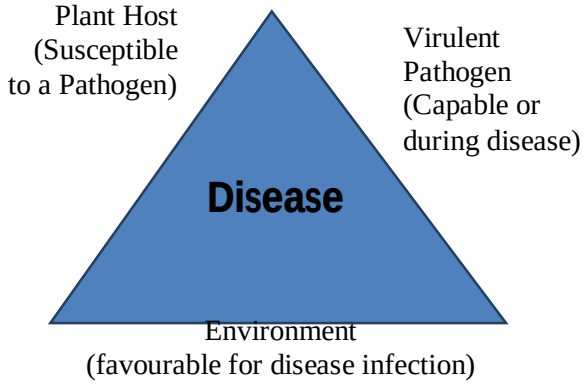
1. Sowing of ergot free seeds by soaking seeds in 32% KCl or NaCl solution. Seeds will sink and sclerotia will float
2. Sanitation – Clearing wild hosts that may serve as source of secondary inoculum
3. Crop rotation – with legumes (non-susceptible)

4. Deep Ploughing – Presents germination of sclerotic as sclerotic are brie deep.

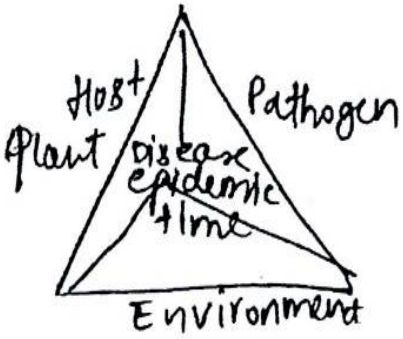
Q17. Write a note on Disease triangle and Disease Pyramid? And Discuss the Classification of diseases. 12.5 marks.

In order for a disease to occur, 3 conditions must be met. First is a susceptible host plant, which can be infected by a virulent pathogen and their the presence of favourable environment for infection to occur.

This interaction between host, pathogen and environment can be represented by a triangle.



Disease pyramid – disease pyramid described how a disease can actually destroy a plant. In addition to all 3 factors above, time is also required for a disease to cause damage and develop into an epidemic.



Also environment conditions may change with time affecting how a disease develops. Symptoms show early on younger plants whereas they reflect late in older plants.

Classification of Diseases

Plant diseases are classified based on causes of disease – Pathogenic or non-pathogenic

A.) Parasites – Parasitic diseases are caused by either biotic or mesobiotic agents

i. Biotic agents – living organism or animate causes

Prokaryotes

- ✓ Bacteria eg. Citrus canker
- ✓ Rickettsia bacteria like eg. Citrus greening
- ✓ Mycoplasma like – Sesamum
- ✓ Organisms (MLO) – Corn stunt
- ✓ Parasitic plant – Broomrape of tobacco
- ✓ Animals – Nematodes – Root knot

Eukaryotes

- ✓ Protiets
- ✓ Fungi - Potato blight.

- ✓ Protozoa rot of coconut
- ✓ Algae – Red rust of mango

ii. Mesobiotic agents – virus (Tobacco mosaic vein disease) and viroids (spindle tuber of potato)

B.) Non-Parasitic-Abiotic agents

- ✓ Physiological diseases – caused by environmental factor – eg. deficiency diseases
- ✓ Temperature – Soil
- ✓ Nutrients – Toxicity – Acidity / Alkalinity
- ✓ Sunlight – lack of Oxygen
- ✓ Soil moisture – Pesticides toxicity

Q18. Write a note on Necrosis and its Symptoms. And Differentiate the Hyperplasia and Hypoplasia. 10 marks.

Necrosis means death of tissues.

It is a symptom of a disease or distress that plant is experiencing. It occurs in form of dark watery spots on leaves, fruits or dry papery spots that are brown or black coloured.

- ✓ Disease is a common cause of necrosis but environmental factors like weather, water availability, nutrient deficiency, pest attack may also cause necrosis.
- ✓ Blossom rot o tomatoes (calcium deficiency), frost damage also produce feature like necrosis but actually occur due to environmental factors.
- ✓ Erwinia causes soft rot – example of necrosis
- ✓ Various necrotic symptoms are blight, carica, rot, dumping ,..… streaks, spots, anthracnose, etc.

Hypoplasia	Hyperplasia
• Atrophy-reduction in size of plant parts	• Hypertrophy enlarged plant parts
• Hypoplasia is failure of plant parts to develop fully due to decrease production of cells	• Hyperplasia is enlargement of plant parts due to increase in number of cells produced
• It causes subnormal size	• It caused over development in size
• Atrophy is decrease in size of cells whereas hypoplasia is reduced cell division Example • Resetting of groundnut due to viral disease dwarfing, stunting • Supressed floral buds due to *Peronospora brassicae* in mustard	Example: • Curb root of cabbage caused by *Plasmodiophora brssicae* causes hyperplasia hypertrophy of roots, which become club shaped • Hypertrophy is due to abnormal enlargement whereas hyperplasia is due to abnormal cell division. • Example- Curling, galls, knots, witch's broom

20. Differentiate the Powdery Mildew with Downey Mildew. And bring out Scope and Impacts of Endosulphan Chemical in India. 15 marks.

Downy mildew a powdery mildew are common diseases of grapes.

Downy mildew caused by *Plasmosphora viticola*

Powdery mildew caused by Erysiphe necator

	Downy Mildew	Powdery Mildew
Condition	High humidity, cool temperature, wet leaves for spores germination	High humidity moderate temperature don't need wet leaves high humidity is enough
Infection symptom	✓ Lower surface of leaves have purple to blackish spots ✓ Later turn yellow ✓ Leaf dies fast ✓ Older leaves affected first	✓ Whitish powdery growth on upper surface of leaves ✓ Leaves become brittle, dry and die away.
Management	✓ Improve air circulation by proper pruning ✓ Wider spacing ✓ Avoid over head irrigation ✓ Irrigate early in day for allowing leaves to dry ✓ Remove dry branches, leaves ✓ Spray Bordeaux mixture	✓ Pruning to allow proper aeration, sunlight penetration ✓ Remove dried leaves, stem, ✓ Bordeaux mixture, Dinocap, Potassium bi carbonate spray, sulfur

Other Important Diseases:

1. Tomato mosaic disease

Caused by Tomato mosaic virus foliage of affected plant shows mottling alternating yellow, green area on leaves. Leaves become fern like and twisted. Fruits may be distorted with necrotic spots and internal browning of fruit wall. Virus can overwinter on weeds and is transmitted by aphids, leaf hoppers whiteflies. Also transmitted by mechanical means, grafting.

Control: No chemical control available, so, sanitation is most important application for controlling isolation and destruction of affected seedlings.

- Keeping the field weed free
- Controlling vector insect pests by chemical insecticides
- Crop rotation with non-susceptible crops for alternate seasons
- Donut plant susceptible crops like cucumber, tobacco beans, squash etc.

2. Leaf curl of chilli – caused by chilli leaf curl virus

- Can infect all stages of the crop
- Leaves curl towards midrib and become deformed stunted plant growth
- Flower buds abscise before full size.
- Anthers don't contain pollen grains

- Transmitted by white fly
- Control by chemical control of whitefly is helpful in controlling the disease- imidacloprid, Dimethoate.
- Sanitation and maintaining weed tree fields.

3. Late Blight of Potato

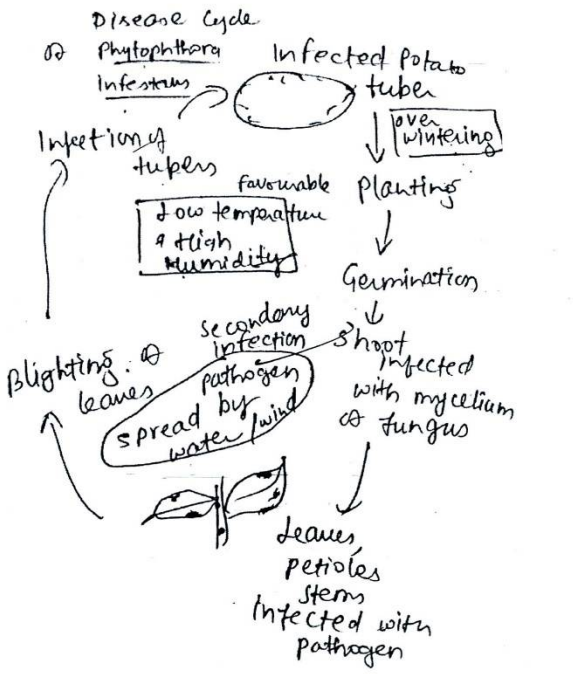
Caused by fungus *Phytophthora infestans* in India disease occurs in Himalayan region right from Kashmir to Assam.

- It affects the crop in rainy season.
- Drought and high temperature kill the fungus in soil. So, moderate temperature of rainy season is favourable for infection (20-25^{o}C)
- Crops grown in plains are usually hot infected because of factors of temperature and moisture that do not favour growth of fungus
- But slowly the crops in Indo-gangetic plain, UP, Bihar, West Bengal are also being affected.

4. Late blight of Potato:

Disease epidemic causes huge damage to the crop of Potato. Plants are stunted, size of tubers is reduced and thus economic value is reduced. Also the number of tubes is reduced.

- In severe cases, these may be complete loss of crop. Infection also leads to decay of tubers in field and in storage.
- Symptoms appear when conditions are favourable for infection (January).
- Purple black lesions appear on leaves, stem, and gradually the size of lesions increase until they cover entire leaf surface.
- First symptoms appear on lower surface and the spread upwards
- Finally the blighted (cause shrivel and curl and dry out [decay])
- After blighting on top, tubers are also affected. Tubers are shrunken, rotten and corky with brown discolouration on inside.



Spread – Infected tubers are primary source of infection. The survival of fungus in soil is short lived. Therefore fungal mycelium overwinter in infected tubers and becomes active at time of germination, planting of tuber.

Control / Management

- Disease free tubers to be used for planting. Tuber treatment before planting
- Storage of tubers at 0.4^{o}C to check growth of pathogen

- Disease resistant varieties
- Use of protectant fungicides
- Foliage spray of Blitox, Fytolan, Pithane
- Dusting wit copper-time
- Sanitation of affected plants, tubers
- Tuber treatment with Mercuric chloride (1:1000)

5. Bunchy top of Banana (Introduced from Sri Lanka)

- Caused by Banana Bunchy top virus (single stranded DNA virus)
- Infected plants are stunted and have bunchy leaves (Dwarfed / 30-60 cm height)
- Transmission of virus is through propagative material suckers, rhizome. Vector – Aphid.
- Leaves show yellowing no bunches of fruit are produced
- Banana aphid – Pentalonia nigronervosa
- Disease is prevalent in tropics where environment is suitable as well as vector is present.

Management

- No resistant varieties
- So, control by chemical control of Aphids
- Roguing – removal of infected plants
- Plant quarantine regulation to prevent introduction through infected planting material, leaves, stem, etc.
- Use of tissue culture, disease free planting material.

6. **Bakanae disease of Rice / Foot rot** also called foolish seedling disease it is a seed borne fungal disease caused by fusarium moniliforme also known as Gibberella fujikuroi.

- It causes 15% loss in UP and Assam area and a major disease in Haryana.
- Symptoms are abnormal elongation of plants. Drying of leaves.
- Thin plants with yellowish leaves and pale green flag leaves
- Root rot happens and seedlings may die before or after transplanting.

Transmission happen by wind, water that carry fungal spores from one plant to another

- Primary infection by infected seeds or pathogen present in soil

Management – Use of clean seeds

- Use of salt water to separate infected seeds (that float)
- Seed treatment with fungicide
- (Benomyl thiram) – use of resistant variety IR6, K5-133
- Rogueing of infected plants to prevent secondary infection.

7. Wilt of Tomato

	Bacterial wilt	Oxysporum wilt (Root Rot)	Tomato spotted wilt (TSW)
Caused by	Bacteria *Pseudomonas solanacearum*	Fungus *Fusarium oxysporum* f.sp. *lycopersicon*	TSW virus
Symptoms	• Wilting of Plant • Stunting • Yellowing of entire plant • Browning of vascular system	• Chlorosis of leaves dropping and wilting • Whole plant dies • Plant roots and stem break open	• Wilting • Dark spot on leaves • Concentric rings on fruits • Streaks on stems
Transmission	Soil borne pathogen	• Seed borne • Fungus over winter in soil	By thrips
Management / control	Crop rotation with cruciferous vegetables in recommended	• Seed treatment • With *Trichoderma viridae, carbendazim* • Crop rotation with a non-solanaceous crop • Summer ploughing	• Control of thrips • Insecticides • Carbofuran granules application • Rogueing and destroying infected plants
Favourable condition	High humidity moist soil, weather rains	High soil moisture and temperature	Humid conditions that encourage thrips attack

8. Powdery mildew of grapes

Caused by fungus *Erysiphe necator*

- Disease appears as whitish gray powdery coating on leaves or fruit due to growth of fungal mycelium on plant surface
- Initially chlorotic lesion of upper surface of leaves that later turn into whitish lesions.
- Infected grape fruits (berries) may shrivel, split and may not ripen properly affecting quality.
- Favourable condition – High humidity and moist weather
- Transmission – fungus overwinter in dormant buds or surface of vines in favourable conditions, spores are released and new infections occur. Secondary infections from spores of these initial infections.
- Management – chemical spray of Dinocap, sulphur, potassium, Bi carbonate solution (in case of cloudy humid conditions)
- Bordeaux mixture
- Training and pruning to promote are action and light penetration
- Removal of dried leaves to eliminate overwintering spores / structure.

10. Rice Tungro disease

- Caused by complex of RTSV (Rice Tungro Spherical Virus) and RTBV (Rice Tungro Bacilliform Virus). Rice Tungro Spherical Virus helps in transmission of Rice Tungro Bacilliform Virus i.e. Rice Tungro Bacilliform Virus that together cause Rice Tungro disease.
- Plants exhibit stunting (dwarf, grassy stunt) and reduced tillering leaves become yellowish
- Delayed flowering, panicles aresterile or partially filled grains
- Disease affects all stages of growth

Transmission by green leaf hopper Nephotettix virescens and zig Zag leaf hopper Nephotettix nigropictus.

- Presence of vector and susceptible variety favour disease development
- Management – growing resistant cultivars like IR-36, IR-50, ADT37, Ponmani, Co-48.
- Controlling leaf hopper by spray of Fenthion, Phorate, Carbofuran application
- High trap to capture leaf hopper
- Neem cake @ 12.5 kg/ 20 cents in nursery
- Carbofuran application in nursery