

**Practical manual
on
Diseases of Field and Horticultural Crops and Their
Management - I**

Course No. PPA-312, Credit Hrs. 3(2+1)

**For
B.Sc. (Agri.) III Year (V Semester)**



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2024

**Department of Plant Pathology
College of Agriculture
Chandrashekhar Azad University of Agriculture and
Technology, Kanpur-208001**

Syllabus: Diseases of Field and Horticultural Crops and their Management-I APP 338 3(2+1)

Practical: Identification and histopathological studies of major diseases of the field and horticultural crops. Diagnosis of field and horticultural crop diseases during field visits. Collection and preservation of plant-diseased specimens for Herbarium

Name of Student

Roll No.

Batch

Session

Semester

Course Name:

Course No.:

Credit

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CERTIFICATE

This is to certify that Shri./Km. ID No. has completed the practical of course course No. as per the syllabus of B.Sc. (Hons.) Agriculture/ Horticulture/ Forestry semester in the year in the respective lab/field of College.

Date:

Course Teacher

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Experiment No. 1

Objective: Preparation of temporary mounts (slides) and stains.

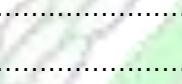
Activity:

1. Write the use and the composition of Lactophenol Cotton Blue.
2. Mount the diseased sample provided to you in a Lactophenol cotton Blue.

Materials Required:

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Procedure:



Preparation of Fungal Stain:.....



Use of Stain:

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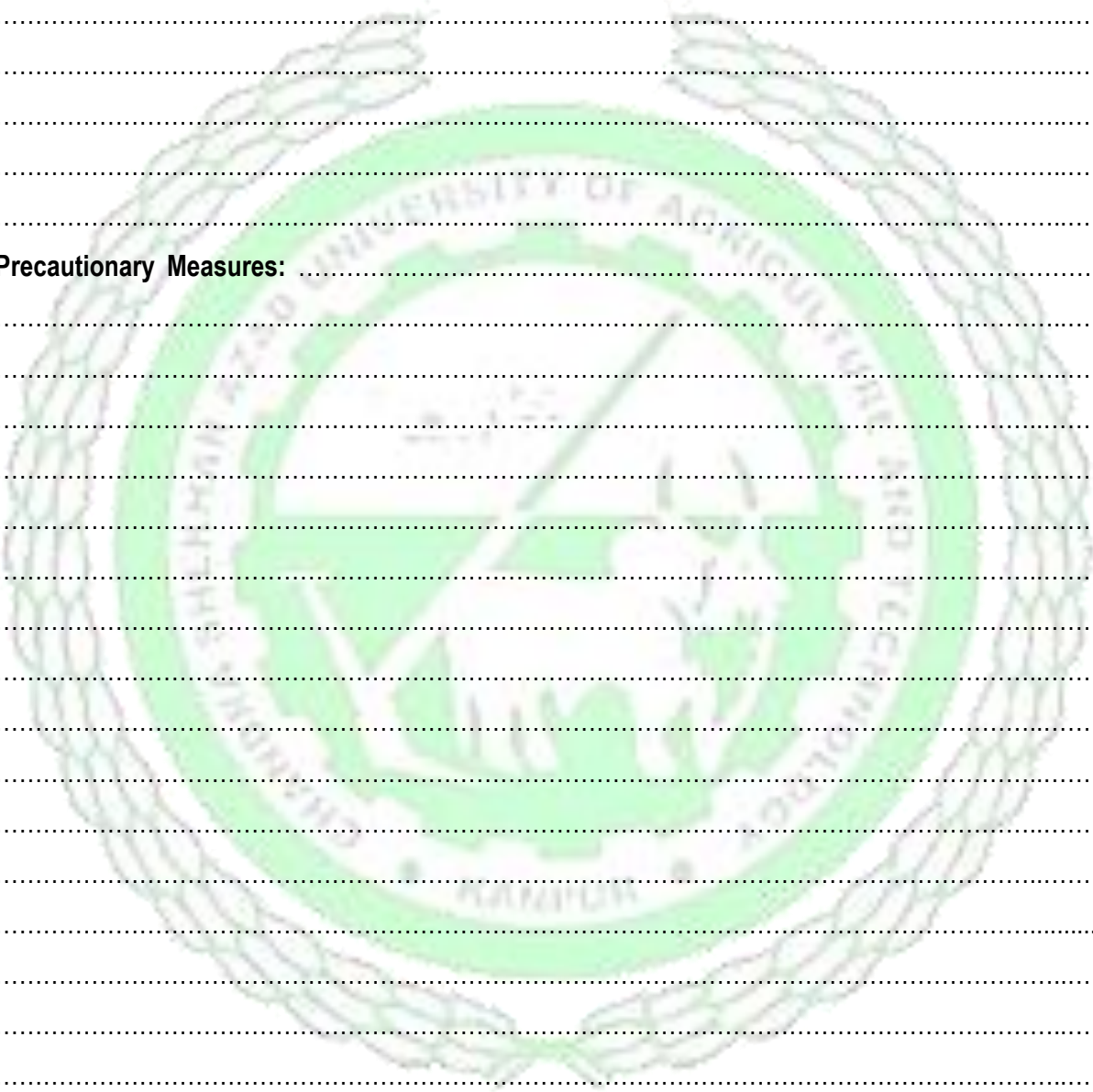
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Experiment No. 2

Objective: Detection and dry preservation of plant-diseased specimens for the herbarium

Activity: Collect twenty disease samples of field and horticultural crops from university research farms and prepare a herbarium with the following details below:

- a. Host (name of the diseased plant)
- b. Name of the pathogen (organism causing the disease)
- c. Place/area where collected
- d. Date of collection
- e. Name of the collector

Materials Required:

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Procedure for Dry Preservation:

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Preparation of Specimen:

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Experiment No. 3

Objective: Detection, collection and wet preservation of plant-diseased specimens

Activity:

1. Prepare FAA solution for preservation of plant disease sample.
2. Collected disease samples preserved in the glass bottle following the wet preservation protocol.

Materials Required:.....

Procedure for Wet Preservation:

Preparation of Formalin Acetic Acid Alcohol (F. A. A):

Experiment No. 4

Objective: Detection and identification of brown spots of rice pathogen

Activity: Prepare a slide to identify the pathogen from the diseased samples provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:



Microscopic:



Identification:.....

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Experiment No. 5

Objective: Detection and identification of sheath blight of rice pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

Microscopic:

Identification:.....

Experiment No. 6

Objective: Detection and identification of maize turcicum and maydis leaf spot pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

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Microscopic:

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Identification:

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Experiment No. 7

Objective: Detection and identification of sorghum anthracnose pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

Microscopic:

Identification:.....

Experiment No. 8

Objective: Detection and identification of ergot of pearl millet pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

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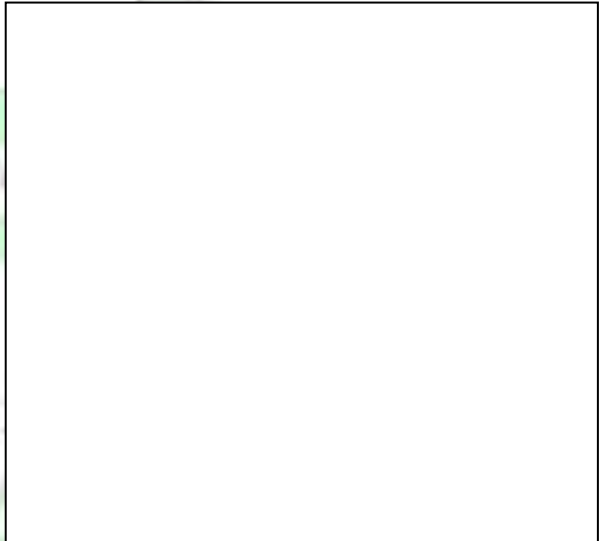
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Microscopic:

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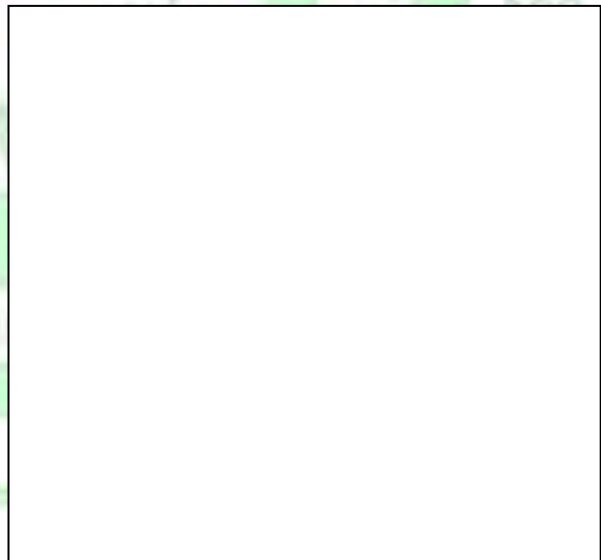
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Identification:

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Experiment No. 9

Objective: Detection and identification of groundnut leaf spots pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

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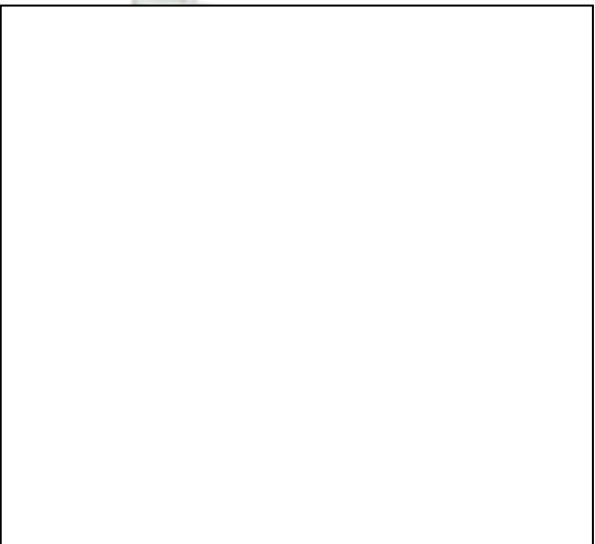
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Microscopic:

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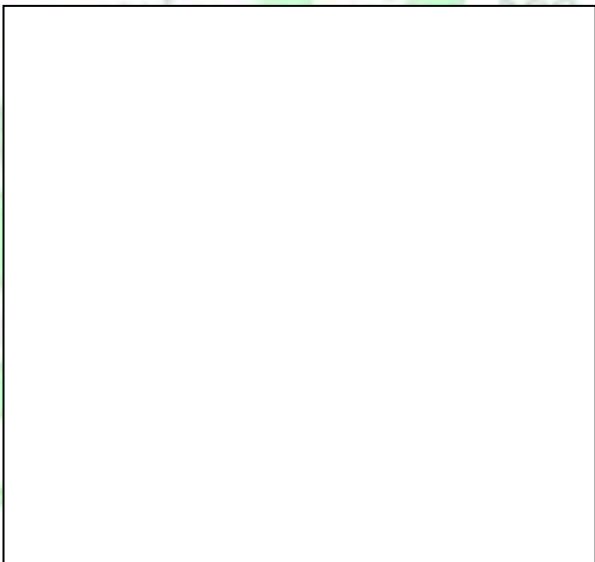
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Identification:.....

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Experiment No. 10

Objective: Detection and identification of pigeon pea phytophthora blight pathogen and sterility mosaic disease

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:



Microscopic:



Identification:.....

Experiment No. 11

Objective: Detection and identification of black and green gram anthracnose pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:



Microscopic:

Identification:.....

Experiment No. 12

Objective: Detection and identification of guava anthracnose pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

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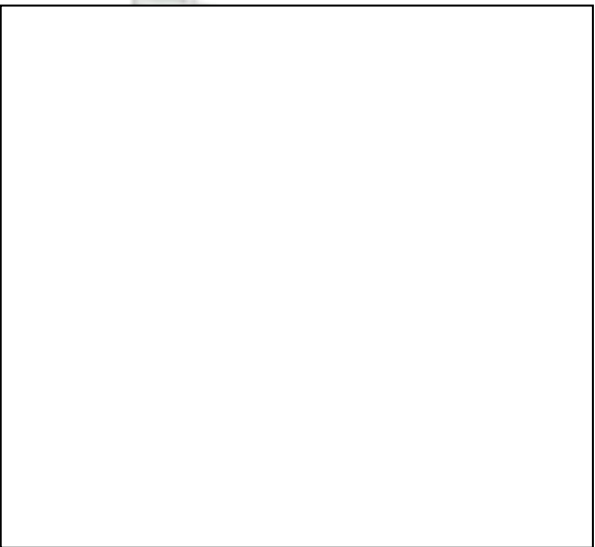
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Microscopic:

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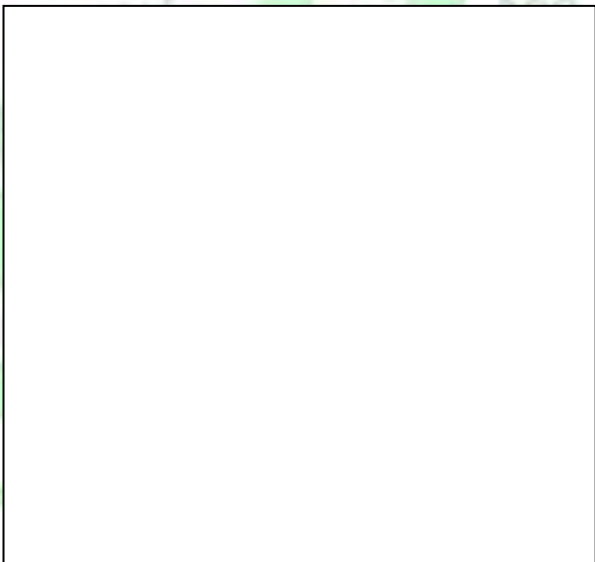
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Identification:.....

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Experiment No. 13

Objective: Detection and identification of papaya leaf curl disease

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

100

Identification:.....

Experiment No. 14

Objective: Detection and identification of pomegranate bacterial blight disease

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	5
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Identification:.....

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Experiment No. 15

Objective: Detection and identification of brinjal phomopsis blight and fruit rot pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

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Microscopic:

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Identification:

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Experiment No. 16

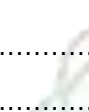
Objective: Detection and identification of tomato leaf curl disease

Activity Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:



Identification:.....

Experiment No. 17

Objective: Detection and identification of tomato early leaf blight pathogen

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

Microscopic:

Identification:.....

Experiment No. 18

Objective: Detection and identification of yellow vein mosaic disease

Activity: Prepare a slide to identify the pathogen from the disease sample provided to you. Draw neat and clean diagrams of characteristic symptoms and spores observed under the microscope.

Materials Required:

Observations:

Symptoms:

[illegible]

Identification:.....

TEMPORARY MOUNTS AND STAIN

Procedure:

1. Take a neat and clean glass slide and cover slip then put a drop of water on the slide.
2. Add the infected plant sample to the drop of water. The specimen is properly aligned on the slide with dissecting needles. In numerous cases, specimens must be torn and teased apart with needles.
3. The cover slip is placed on top of the sample. This is done by placing one edge of the cover slip on the glass slide in contact with the drop of water. Using the tip of a dissecting needle, gently lower the coverslip into position.

Fungal Stain:

Lactophenol Cotton Blue: It is used as a staining and mounting agent for staining fungal structures. It has the following constituents:

Phenol (pure crystals)	-	20 gm
Lactic acid	-	20 gm
Glycerine	-	40 gm
Water	-	20 ml.
Cotton Blue	-	In traces (0.5%)

Mounting Agent:

Gelatin	-	1.0 g
Glycerine	-	7.0 g
Water	-	6.0 ml
With the addition of phenol	-	1%

Use of Stain:

- (i) It helps in proper visualisation and correct study of the micro-organisms under the microscope.
- (ii) It differentiates the host tissue and the micro-organism.
- (iii) It helps in the identification of the parts of the micro-organism.

Precautionary Measures:

1. Always use thin planting material on the slide. Only very thin objects can be studied with the compound microscope.
2. The cover slip must lie flat.
3. The specimen and area under the cover slip must be flooded with the mounting medium. Avoid the presence of water on the rest of the slide or top of the coverslip.

DRY PRESERVATION

Materials Required: Polythene bags, Newspaper, Pruning shear, knife, Scissors, Hand lens, Pencil, Ink markers, Plant press, Paper bags, Envelopes, blotting sheets methyl bromide

Specimen: A herbarium specimen may be a single sporocarp or a portion of it, dried culture, slide or the material on its host or substrate (e.g. leaf, stem, bark, rock, soil, paper, cloth). Two types of preservation methods are used for diseased plant specimen: Dry preservation and Wet preservation.

Procedure for Dry Preservation:

1. **Collection and drying:** The sample should have distinctively visible symptoms. Dry the specimen in a layer of blotting sheets under sunlight or in a hot air oven for a few days.
2. **Labelling and packaging:** The material should be kept in good herbarium packets. This is attached to a chart paper sheet. The two sides of a packet are folded first then the bottom flap and finally the top flap. The name of the pathogen, host, locality, date, and name of a scientist who identified the specimen, should be mentioned on the label.
3. **Disinfection and storage:** Bundles of specimens (15-20) packed in double-layered polythene bags are tightly sealed and exposed to **-20°C** for 48-72 hours at 6-8 months intervals.

4. **Preparation of Specimen:** A specimen should ideally be 25–40 cm long and up to 26 cm wide, allowing it to fit on a standard herbarium mounting sheet which measures 42 x 27 cm. This is also the approximate size of tabloid newspapers. Plant parts that are too large for a single sheet may be cut into sections pressed on a series of sheets, for example, a palm or cycad frond. Long and narrow specimens such as grasses and sedges can be folded once, twice or even three times at the time of pressing. In this way a plant of up to 1.6 metres high may be pressed onto a single sheet. For very small plants, a number of individuals may be placed on each sheet.

WET PRESERVATION

Preservative is a chemical which is used to fix (to maintain) the tissues of plants and animals for a long time so that decomposition does not take place. Chemicals are used to kill, preserve and fix plant/animal tissues and specimens in such a way that they retain their original shape, form size and structure. These make the tissues hard and prevent them from decaying. A fixative must penetrate rapidly the tissue removed from the body.

Procedure:

1. Washed fresh diseased specimens are put in a boiling mixture of 1 part glacial acetic acid saturated with normal copper acetate crystals and 4 parts water till the green colour reappears and then preserved in 5 per cent formalin in the glass jars.
2. All mounted or preserved specimens must be labelled with as much of the following information as far as possible:
 - a. Host (name of the diseased plant)
 - b. Name of the disease Parasite (the name of the organism causing the disease)
 - c. Place where collected (nearest town and state is usually sufficient)
 - d. Date of collection
 - e. Name of the collector

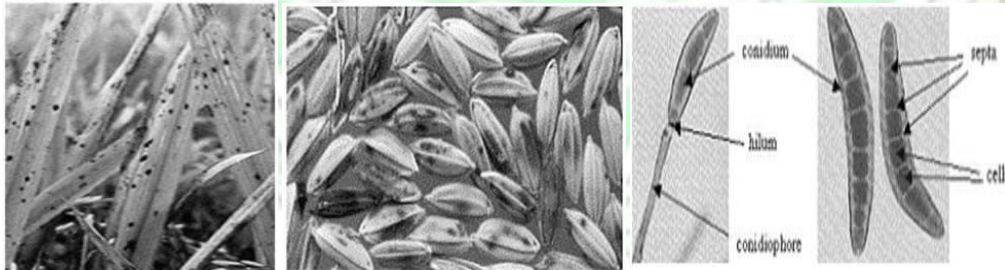
Preparation of Formalin Acetic Acid Alcohol (F.A.A.): It is a very good fixative and tissues could be left in it for a long period without any harm.

Composition: 50% Alcohol - 100 ml; 40% Formaldehyde - 6.5 ml; Glacial Acetic Acid - 2.5 ml

BROWN SPOT OF RICE (*Oryza sativa*)

Symptoms

- Minute spots on the coleoptile, leaf blade, leaf sheath, and glume
- Spots most prominent on the leaf blade and glumes
- The spots become cylindrical or oval, dark brown with a yellow halo later become circular
- Several spots coalesce and the leaf dries up
- The seedlings die and affected nurseries can be often recognised from a distance by scorched appearance
- Dark brown or black spots also appear on glumes leading to grain discoloration
- It causes failure of seed germination, and seedling mortality and reduces the grain quality and weight



Microscopic

Pathogen- *Helminthosporium oryzae* (Syn: *Drechslera oryzae*, *Bipolaris oryzae* (Perfect stage: *Cochliobolus miyabeanus*))

- Mycelium - brown septate
- Conidiophores - single or in small groups, geniculate, brown
- Conidia - pale to golden brown, usually curved with a bulged centre and tapered ends, 6-14 septate

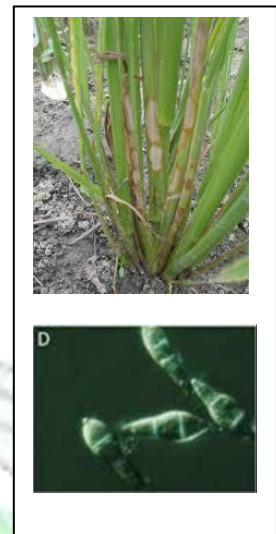
SHEATH BLIGHT OF RICE (*Oryza sativa*)

Symptoms

- Initial symptoms appeared on leaf sheaths near the water level,
- On the leaf sheath oval or elliptical or irregular greenish-grey spots are formed,
- As the spots enlarge, the centre becomes greyish-white with an irregular blackish-brown or purple-brown border,
- Lesions on the plants' upper parts extend rapidly coalescing to cover entire tillers from the water line to the flag leaf,
- In severe cases, all the leaves of a plant may be blighted
- The infection extends to the inner sheaths resulting in the death of the entire plant,
- Older plants are highly susceptible,
- Plants heavily infected in the early heading and grain-filling growth stages produce poorly filled grain, especially in the lower part of the panicle,

Microscopic

- **Pathogen: *Rhizoctonia solani*** (Imperfect stage),
- *Thanatephorus cucumeris* (Frank.) Donk (Perfect stage),
- The fungus produces septate mycelium which is hyaline when young, yellowish brown when old,
- It produces a large number of spherical brown sclerotia.



MAYDIS AND TURCICUM LEAF SPOTS OF MAIZE (*Zea mays*)

Symptoms (Maydis)

- The fungus affects the crop at a young stage
- Early symptoms are oval, water-soaked spots on leaves
- Mature symptoms are characteristic cigar-shaped lesions that are 3 to 15 cm long
- Lesions are elliptical and tan in colour, developing distinct dark areas
- Lesions typically first appear on lower leaves, spreading to upper leaves and the ear sheaths as the crop matures
- Under severe infection, lesions may coalesce, blighting the entire leaf

Symptoms (Turcicum)

- Affects the crop at a young stage
- Small yellowish round to oval spots are seen on the leaves
- Spots gradually increase into bigger elliptical spots and are straw to greyish brown in the centre with dark brown margins
- The spots coalesce giving a blighted appearance
- The surface is covered with olive-green velvety masses of conidia and conidiophores

Microscopic

Pathogen - *Helminthosporium maydis* (Syn: *H. turcicum*)

- Conidia are distinctly curved, fusiform, pale to mid-dark golden brown with 5-11 septa
- Conidiophores are in groups, geniculate, mid-dark brown, pale near the apex and smooth

Pathogen – Pathogen – *Exserohilum turcicum*

- The conidia are 18-23 u wide and 73-137 u long with 4-9 septa and born singly at the tips of the conidiophores.
- The conidial shape is fusoid, obclavate, straight, or curved; the hilum is strongly protruding.
- Conidia germinate commonly from one or both polar cells, rarely from intermediate cells.
- The conidiophores (7-11 x 165-283 u) are brown, irregularly cylindrical and 3-7 septate.
- They emerge in groups of two to six or more through stomata, or less frequently directly through the epidermis.



ANTHRACNOSE OF SORGHUM (*Sorghum bicolor*)

Symptoms

- The fungus causes both leaf spot (anthracnose) and stalk rot (red rot)
- The disease appears as small red-coloured spots on both surfaces of the leaf
- The centre of the spot is white encircled by a red, purple or brown margin
- Numerous small black dots like acervuli are seen on the white surface of the lesions
- Red rot can be characterized externally by the development of circular cankers, particularly in the inflorescence
- Infected stem when split open shows discoloration, which may be continuous over a large area or more generally discontinuous giving the stem a marbled appearance



Microscopic

Pathogen - *Colletotrichum graminicolum*

- Fungus mycelium is localised on the spot
- Acervuli with setae arise through the epidermis
- Conidia are hyaline, single-celled, vacuolate and falcate in shape

LEAF SPOTS OF GROUNDNUT (*Arachis hypogaea*)

Symptoms: Tikka disease/Early leaf spot and Late leaf spot

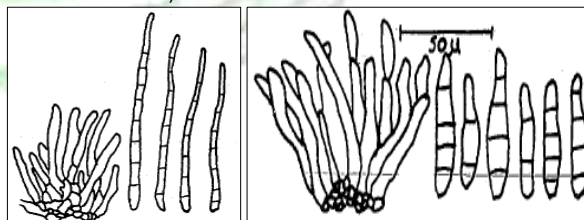
Early leaf spot	Late leaf spot
Appears within a month after sowing	Appears towards the maturity of the crop
Lesions are brown when seen on the undersurface of the leave	Carbon black
Spots encircled by a bright yellow halo	Yellow halo is absent
Spots are circular to irregular 1-10 mm in dia., larger than late leaf spot	Spots are smaller 1-6 mm in dia. and more circular than early leaf spot
	

Microscopic

Early leaf spot

Pathogen - *Cercospora arachidicola* (Sexual Stage: *Mycosphaerella arachidis*)

- The fungus produces abundant sporulation on the upper surface of the leaves
- Conidiophores are olivaceous brown or yellowish brown, short, 1 or 2 septate, unbranched and geniculate and arise in clusters
- Conidia are sub-hyaline or pale yellow, obclavate, often curved 3-12 septate, 35- 110 x 2.5 - 5.4 μ m in size with rounded to distinctly truncate base and sub-acute tip



Late leaf spot

Pathogen - *Phaeoisariopsis personata* (Sexual stage: *Mycosphaerella berkeleyi*)

- The conidiophores are long, continuous, 1-2 septate, geniculate, arise in clusters on a lower surface of leaves and are olive-brown.
- The conidia are cylindrical or obclavate, short, measure 18-60 x 6-10 μ m, hyaline to olive brown, usually straight or curved slightly with 1-9 septa, but mostly 3-4 septate.

PHYTOPHTHORA BLIGHT AND STERILITY MOSAIC OF PIGEONPEA (*Cajanus cajan*)

Symptoms: (Phytophthora blight)

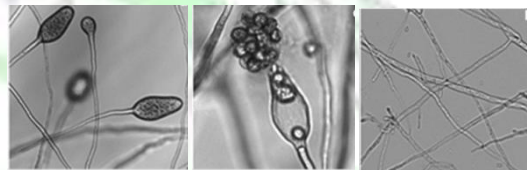
- Affected plants show water-soaked brown to dark lesions on the leaves later become necrotic
- The lesions on the stem and petiole are somewhat brown and sunken
- The lesions enlarge in size and girdle the stem resulting drying of branches and foliage
- The seedlings die suddenly due to infection
- No symptoms are found on the root system
- Branches and petioles lead to desiccation
- In severe cases, the whole foliage becomes blighted
- Infected stem can easily break by the wind
- In advanced stages, the stem is commonly swollen into cankerous structures near the lesions
- The seedlings are highly prone to this infection and dry plants are common during the rainy season
- The disease is serious when continuous rains occur or there is water logging in the field



Microscopic

Pathogen - *Phytophthora drechsleri* f. sp. *cajani*

- Mycelium - hyaline, coenocytic
- Sporangioophores - hyaline-bearing ovate or pyriform, non-papillate sporangia
- Each sporangium produces 8-20 zoospores
- Oospores - globose, light brown, smooth and thick-walled



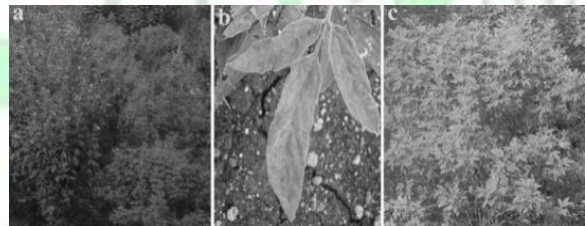
STERILITY MOSAIC

Symptoms

- The plants infected remain stunted
- The leaves show mosaic symptoms
- The symptoms may develop on all the leaves of infected plants
- The flowering is partially or completely stopped and a few flowers which develop are sterile

Pathogen - Pigeonpea sterility mosaic (PPSMV)

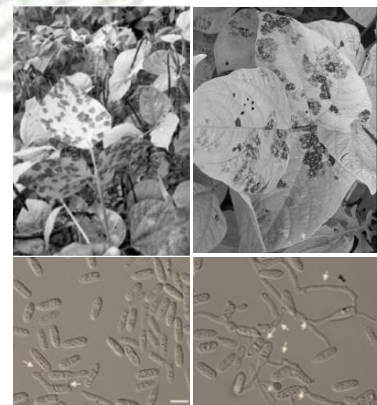
- Shows properties similar to viruses in the genus Tenuivirus
- Asymmetric morphology measuring 3-8 nm in diameter with 32 kDa coat protein
- Genetic material RNA 4-5 segmented size 0.8-3.5 kilo-base
- The virus particles are highly flexuous and of branched filamentous
- Ultrastructural studies of PPSMV-infected tissues showed 100 – 150 nm quasi-spherical membrane bound bodies (MBBs) and fibrous inclusions
- The sterility mosaic causal agent is transmitted by the arthropod mite vector – *Aceria cajani* an eriophyid mite



ANTHRACNOSE OF BLACK GRAM (*Vigna mungo*) AND GREEN GRAM (*Vigna radiata*)

Symptoms

- Observed in all aerial parts of the plants and at any stage of crop growth
- Dark brown to black sunken lesions appear on the hypocotyl and cause death of the seedlings
- Small angular brown lesions appear on leaves, mostly adjacent to veins, which later become greyish white centre with dark brown or reddish margin
- Lesions may be seen on the petioles and stem
- The prominent symptom is seen on the pods
- Minute water-soaked lesion appears on the pods initially and becomes brown and enlarges to form a circular, depressed spot with a dark centre with bright red or yellow margin
- Several spots join to cause necrotic areas with acervuli
- The infected pods have discoloured seeds



Microscopic

Pathogen: *Colletotrichum lindemuthianum* (Sexual stage: *Glomerella lindemuthianum*)

- Mycelium is branched, septate, and hyaline becomes dark-coloured with age
- Conidiophores on short, erect, hyaline, unbranched which measure 40-60 μm long
- Conidia are formed singly at the ends of free hyphae or on stromatoid masses in acervuli.
- On the host the conidial stage develops on stomata beneath the cuticle, later rupturing it and becoming erumpent
- Conidia are 1-celled, hyaline, oblong, cylindrical with rounded ends or with one end slightly pointed, measure 13-22(11-20) x 2.5-55 μm borne in acervuli acrogenously.

ANTHRACNOSE OF GUAVA (*Psidium guajava*)

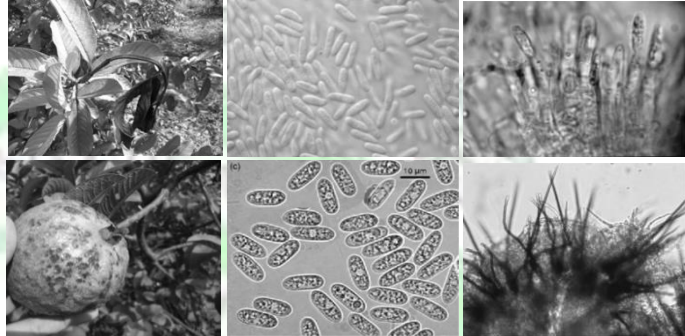
Symptoms

- Symptoms are observed on mature fruits on the tree
- The characteristic symptoms consist of sunken, dark-coloured, necrotic lesions
- Under humid conditions, the necrotic lesions become covered with pinkish spore masses
- The disease progresses, the small sunken lesions coalesce to form large necrotic patches affecting the flesh of the fruit

Microscopic

Pathogen: *Colletotrichum gloeosporioides*

- Conidia - hyaline, aseptate, oval to elliptical
- Conidiophore is cylindrical
- Acervuli - dark brown to black



LEAF CURL OF PAPAYA (*Carica papaya*)

Symptoms

- Curling, crinkling and distortion of leaves
- Reduction of leaf lamina
- Rolling of leaf margins inward and downward
- Thickening of veins
- Leaves become leathery, brittle and distorted
- Plants become stunted
- Affected plants do not produce flowers and fruits

Pathogen: Papaya leaf curl virus (PaLCuV)

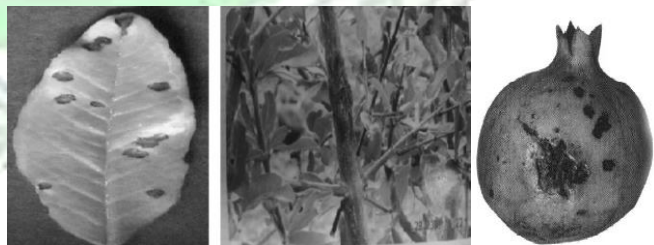
- The virus belongs to the begomovirus genus of Geminiviridae
- It is a single-stranded DNA virus
- It is transmitted in nature by the whitefly (*Bemisia tabaci*)
- This virus is not transmitted through seed and mechanically



BACTERIAL BLIGHT OF POMEGRANATE (*Punica granatum*)

Symptoms

- Dark red spots appear on leaves
- Affected leaves get distorted and malformed
- Severely affected young leaves fall off
- Brown to black spots around the nodes of the stem
- Cracking of nodes in infected plants due to girdling of the stem
- Fruits brown to black spots developed on the pericarp of fruit with L or Y-shaped cracks
- Raised dark brown lesions with indefinite margins are seen on the fruit surface



Microscopic

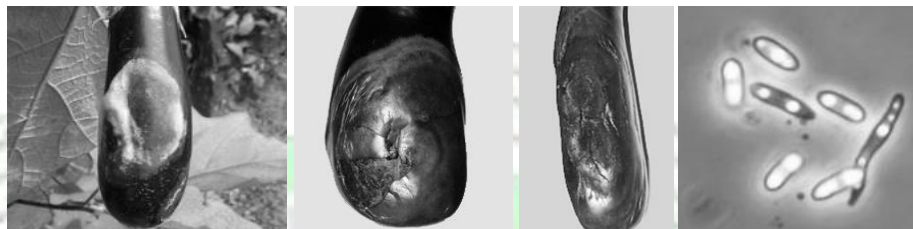
Pathogen: *Xanthomonas axonopodis* pv. *punicae*

- The bacterium is rod-shaped, gram-negative has a single polar flagellum
- Colonies on laboratory media are usually yellow due to 'xanthomonadin' pigment production

PHOMOPSIS BLIGHT AND FRUIT ROT OF BRINJAL (*Solanum melongena*)

Symptoms

- Affects all above the ground plant parts
- Spots generally appear first on seedling stems or leaves
- Girdle seedling stems and kill the seedlings
- Leaf spots are clearly defined, circular, up to about 1 inch in diameter, brown to grey with a narrow dark brown margin
- Fruit spots are much larger, affected fruit are first soft and watery
- Later on, affected fruits may become black and mummified
- The centre of the spot becomes grey and black pycnidia develop on it



Microscopic

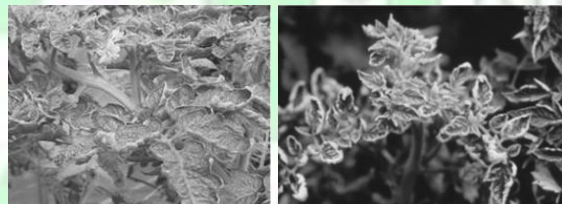
Pathogen: *Phomopsis vexans*

- Pycnidia –
 - With or without beak
 - Found in the affected tissue
 - Globose or irregularly shaped
- Conidiophores – found in the pycnidium are hyaline, simple or branched
- Conidia - hyaline, one-celled and sub-cylindrical
- Ascospores - hyaline, narrowly ellipsoid to bluntly fusoid with one septum

LEAF CURL OF TOMATO (*Solanum lycopersicum* / *Lycopersicon esculentum*)

Symptoms

- Leaf curl disease is characterized by severe stunting of the plants with downward rolling and crinkling of the leaves
- The newly emerging leaves exhibit slight yellow colouration and later they also show curling symptoms
- Older leaves become leathery and brittle
- The nodes and internodes are significantly reduced in size
- The infected plants look pale and produce more lateral branches giving a bushy appearance
- The infected plants remain stunted



Pathogen: Tomato leaf curl virus (ToLCV)

- The genus *Begomovirus* is a circular single-stranded DNA virus
- Virus exclusively transmitted by whitefly (*Bemisia tabaci*)
- Two species namely *Tomato leaf curl New Delhi virus* and *Tomato leaf curl Palampur virus* predominantly distributed in Northern India
- One species namely *Tomato leaf curl Bangalore virus* is dominant in Southern India
- The virus particles are 80 nm in diameter

EARLY BLIGHT OF TOMATO (*Solanum lycopersicum* / *Lycopersicon esculentum*)

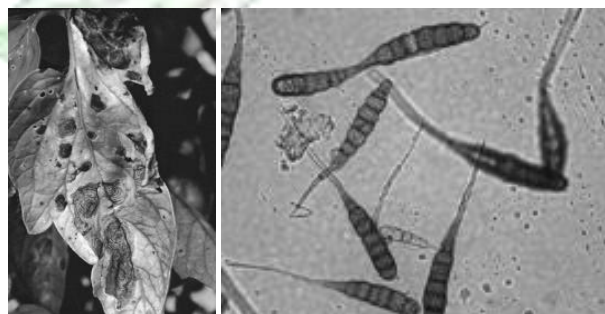
Symptoms

- Affects the foliage at any stage of the growth
- Early blight first observed on the plants as small, black lesions mostly on the older foliage
- Spots enlarge and become one-fourth of an inch in diameter or larger and concentric rings in a bull's eye pattern can be seen in the centre of the diseased area
- Tissue surrounding the spots may turn yellow

Microscopic

Pathogen: *Alternaria solani*

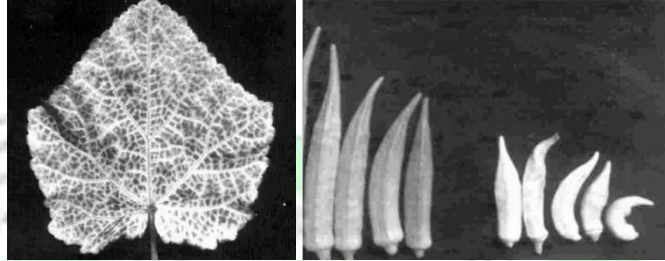
- Mycelium septate, branched, light brown becomes darker with age
- Conidiophores are dark coloured
- Conidia are beaked, muriform, dark colored and borne singly



YELLOW VEIN MOSAIC OF OKRA (*Abelmoschus esculentus*)

Symptoms

- Infection may start at any stage of plant growth
- Characteristic symptom is the yellowing of the entire network of veins in the leaf blade
- Veins of the leaves will be cleared due to the virus
- Interveneal area may become completely yellow or white
- Severe infections - younger leaves turn yellow, reduced in size and the plant is highly stunted
- Infection restricts flowering and fruits, if formed, may be smaller and harder
- Affected plants produce fruits with yellow or white colour



Pathogen- Bhendi yellow vein mosaic virus (MYVMV) / okra yellow vein mosaic (OYVMV)

- Viral disease caused by monopartite Begomovirus
- Transmitted by white fly (*Bemisia tabaci*)
- The virus particles are 16 – 18 nm in diameter

