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Foldscope Microscope

A Novel Tool from Frugal Science

भाकृअनुप ICAR

रा जै स्ट्रे प्र सं NIBSM

FOLDSCOPE INSTRUMENTS

2022

ICAR
NATIONAL INSTITUTE OF
BIOTIC STRESS
MANAGEMENT
Rendering solution to biotic stresses

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FOREWORD

Foldscope is a part of the "frugal science" movement which aims to make cheap and easy tools available for scientific use in the developing world.

Foldscope microscopy research concept was conceptualized during 2018 at ICAR-NIBSM, Raipur and subsequently we have received the grant from DBT, GoI to study *the "Surveillance and minimizing the risk of zoonotic diseases among tribal farmers through Foldscope Microscopy"*. Under this initiative, our research team explored the knowledge level of tribal farmers on zoonotic diseases and tribal farmer's attitude towards the use of foldscope microscopy. As a field level application, foldscope identified as a novel tool to assess the frozen semen quality to reduce the infertility rate and it is a novel application of Frugal Science movement. Foldscope identified as a novel and user-friendly tool to identify the plant pathogenic fungal diseases at In-situ condition. Total 16 fungal diseases and their causal organisms were identified based on morphological structure of pathogen and host species. As a capacity building initiative, 42 Foldscope demonstration cum hands on training on diagnosis of plant pathogenic fungal diseases organized, 1470 participants were benefitted. In addition, 31 rural youth trained as village level trainer to demonstrate the Foldscope microscopy for crop disease diagnosis at village level. More than 290 foldscopic observations and its results has been published in the online platform called *MICROCOSMOS* (https://microcosmos.foldscope.com/) Foldscope Community as a part of global knowledge sharing and free access of foldscopic research findings among scientific community.

I compliment the Foldscope Project team for their sincere efforts in disseminating the frugal science-based foldscope applications to reach the unreached and explored the multi-dimensional utility of Foldscope in agricultural research.

(P. K. Ghosh)

Foldscope Project Partners

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RAIPUR

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Introduction

Foldscope microscopy research concept was conceptualized during 2018 at ICAR-NIBSM, Raipur and subsequently we have received the grant from DBT, GoI to study *the "Surveillance and minimizing the risk of zoonotic diseases among tribal farmers through Foldscope Microscopy"*. Under this initiative, our research team explored the knowledge level of tribal farmers on zoonotic diseases and tribal farmer's attitude towards the use of foldscope microscopy. As a field level application, foldscope identified as a novel tool to assess the frozen semen quality to reduce the infertility rate and it is a novel application of Frugal Science movement. In second phase, we have received the grant from Department of Science and Technology, GoI under SYST for three years (2020-23) to study the *In-situ diagnosis and digital cataloging of plant-pathogenic fungi through Foldscope Microscopy - A frugal science approach.* Under this initiative, foldscope identified as a novel and user-friendly tool to identify the plant pathogenic fungal diseases at In-situ condition.

Objectives of Foldscope Initiatives at ICAR-NIBSM

- ★ To develop digital catalogue of plant-pathogenic fungi from various diseased plant parts using Foldscope Microscopy.
- ★ To develop protocols for in-situ diagnosis of major plant-pathogenic fungi through Foldscope Microscopy at field level.
- ★ To educate and upscale the knowledge of rural youths and field-level extension workers on Foldscope microscopy for field-level diagnosis.
- ★ To minimize the risk of zoonotic diseases among tribal farmers through Foldscope microscopy.

Summary

Major Achievements (2018-22)

District covered for Capacity Building Programme 08	District covered for sampling 15	Villages covered 22	Institutes covered 10
Schools covered 05	Samples collected 407	Diagnosed samples 171	Organisms covered 56
Significant achievement (Semen quality) 01	Capacity building events 42	Total participants 1470	Trainers created 31
Online published (Microcosmos) 297	Bio-agent viability test 02	Number of projects 02	Extension functionaries benefitted 93

Area Covered

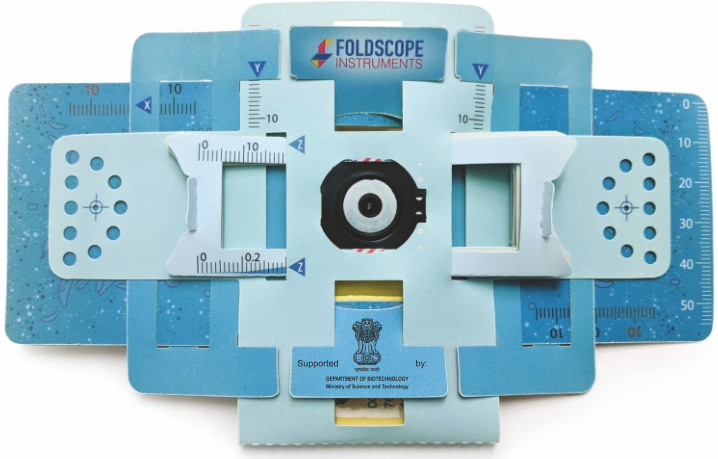
Chhattisgarh State

- **Project implemented : 2018 / 2020**
- **Budget : Rs. 49.11 Lakh**
- ★ **Districts covered for capacity building**
  - ★ Raigarh
  - ★ Janjgir-Champa
  - ★ Balodabazar-Bhatapara
  - ★ Raipur
  - ★ Dhamtari
  - ★ Durg
  - ★ Rajnandgaon
  - ★ Mohla-Manpur-Ambagarh Chowki
- ⬟ **Sampling districts**
  - ⬟ Koriya
  - ⬟ Surguja
  - ⬟ Jashpur
  - ⬟ Raigarh
  - ⬟ Korba
  - ⬟ Sakti
  - ⬟ Mahasamund
  - ⬟ Balodabazar-Bhatapara
  - ⬟ Bilaspur
  - ⬟ Mungeli
  - ⬟ Kabirdham
  - ⬟ Bemetara
  - ⬟ Raipur
  - ⬟ Kanker
  - ⬟ Bastar

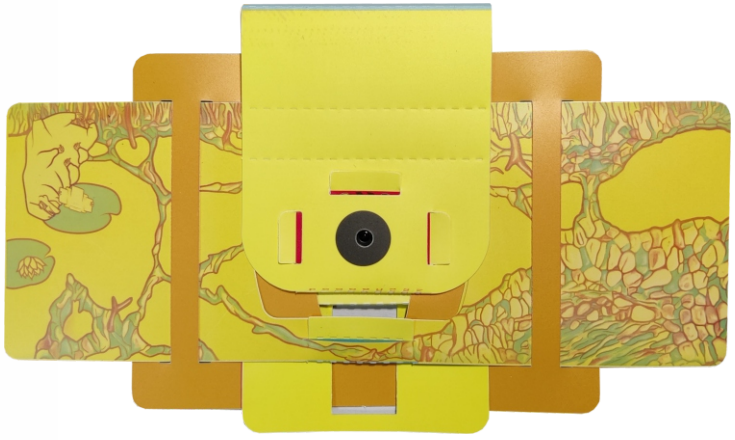
Facts and Application of Foldscope

What is Foldscope microscope?

- “Foldscope is an optical microscope that can be assembled from simple components, including a sheet of paper and a lens.
- Foldscope names indicate that it is a folding microscope and It's designed to be an extremely very low-cost, portable, durable, foldable paper microscope and to give optical quality similar to conventional research light microscopes
- It was developed by Dr. Manu Prakash, Associate professor, Stanford University, California, USA and designed to cost less than US$1 to build.
- It is part of the *"frugal science"* movement which aims to make cheap and easy tools available for scientific use in the developing world.
- The Foldscope weighs 8 grams and comes in a kit with multiple lenses that provide magnification from 140X to 2,000X.
- The kit also includes magnets that can be stuck onto the Foldscope to attach it to a smartphone, allowing the user to take pictures/videos of the magnification.
- The magnification power is enough to enable the spotting of organisms such as major plant-pathogenic fungus, nematodes, algal pathogen, *Leishmania donovani,* and *Escherichia coli*, as well as malarial parasites”.



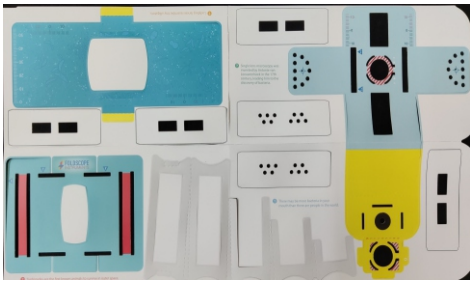
Front view



Rear view

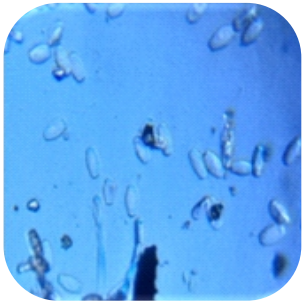
Why paper microscope is invented?

Microscopes are important tools for science, but they are often expensive to access and own. Foldscope's design uses low-cost materials (like paper) to provide a research-quality microscope for a fraction of the price so that everyone can explore the microscopic world.



What can be seen with Foldscope?

- Foldscope's lens has a magnification of 140x and 2-micron resolution. With that, we can see tiny things or samples like fungi, bacteria, algae and nematodes, etc.
- The larger things like insects, fabrics, pollens, and tissues can be also observed very easily under Foldscope.
- Foldscope can also allow the observation of non-biological samples, such as particulates detrimental to air quality or the microscopic crystalline differences between real and fake medications.
- As a field application, foldscope identified a novel tool for foliar plant pathogenic fungal diseases *viz.* powdery mildew, downy mildew, leaf blight, leaf spot, and post-harvest diseases, etc.

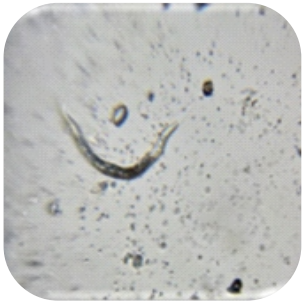


Fungus (*Golovinomyces*)

Bacteria (*Rhizobium*)

Insect (*Trichogramma*)

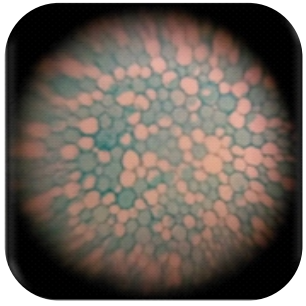
Algal (*Cephaleuros*)



Nematode (*Meloidogyne*)

Histology - Uterus T.S.

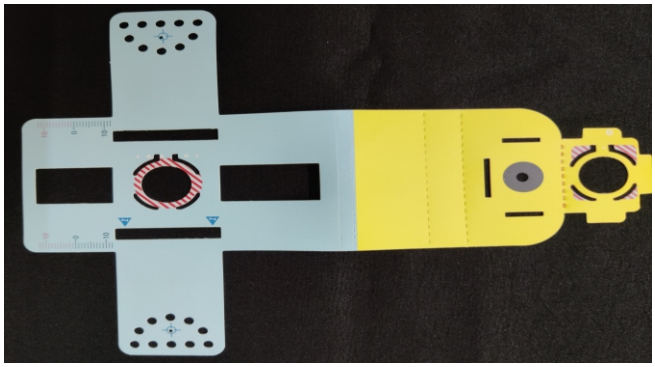
Histology stomach T.S.



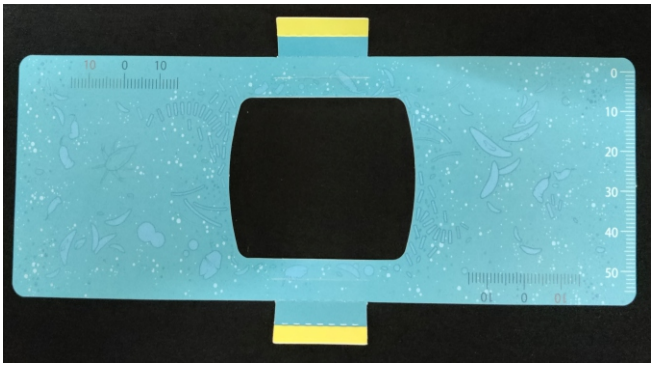
Dicot stem T.S.

Components of Foldscope

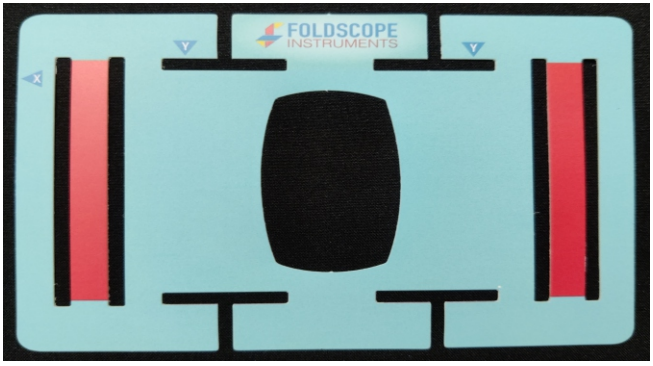
In fact, it is a conveyable type of microscope that is made from a series of paper clippings. Foldscope is made by very simple like paper seat, lens, and magnets. It can be mainly divided into four parts- lens stage, sample stage, penning guide and focus ramp. The lens is a glass ball that magnifies samples or specimens. The magnets align and place the lens and help devices attach to the Foldscope. The rest is of the Foldscope is paper.



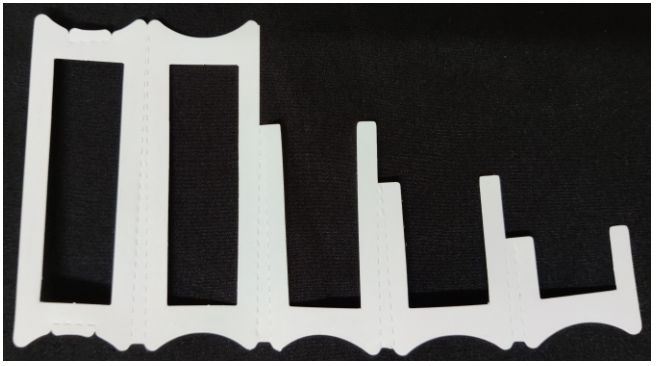
Lens stage



Sample stage



Penning guide



Focus ramp

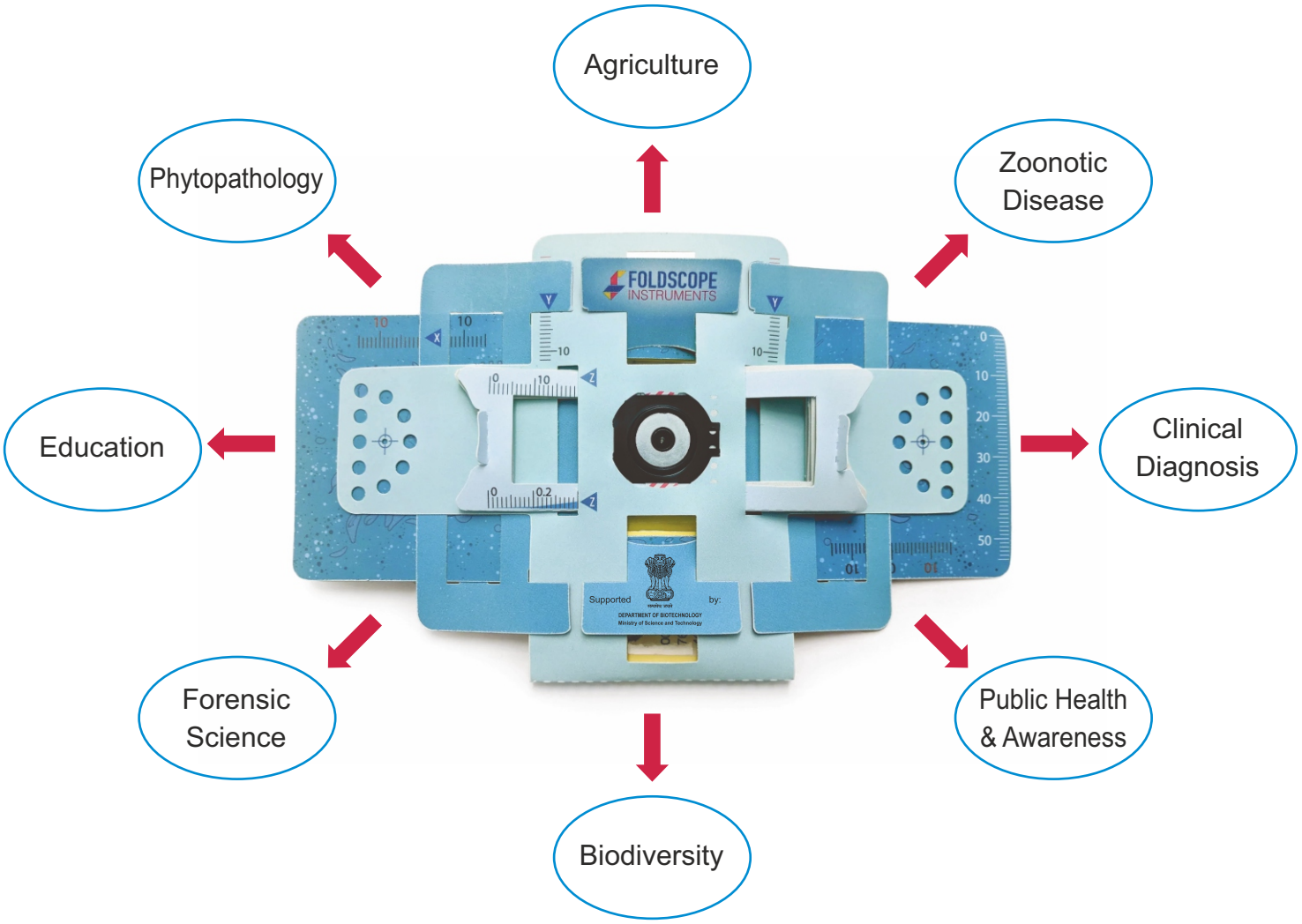
Key Metrics

Foldscope is a paper microscope with the following metrics:

- Magnification: 140x
- Resolution: 2 microns
- Back focal length: 0.56 mm
- Depth of field: 0.013 mm
- Field of view: 0.51 mm (diagonal radius)

Important area for Foldscope application:

The accuracy, speed, low cost, and effectiveness of the Foldscope microscope make better it to be easily used and studied in different sectors of agriculture, phytopathology, zoonotic disease, clinical diagnostics, public health and awareness, forensic science, biodiversity, and education.



Attachment of camera phone with Foldscope

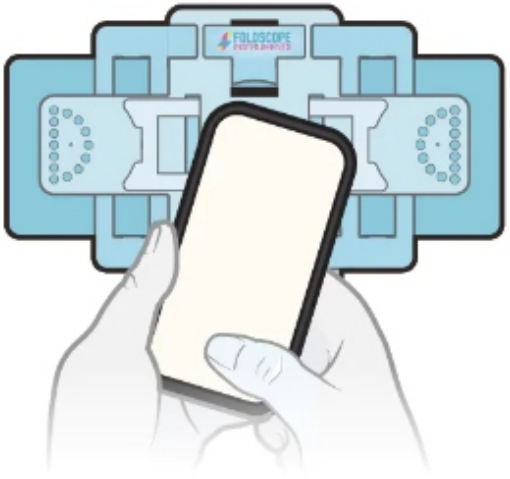
The design philosophy of Foldscope is to bring the microscopic world to everyone. For this reason, Foldscope is designed to be an independent instrument and does not require a phone to use. Having said that, Foldscope works fantastically when coupled to phones or recording devices. No special app is required, only a standard camera application will be sufficient.

Projection is great for group viewing and sketching. Best results require a white flat surface in a dark room.

1. Place a double stick ring sticker* over the center of the phone's **flashlight.**
   **Tape can also be used to atta coupler in place of ring sticker*

2. Place coupler (silver side UP) on top of sticker.

3. Mount the **blue side** of the Foldscope to the back of the phone.



Viewing method

Foldscope has three possible viewing methods like eye, phone, and projection. All of these methods are made to Foldscope very effective and smart.

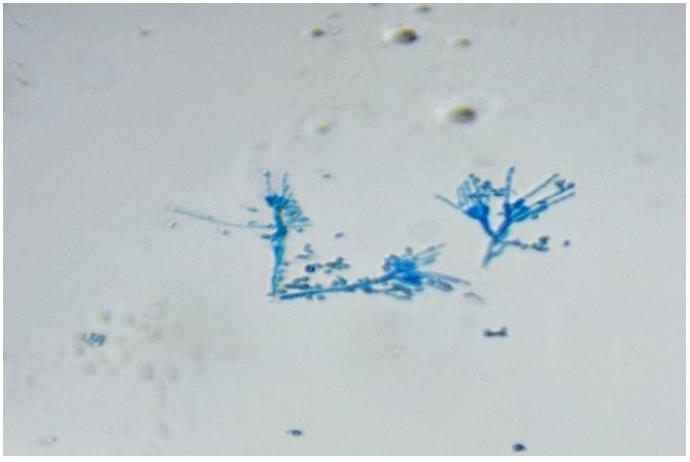
(A) Eye viewing

- To view any sample directly with your eye, first up make the temporary slides of the sample than hold the Foldscope with the blue side facing and bring the lens to the eye.
- While we view, point the back of the Foldscope toward a light source, such as a lamp or clear sky *(but do not look directly towards the sun).*
- Adjust the focus by nudging the focus ramp left or right with your thumb until the image appears clearly and pan to look at other areas of the sample by using your thumbs to shift around the lens stage.

(B) Phone viewing

We can use a phone camera as usual to record photos, videos and also zoom further into a sample.

- To view any sample with a phone, first off attach a coupler over the lens of mobile phone camera. (Make sure to place the coupler with the silver magnet side down, facing the phone.) The phone camera lens should be centered in the hole of the ring magnet. Attach the coupler to the phone by using a double-sided ring sticker or with any other tape.
- Once the coupler is attached bring phone's camera up to the Foldscope's lens. Phone should magnetically snap into place. If it does not, the coupler attached with phone is facing the wrong direction than once again try flipping the coupler over and reattach it.
- While viewing, point the back of the Foldscope toward a light source such as a lamp, LED magnifier or clear sky *(but do not look directly towards the sun).*



(C) Projection

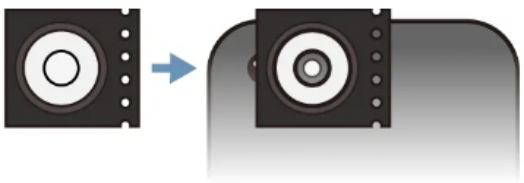
Projection is another great method for group viewing and sketching. Best results require projecting onto a white flat surface area in a dark room.

- Projection requires a strong light source. A phone's flashlight works should be well. We can try using another flashlight using the same attachment method outlined here.
- Attach a coupler over the phone's flashlight. (Make sure to place the coupler with the silver magnet side UP.)
- Once the coupler is attached, bring the phone's flashlight up to the aperture on the back side of the Foldscope.
- Turn on the phone's flashlight and aim the front of the Foldscope at the smooth white surface. Now we should see an image of sample or specimen projected on the surface.
- From here we can pan and focus the sample as usual until this image is clear. To zoom in and move phone, Foldscope further away from the surface and watch the image expand. If it doesn't appear bright enough, try moving your phone and Foldscope closer to the surface.

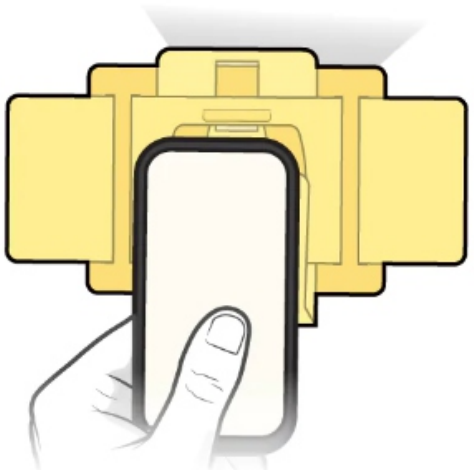
Projection is great for group viewing and sketching. Best results require a white flat surface in a dark room.

1. Place a double stick ring sticker* over the center of the phone's **flashlight.**
   **Tape can also be used to atta coupler in place of ring sticker*

2. Place coupler (silver side UP) on top of sticker.



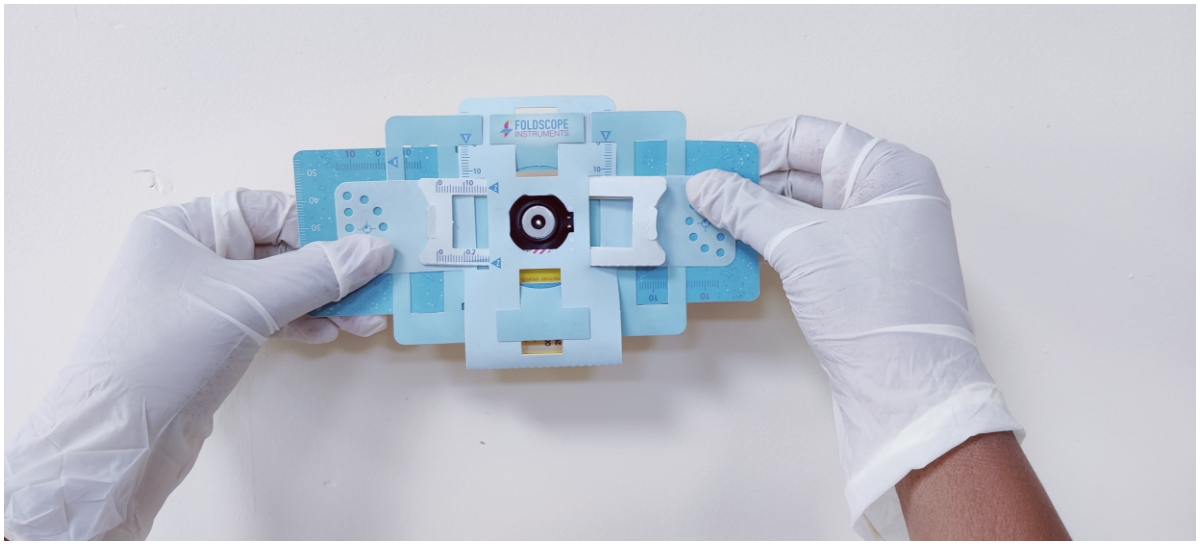
3. Mount the **yellow side** of the Foldscope to the back of the phone. Then project!



Moving and Focusing

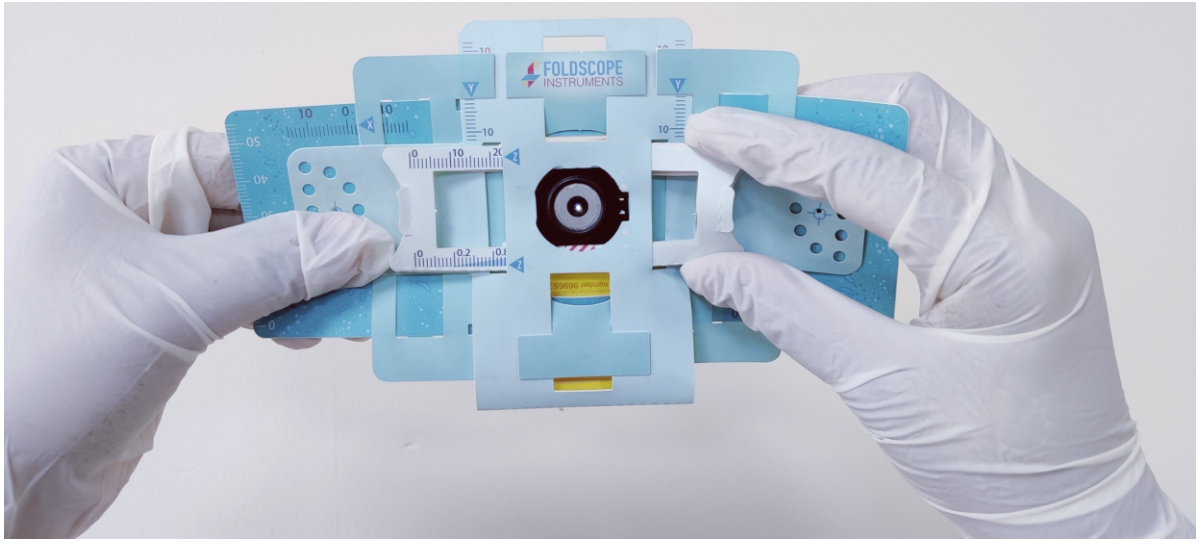
To move, press and move with the help of thumbs in the same direction.

- This motion will move the lens, allowing to explore different areas of the sample.
- See the objects in field of view move as with thumbs.



To focus, slide focus ramp either left/right or up/down with index finger.

- This motion will move the lens further/closer to sample, allowing to adjust focus.
- We should see the objects in field of view shift from blurry to crisp as slide the ramp.

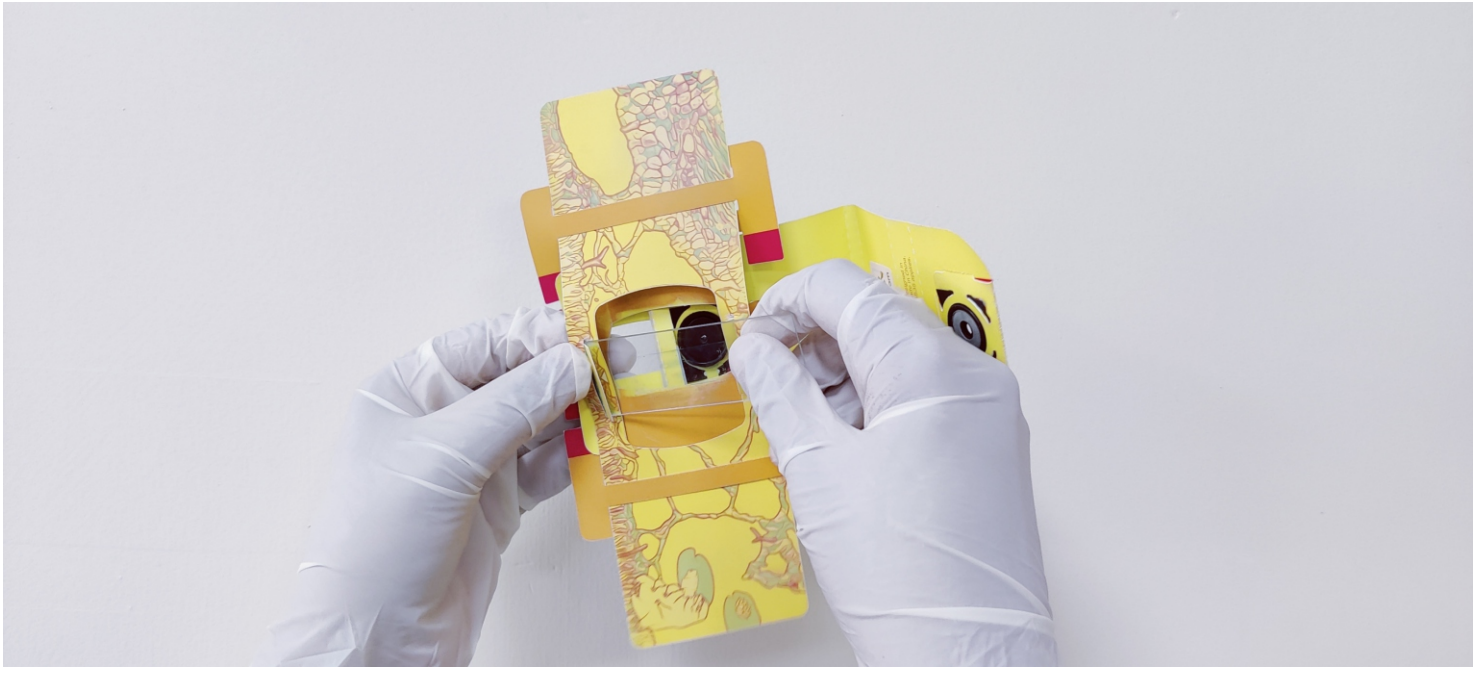


Samples and Slides

Sample insertion

To use Foldscope microscope, just need to insert a sample so that there's something to see. It's easiest to view samples mounted on either a glass or paper slide. To insert a sample, flip your Foldscope to the yellow side and open the back flap.

- Hold your slide so that the sample is facing down, towards the lens.
- Hold the slide vertically in the middle of the Foldscope and insert each end of the slide into the top and bottom slots on the slide stage. The slide ends should be tucked under the folded flap.

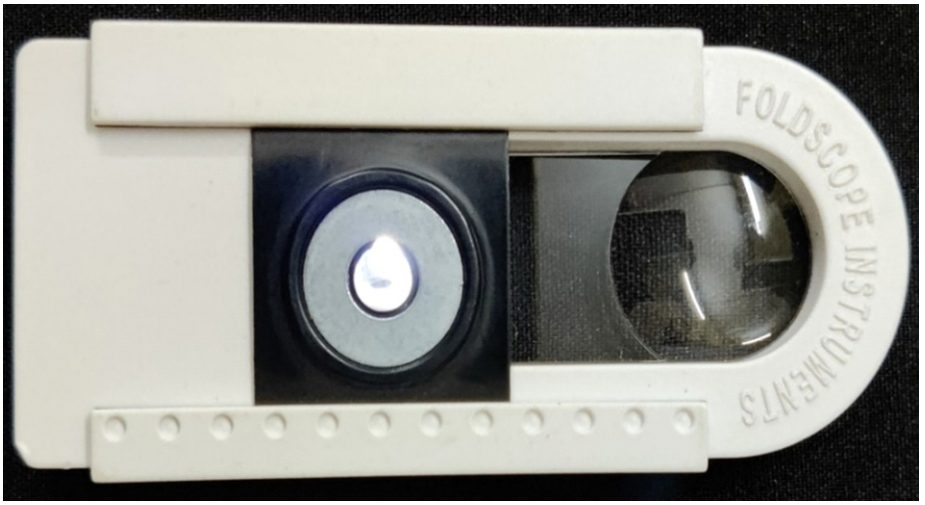


Benefits of Foldscope:

- The foldscope is an ultra-low-cost microscope (less than a dollar) that can literally carry anywhere in pocket.
- It can be used in agriculture, to detect easily various types of microorganisms (fungi and nematode) which affect the crops and animals.
- It can also be employed in medical field like public healthcare centres for primary diagnosis or as personal health monitoring devices.

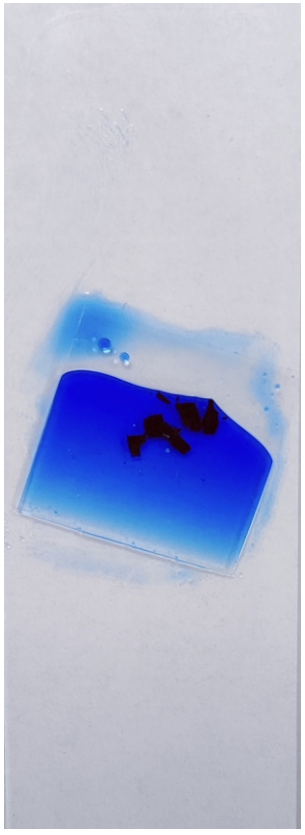
Light source

If we facing a light source and we won't be able to see anything if our sample or specimen isn't properly illuminated. To view a sample clearly, there must be light coming in through the aperture on the back flap. Make sure that we are facing something bright, such as the sky, a lamp, or a window. We can also use LED light instrument for more stable lighting.



Sample quality

If inserted a large sample that's over the lens and are facing a light source but still can't see anything clearly, our sample might be too thick. Try slicing it, squishing it, or spreading it out so that it is translucent enough to let light through or try using a brighter light source.



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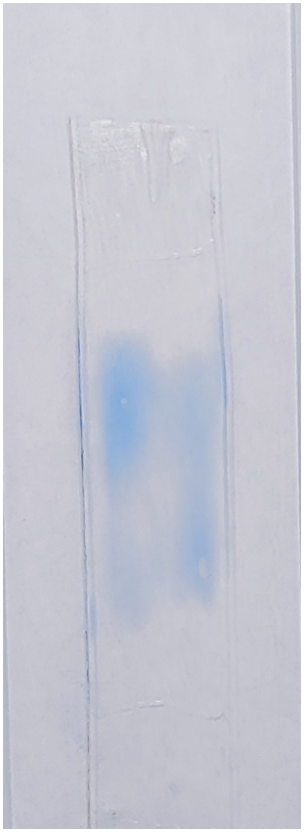

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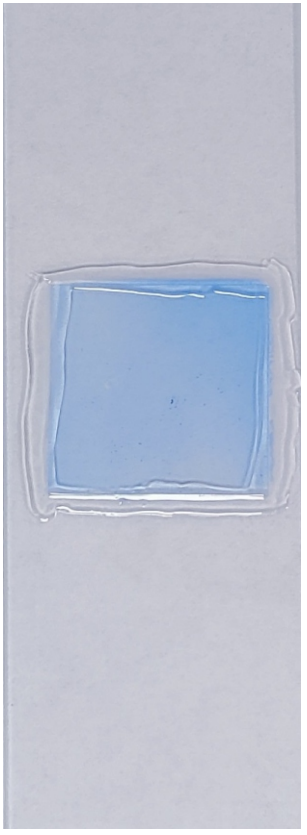
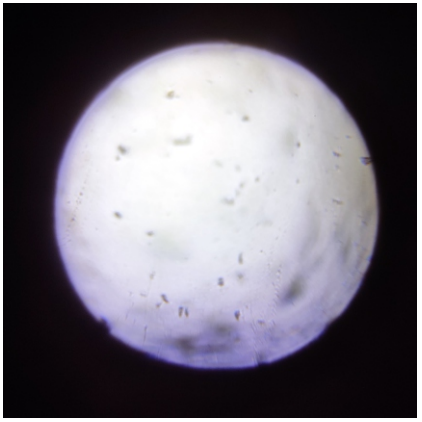


✓

Sample blurry

- **Focus:** Almost mostly time view a sample in a foldscope microscope, it will be blurry when first look at it. This is because need to bring it into focus by moving the sample closer to or further from the lens. With Foldscope, this is by sliding the focus ramp side to side. If the image is blurry, first try adjusting the focus and see if that makes it clear.



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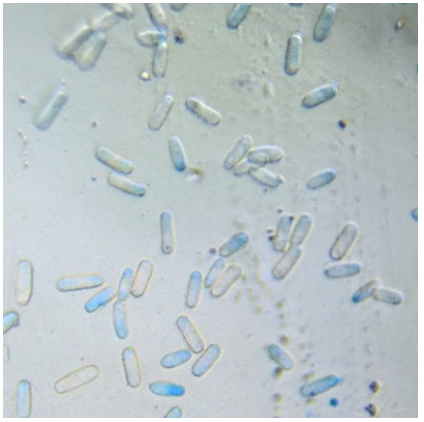


✓

- **Sample towards the lens:** If we tried the full range of focus and image is still blurry than make sure slide is inserted so that the sample is as close as possible to the lens. In glass slides, this means that the side with the coverslip should be facing the lens, and the smooth glass side should be facing out. In paper slides, using only one piece of plastic tape, the sticky side with your sample should be facing the lens and the smooth tape side should be facing out.

✗

✓

- **Lens:** Make sure that lens should be clean and properly attached. Before viewing the sample, first should be clean to lens by rubbing each side of the glass ball for 10 to 15 seconds with the help of pointed cotton swab. Try to avoid touching the glass surface of the lens with your fingertips because our skin has oil that will smudge it. Check that we did not accidentally stack two lenses or attach an extra coupler this will make it very problematic and impossible to focus.

- **Lighting:** A good light source can make a huge difference in the quality of sample or specimen image. Make sure that you are pointing your Foldscope towards a bright, evenly illuminated area, such as the sky, a well-lit wall, or a window. If image seems unclear, try shifting angle towards the light or use a different light source. Although any bright light source works, the most stable and reliable way to illuminate Foldscope sample is to use LED magnifier light source.

Comparison of Foldscope and Conventional Microscope

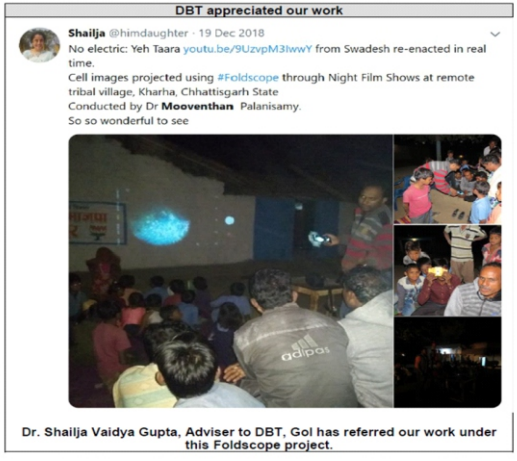
- Conventional microscopes typically have better optical performance, greater stability and control. Conventional microscopes are also often very expensive, less durable and big sizes.
- Foldscope is smaller, lighter, less expensive and more durable. This portability makes it ideal for field research, hiking trips, in situ disease diagnosis and other rugged scenarios.
- It is also ideal for under-resourced settings where people would not otherwise have access to a microscope.
- Although the low price is also an appeal for classroom use, Foldscope's main benefit is that it allows every student to have their own microscope, providing more hands-on microscopy time and opening new possibilities for independent research projects as students can take the Foldscopes home with them.
- Foldscope is not trying to replace conventional light microscopes. We still believe that it is important for students to learn traditional lab microscopy techniques when possible.

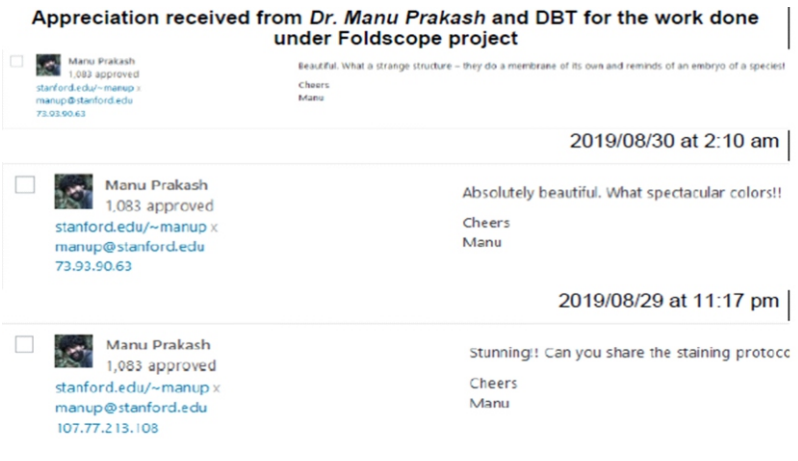
Foldscope microscope

Light microscope

Foldscope Community

The best part of Foldscope is not in the tool itself, but the people that use it. The Microcosmos is the collective term used for the Foldscope community & it provides an online platform for better connectivity among people community.





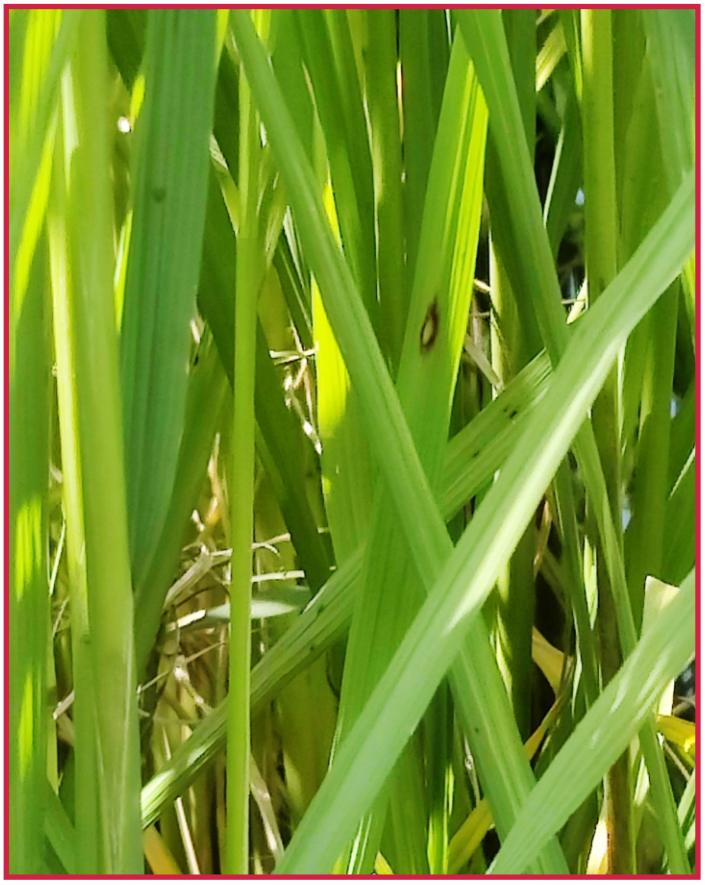
Diagnosis through Foldscope microscope

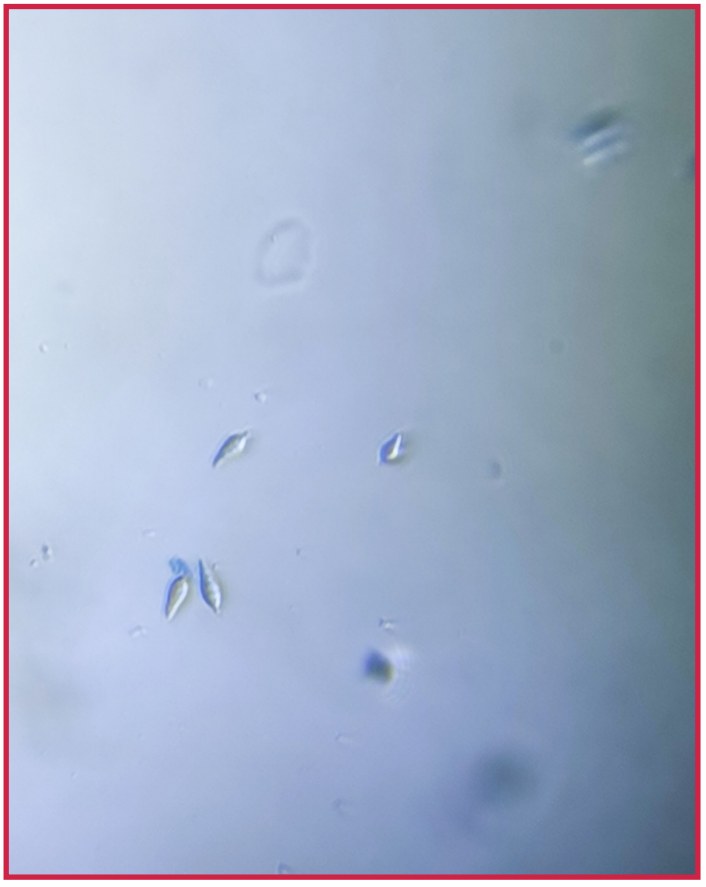
In situ diagnosis

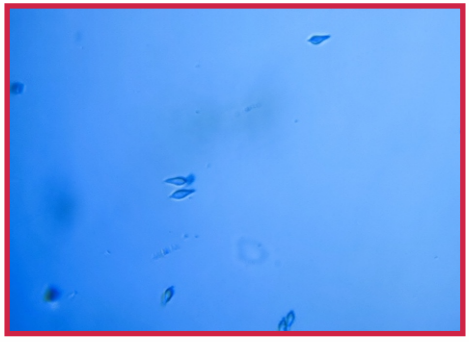
(A) Disease of Cereal Crops

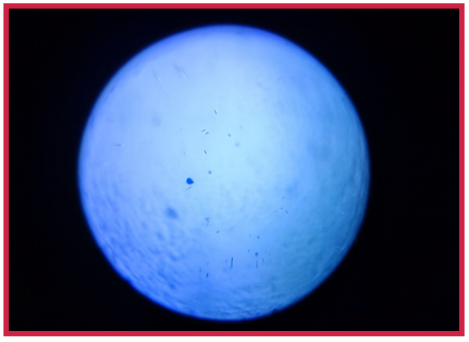
S. No.	Name of Disease	Identified Pathogen (Organism)
1	Blast disease of rice	*Magnaporthe grisea*
2	False smut disease of rice	*Ustilaginoidea virens*
3	Brown spot disease of rice	*Helminthosporium* spp
4	Brown rust disease of wheat	*Puccinia* spp
5	Loose smut disease of wheat	*Ustilago tritici*
6	Blast disease of finger millet	*Magnaporthe grisea*
7	Wheat seed (Seed pathogen)	*Curvularia* spp
8	Wheat seed (Seed pathogen)	*Helminthosporium* spp

Blast disease of rice



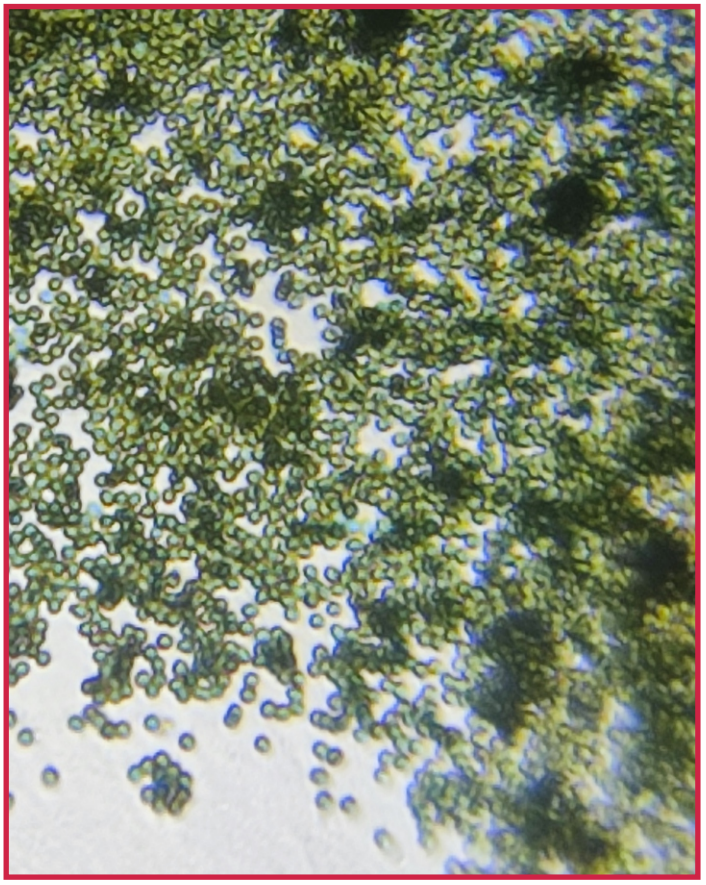


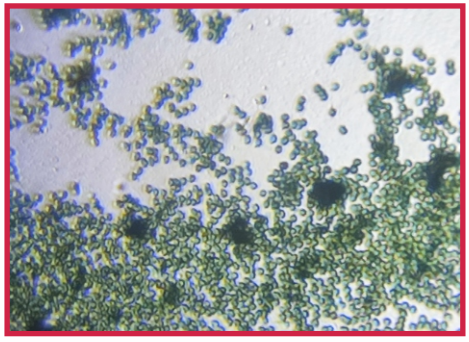


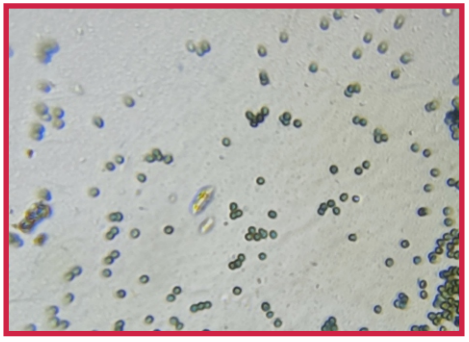


In situ diagnosis of *Magnaporthe grisea* (Blast disease of rice) under Foldscope

False smut disease of rice

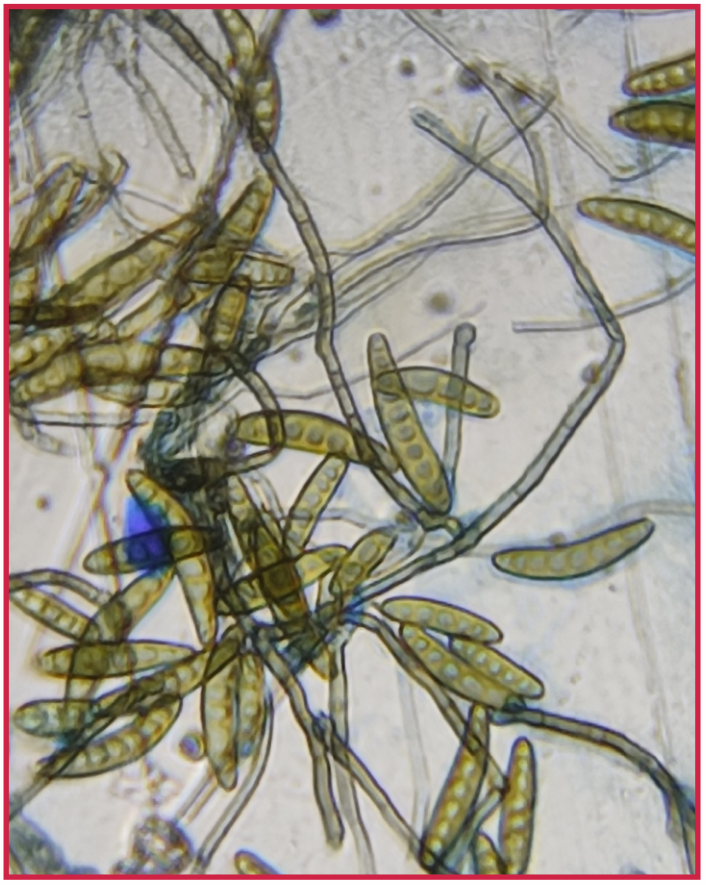


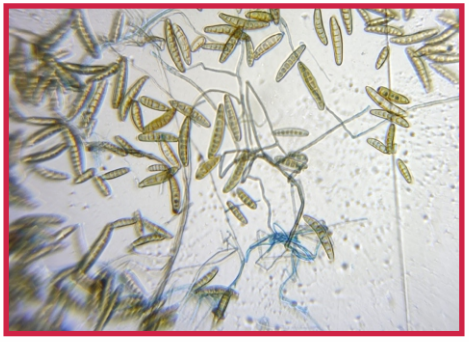




In situ diagnosis of *Ustilaginoidea virens* (False smut disease of rice) under Foldscope

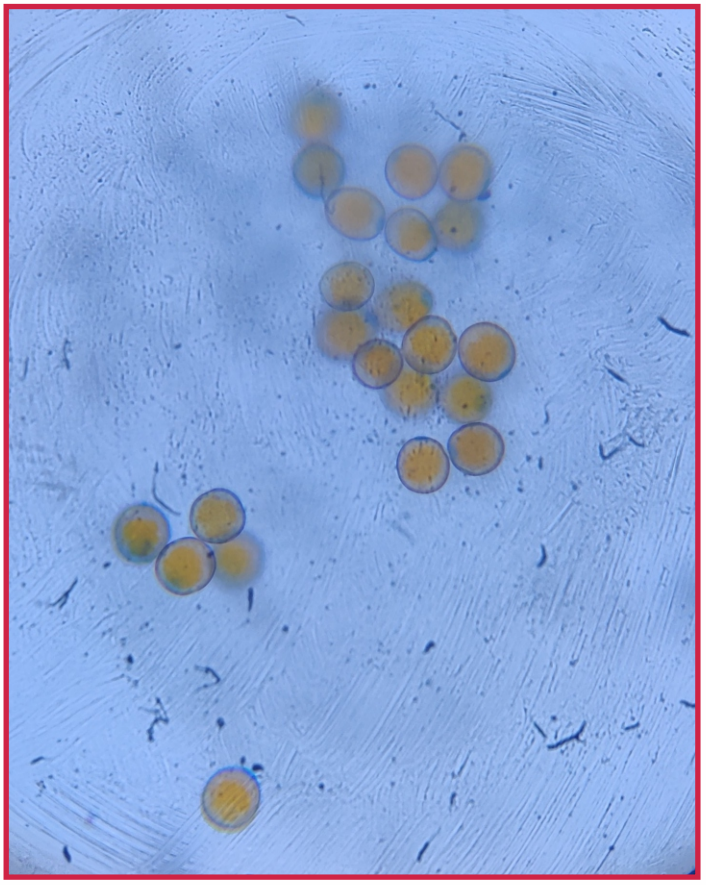
Brown spot disease of rice

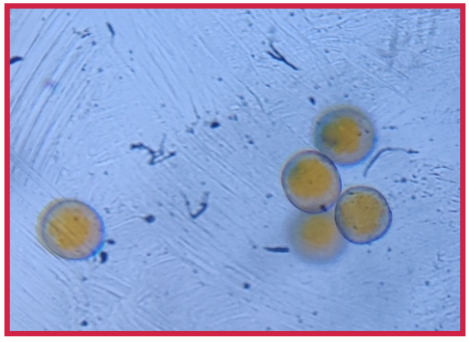




In situ diagnosis of *Helminthosporium* spp (Brown spot disease of rice) under Foldscope

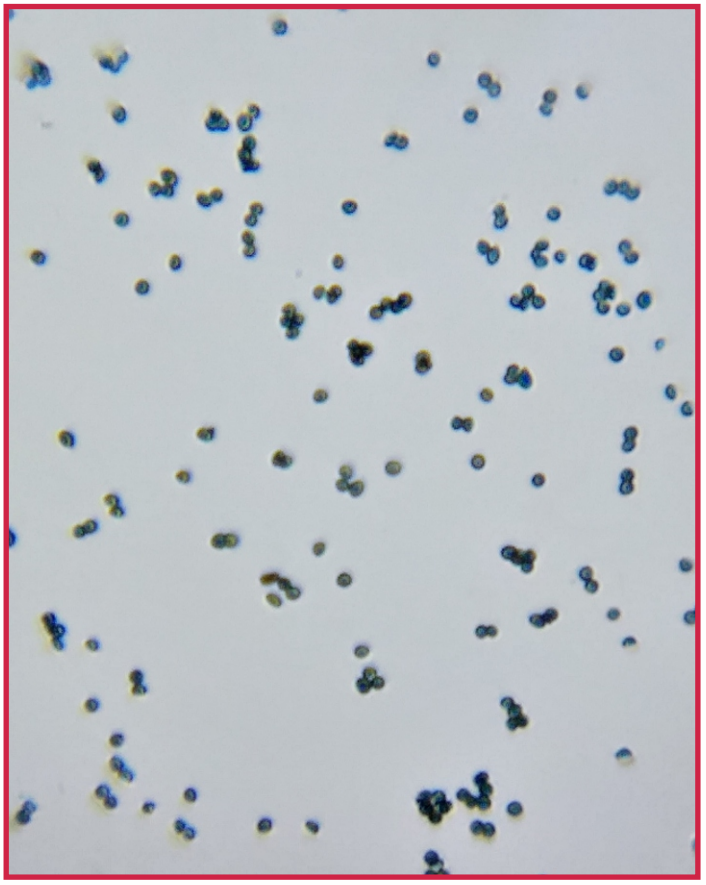
Brown rust disease of wheat

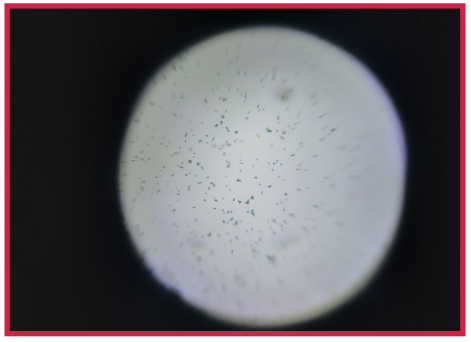


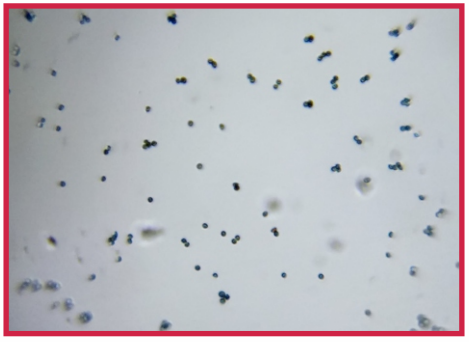


In situ diagnosis of *Puccinia* spp (Brown rust disease of wheat) under Foldscope

Loose smut disease of wheat

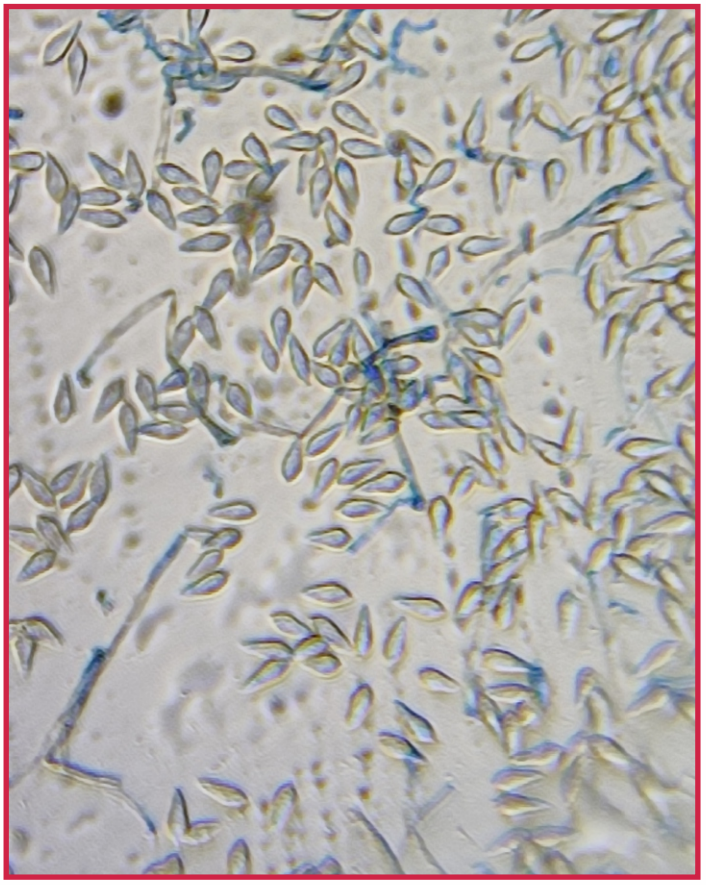


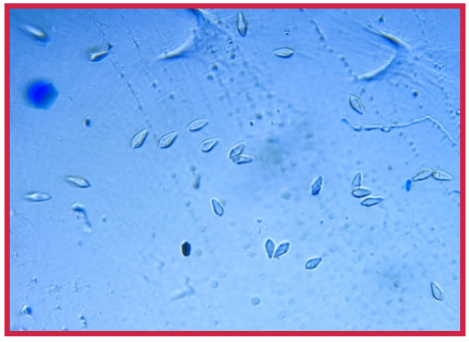




In situ diagnosis of *Ustilago tritici* (Loose smut disease of wheat) under Foldscope

Blast disease of finger millet



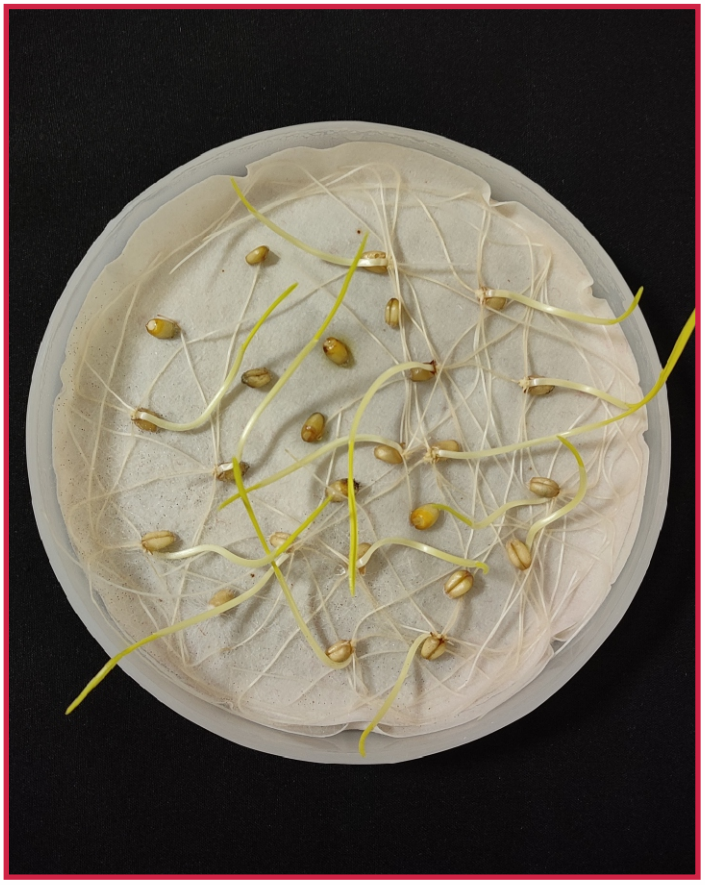


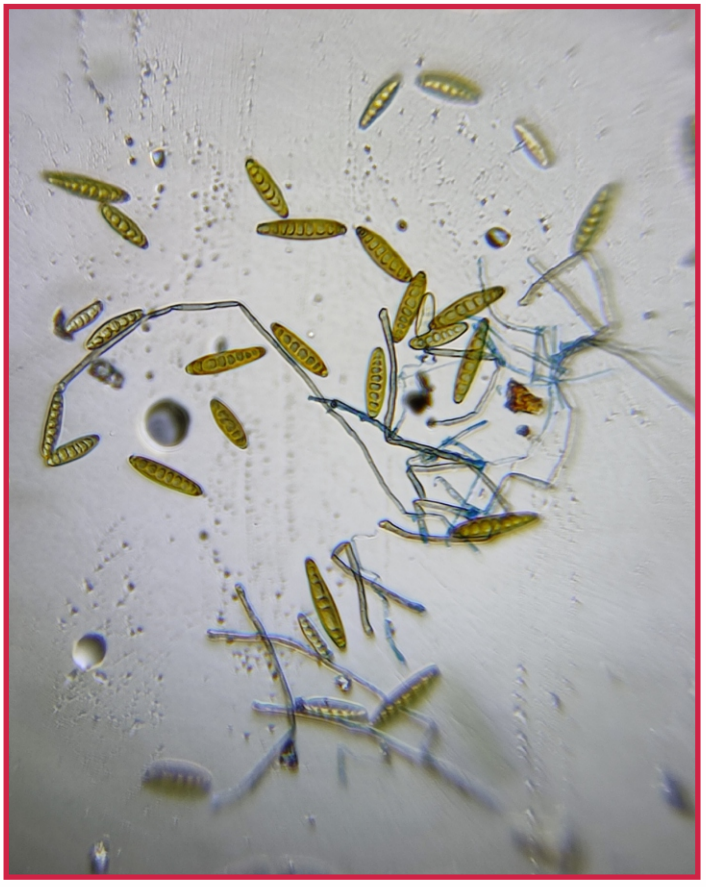
In situ diagnosis of *Magnaporthe grisea* (Blast disease of finger millet) under Foldscope

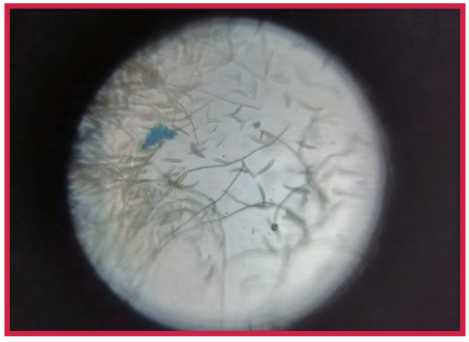
Wheat seed (Seed pathogen)

In situ diagnosis of *Curvularia* spp (Wheat seed) under Foldscope

Wheat seed (Seed pathogen)





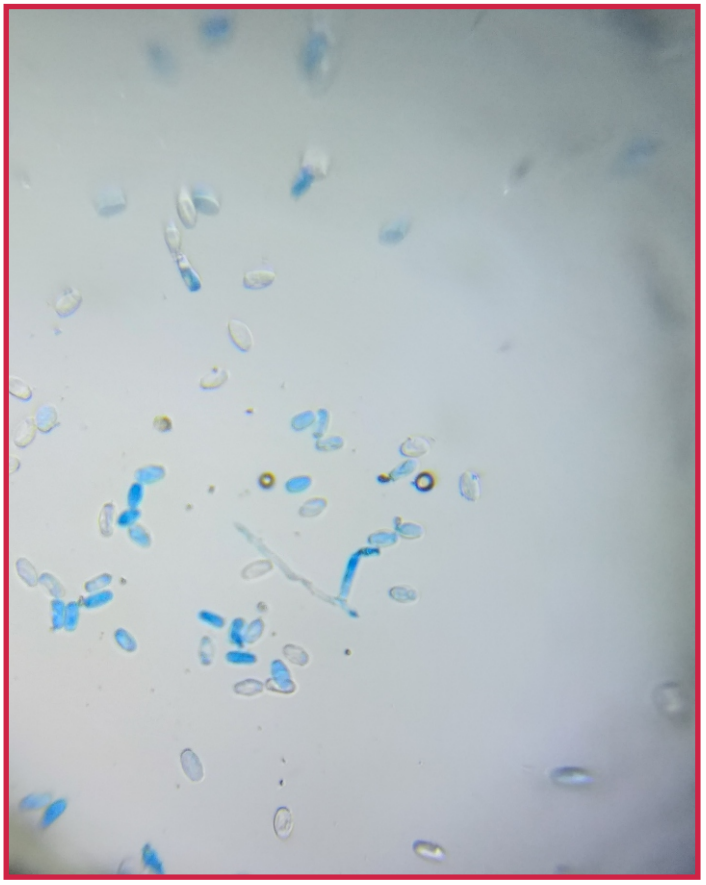


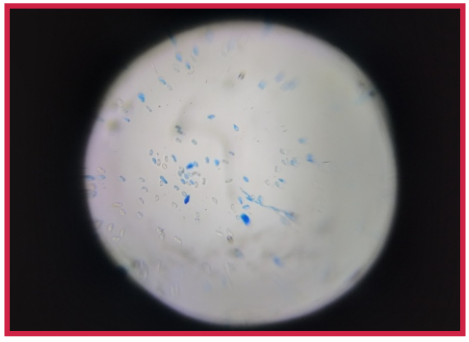
In situ diagnosis of *Helminthosporium* spp (Wheat seed) under Foldscope

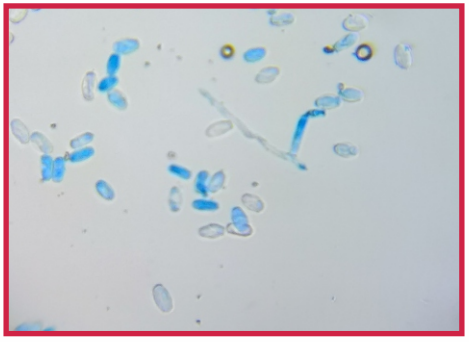
(B) Disease of Pulse Crops

S. No.	Name of Disease	Identified Pathogen (Organism)
1	Powdery mildew disease of mungbean	*Erysiphe* spp
2	Powdery mildew disease of blackgram	*Erysiphe polygoni*
3	Root rot disease of chickpea	*Rhizoctonia* spp
4	Rust disease of chickpea	*Uromyces* spp

Powdery mildew disease of mungbean

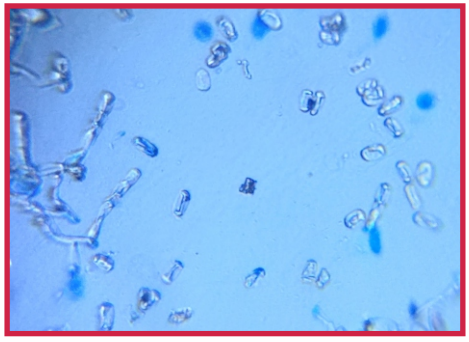


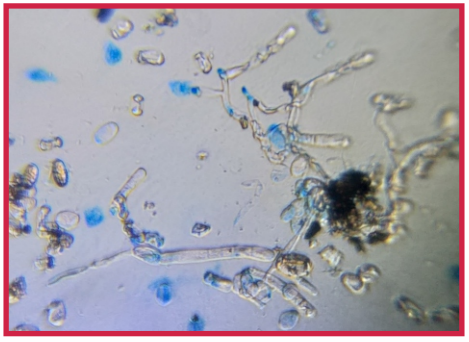




In situ diagnosis of *Erysiphe* spp (Powdery mildew disease of mungbean) under Foldscope

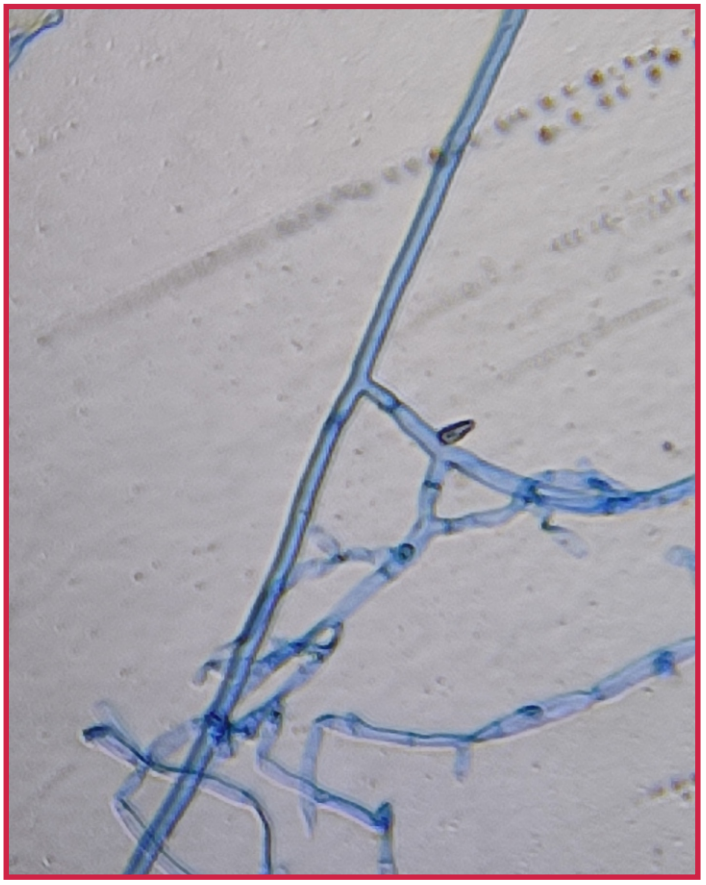
Powdery mildew disease of blackgram

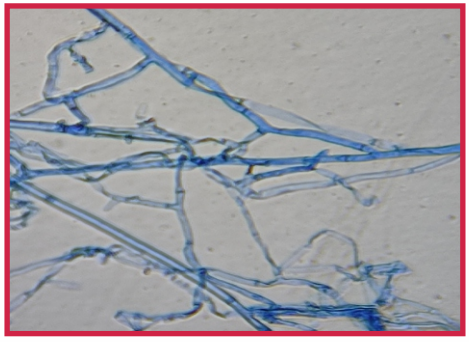


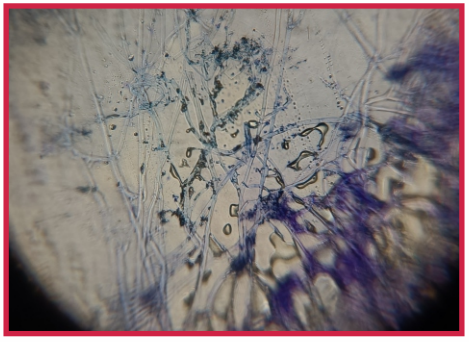


In situ diagnosis of *Erysiphe polygoni* (Powdery mildew disease of blackgram) under Foldscope

Root rot disease of chickpea

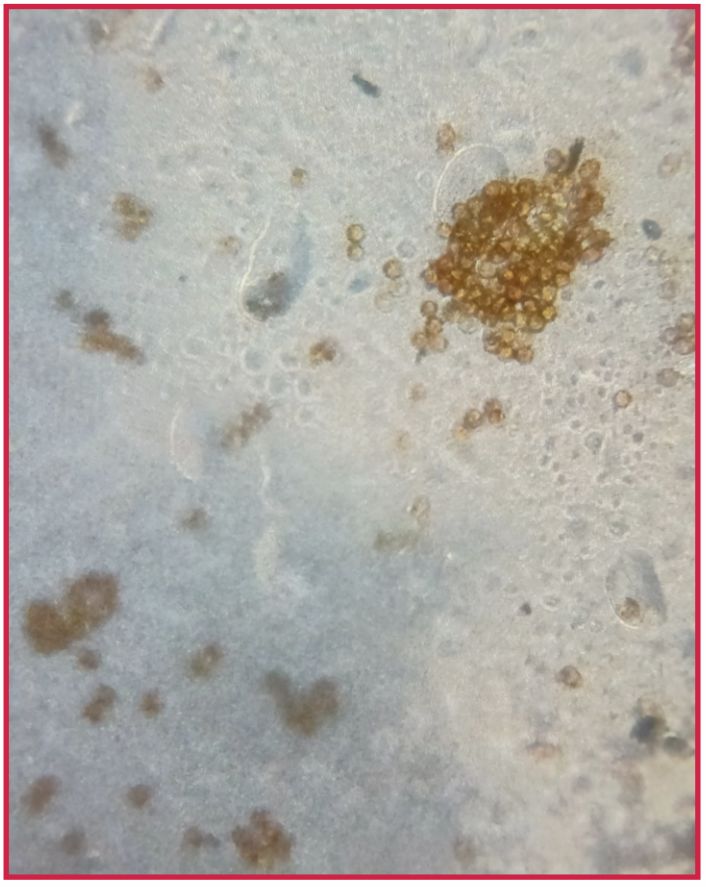


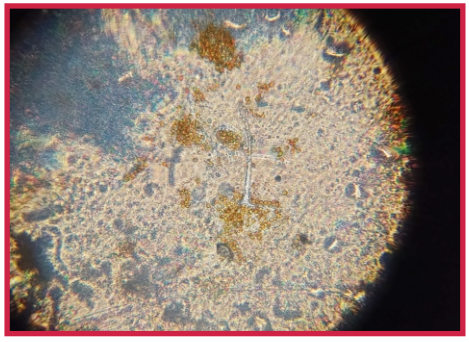


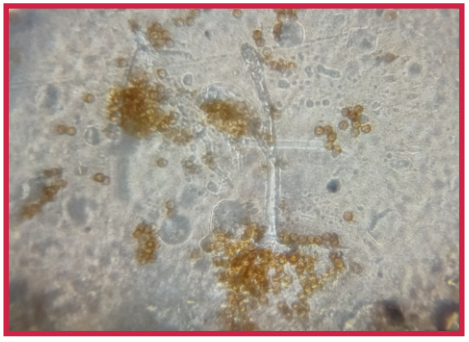


In situ diagnosis of *Rhizoctonia* spp (Root rot disease of chickpea) under Foldscope

Rust disease of chickpea





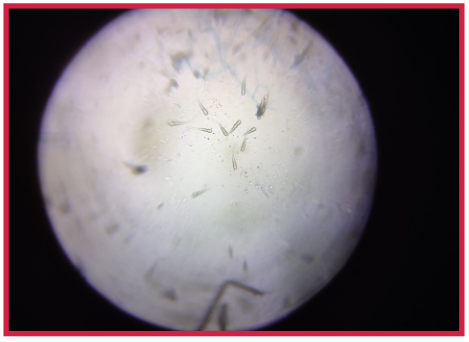


In situ diagnosis of *Uromyces* spp (Rust disease of chickpea) under Foldscope

(C) Disease of Oilseed Crops

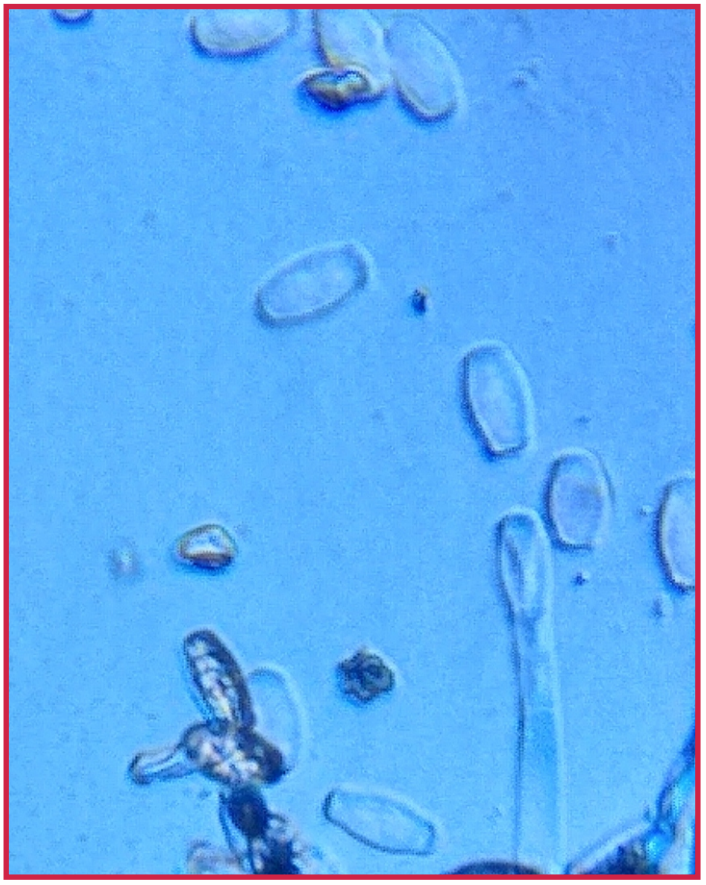
S. No.	Name of Disease	Identified Pathogen (Organism)
1	Leaf blight disease of linseed	*Alternaria lini*
2	Powdery mildew disease of sunflower	*Golovinomyces cichoracearum*
3	Leaf blight of safflower	*Alternaria carthemi*
4	Alternaria leaf blight of mustard	*Alternaria* spp

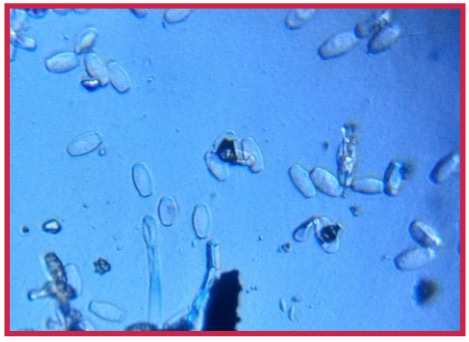
Leaf blight disease of linseed



In situ diagnosis of *Alternaria lini* (Leaf blight disease of linseed) under Foldscope

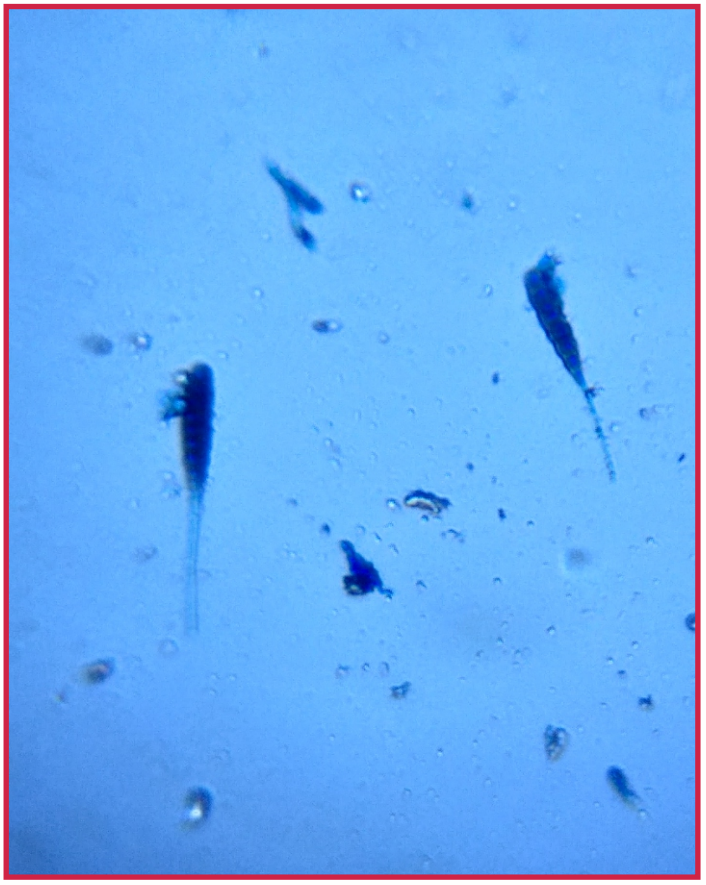
Powdery mildew disease of sunflower

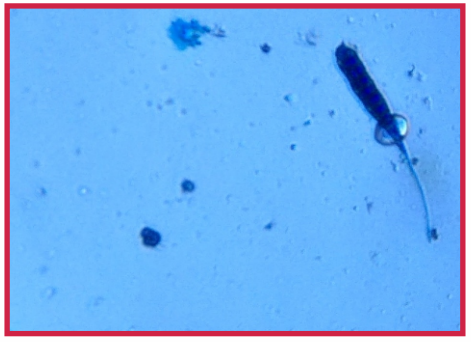


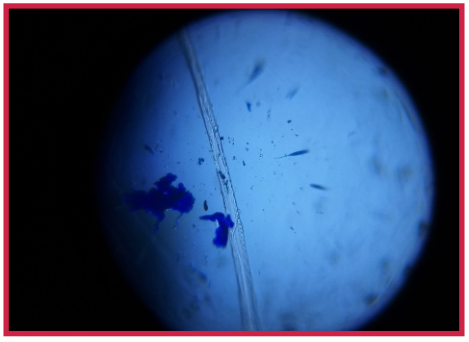


In situ diagnosis of *Golovinomyces cichoracearum* (Powdery mildew disease of sunflower) under Foldscope

Leaf blight of safflower

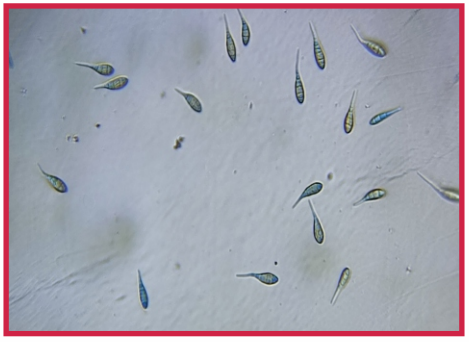






In situ diagnosis of *Alternaria carthemi* (Leaf blight of safflower) under Foldscope

Alternaria leaf blight of mustard

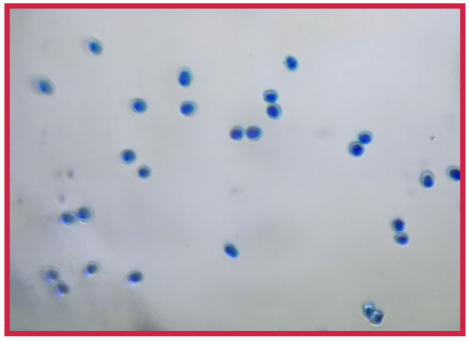


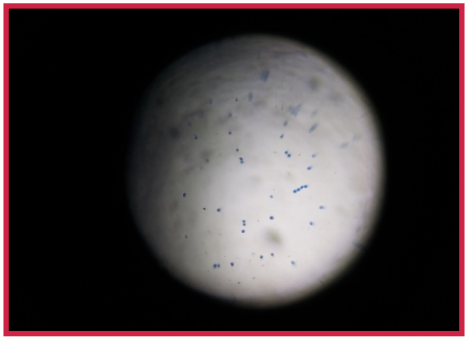
In situ diagnosis of *Alternaria* spp (Alternaria leaf blight of mustard) under Foldscope

(D) Disease of Horticultural Crops

S. No.	Name of Disease	Identified Pathogen (Organism)
1	White rust disease of Amaranthus	*Albugo bliti*
2	Early blight of tomato	*Alternaria solani*
3	Damping off disease of tomato	*Fusarium* spp
4	Seedling blight disease of tomato	*Rhizopus* spp
5	Powdery mildew disease of muskmelon	*Erysiphe cichoracearum*
6	Powdery mildew disease of coriander	*Erysiphe* spp
7	Powdery mildew disease of fenugreek	*Leveillula taurica*
8	Purple blotch of onion	*Alternaria porri*
9	Alternaria leaf blight of cabbage	*Alternaria* spp
10	Alternaria leaf blight of brinjal	*Alternaria* spp
11	Leaf spot of okra	*Cercospora* spp
12	Powdery mildew disease of cucurbits	*Erysiphe* spp
13	Leaf blight of ash gourd	*Alternaria* spp
14	Botrytis blight of brinjal	*Botrytis* spp
15	Powdery mildew disease of ber	*Oidium erysiphoides*
16	Red rust disease of mango	*Cephaleuros virescens*

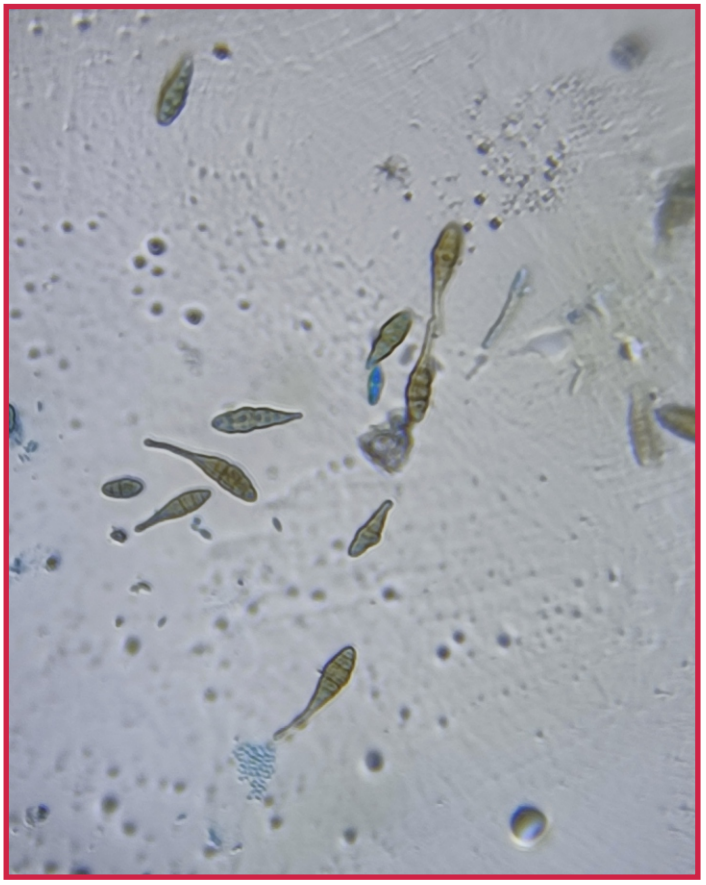
White rust disease of Amaranthus

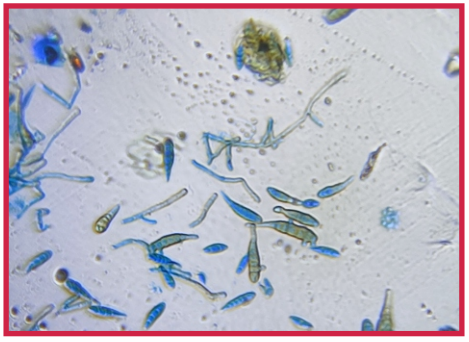




In situ diagnosis of *Albugo bliti* (White rust disease of Amaranthus) under Foldscope

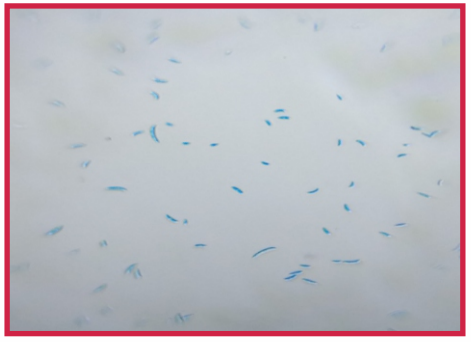
Early blight of tomato

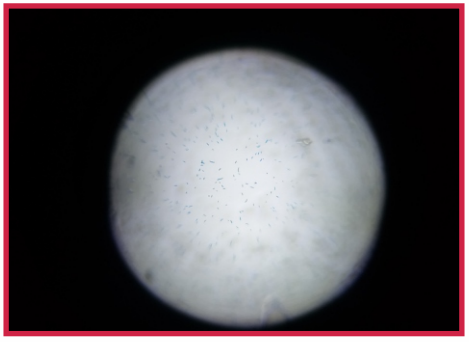




In situ diagnosis of *Alternaria solani* (Early blight of tomato) under Foldscope

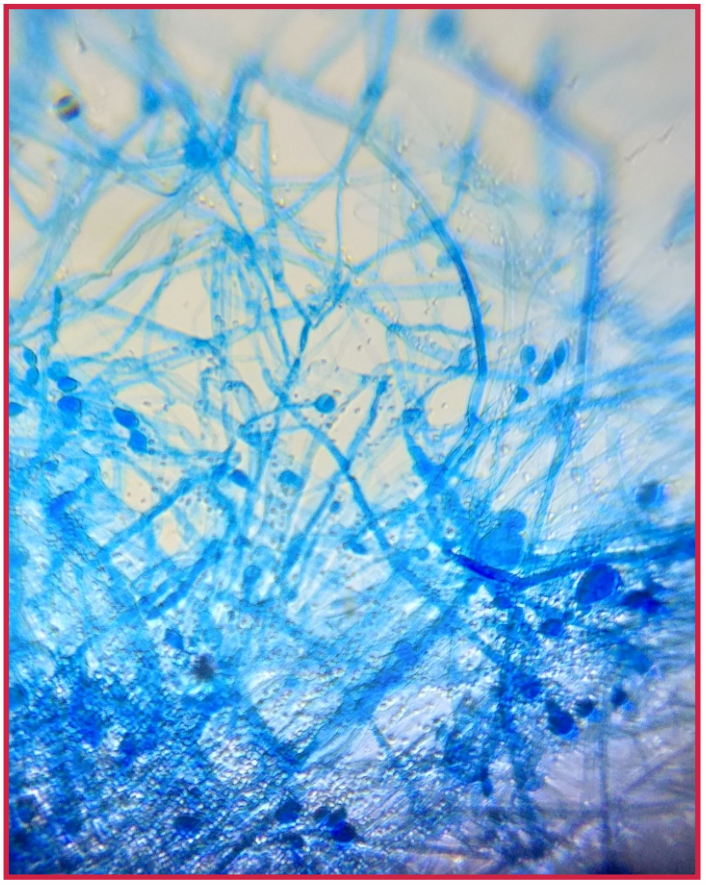
Damping off disease of tomato

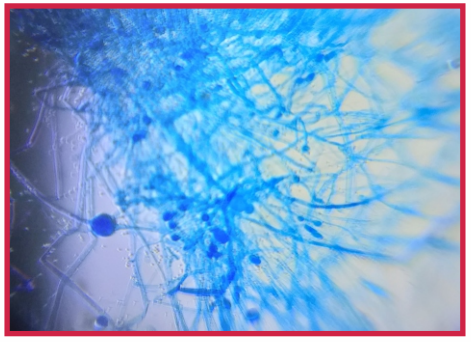


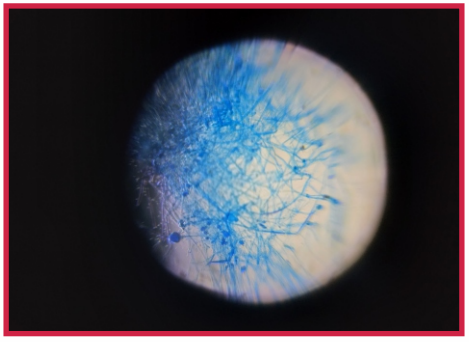


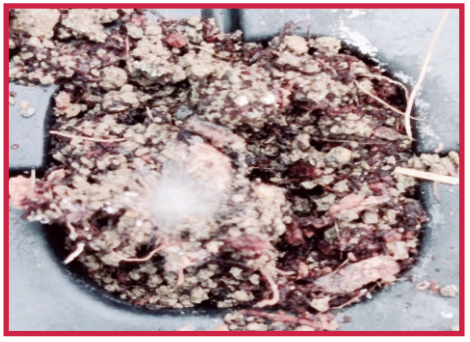
In situ diagnosis of *Fusarium* spp (Damping off disease of tomato) under Foldscope

Seedling blight disease of tomato



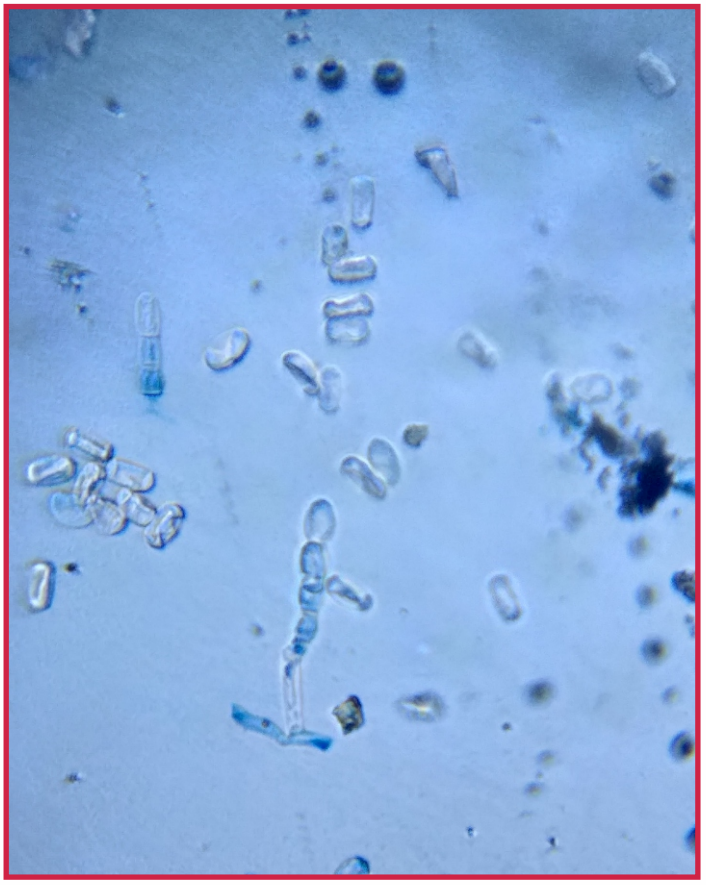


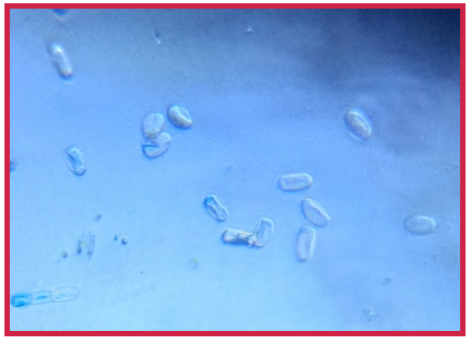


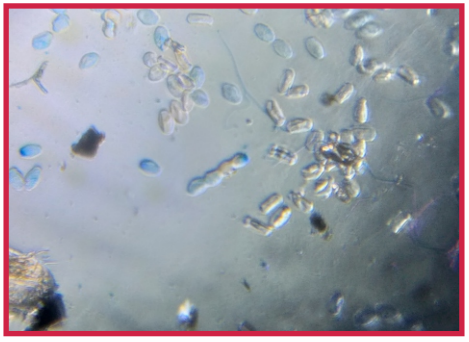


In situ diagnosis of *Rhizopus* spp (Seedling blight disease of tomato) under Foldscope

Powdery mildew disease of muskmelon

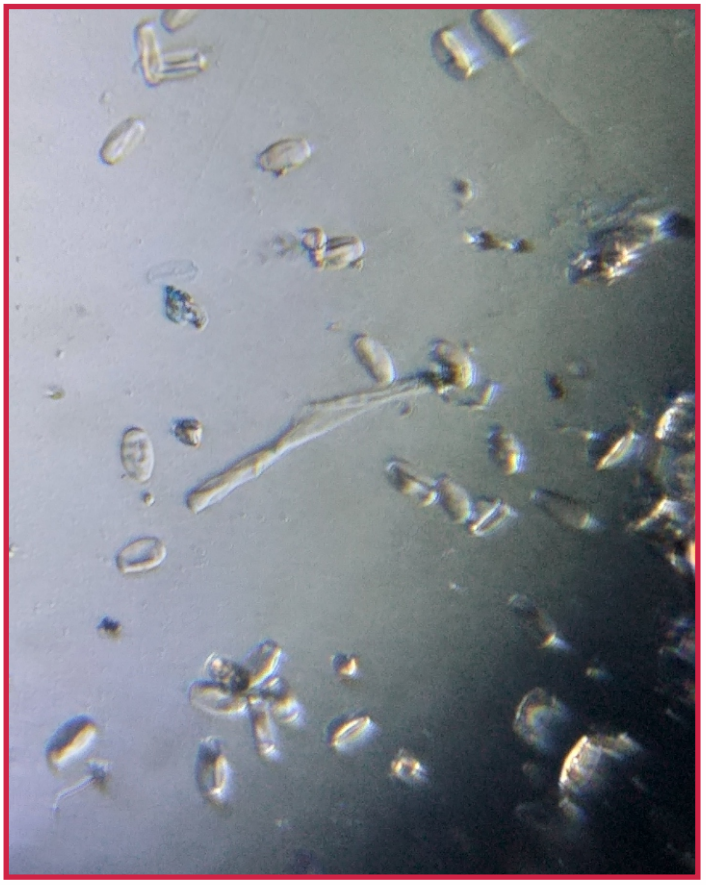


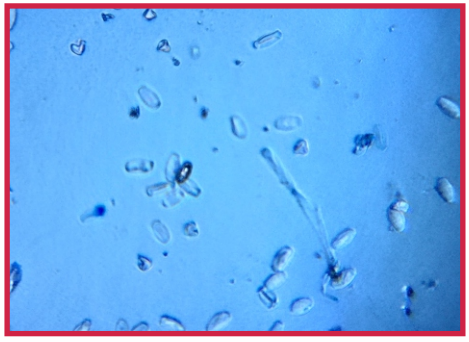


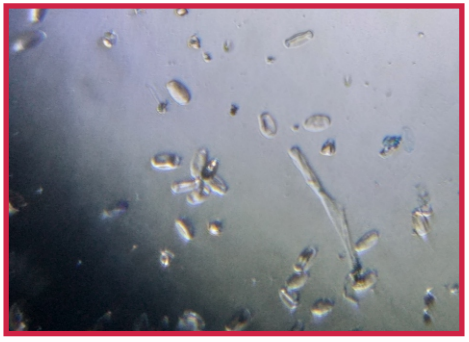


In situ diagnosis of *Erysiphe cichoracearum* (Powdery mildew disease of muskmelon) under Foldscope

Powdery mildew disease of coriander

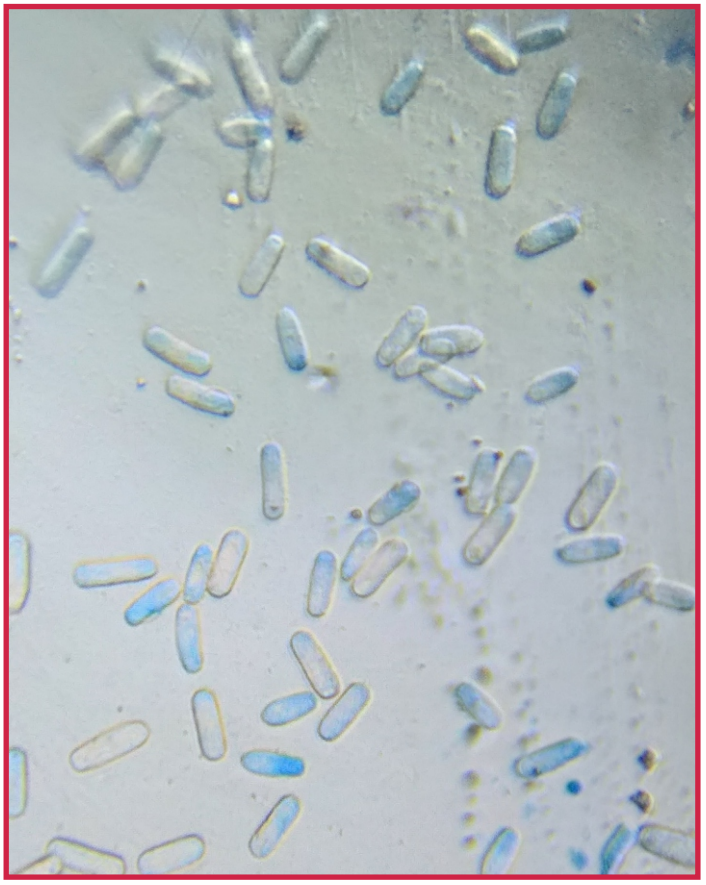


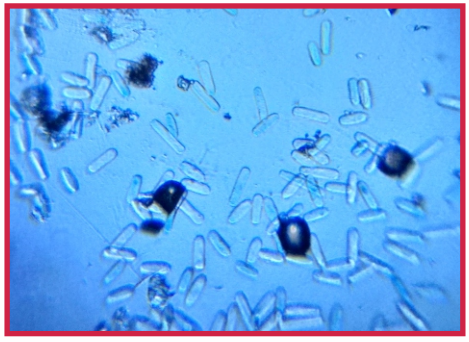


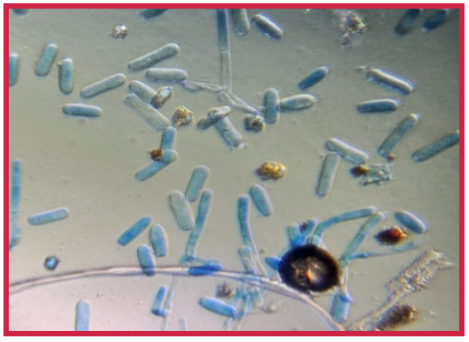


In situ diagnosis of *Erysiphe* spp (Powdery mildew disease of coriander) under Foldscope

Powdery mildew disease of fenugreek

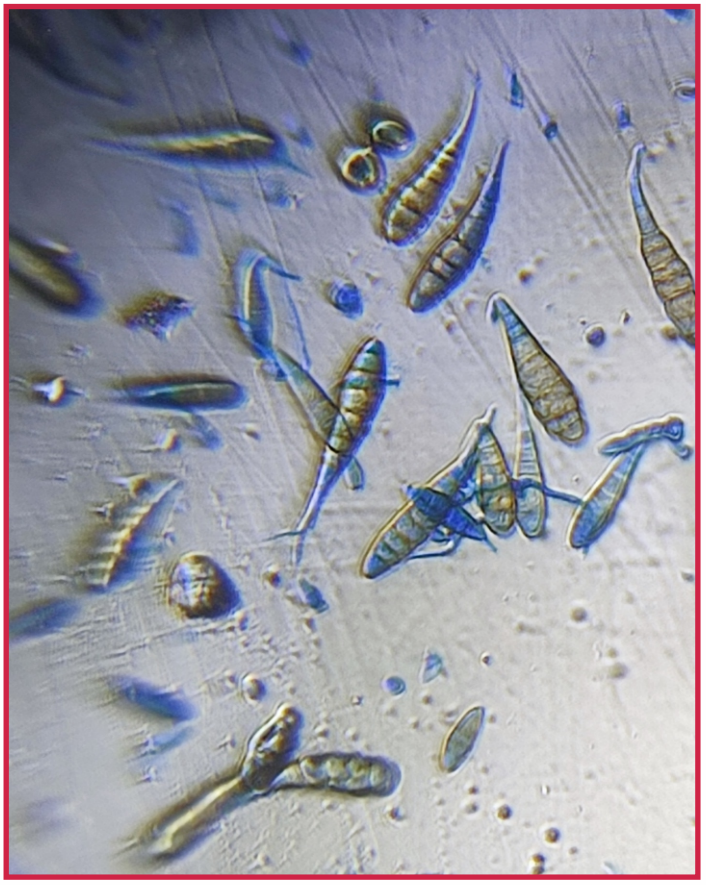






In situ diagnosis of *Leveillula taurica* (Powdery mildew disease of fenugreek) under Foldscope

Purple blotch of onion



In situ diagnosis of *Alternaria porri* (Purple blotch of onion) under Foldscope

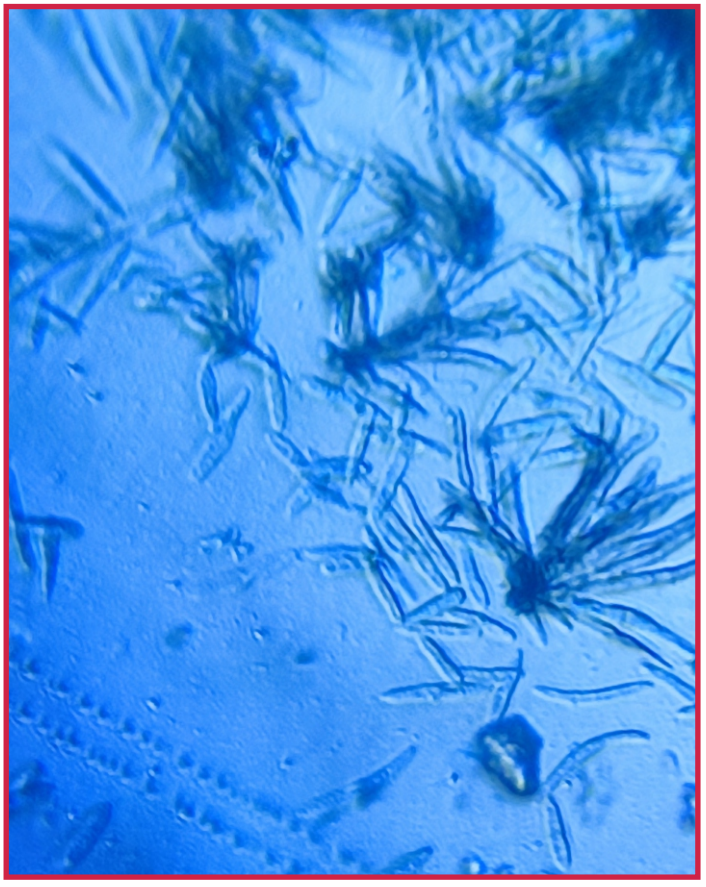
Alternaria leaf blight of cabbage

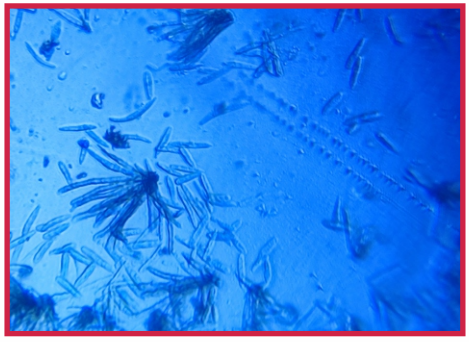
In situ diagnosis of *Alternaria* spp (Alternaria leaf blight of cabbage) under Foldscope

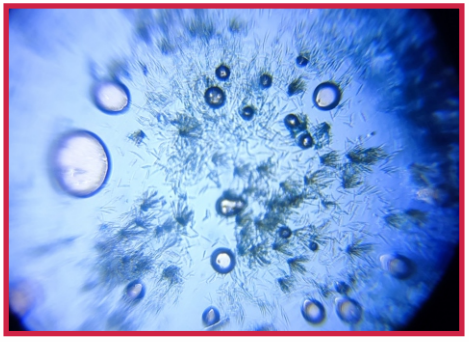
Alternaria leaf blight of brinjal

In situ diagnosis of *Alternaria* spp (Alternaria leaf blight of brinjal) under Foldscope

Leaf spot of okra

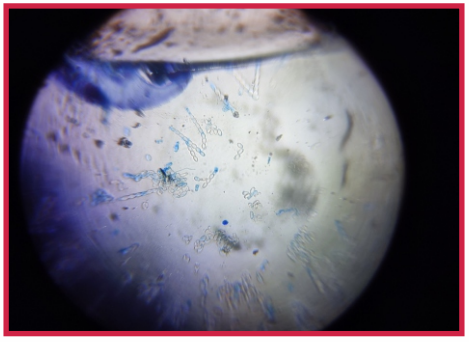






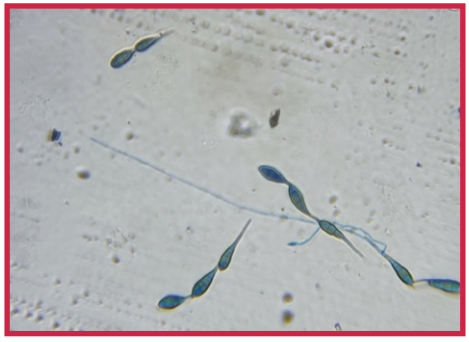
In situ diagnosis of *Cercospora* spp (Leaf spot of okra) under Foldscope

Powdery mildew disease of cucurbits



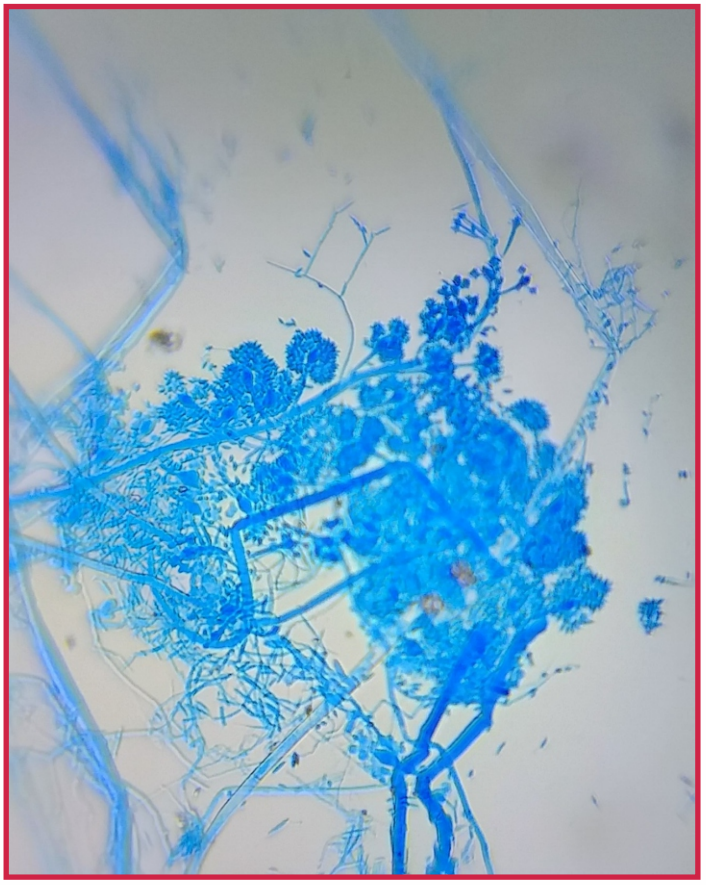
In situ diagnosis of *Erysiphe* spp (Powdery mildew diseaseof cucurbits) under Foldscope

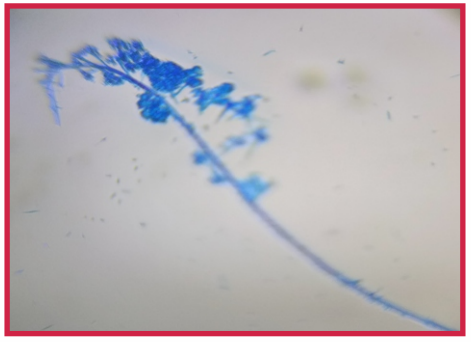
Leaf blight of ash gourd

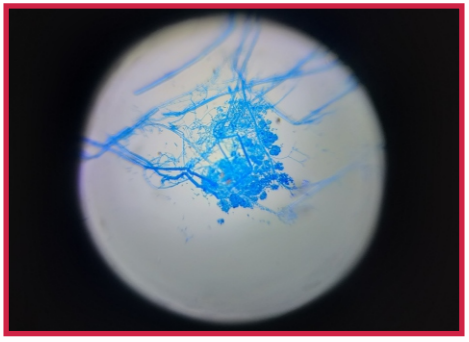


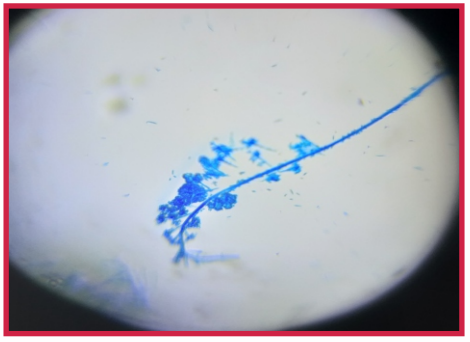
In situ diagnosis of *Alternaria* spp (Leaf blight of ash gourd under Foldscope

Botrytis blight of brinjal



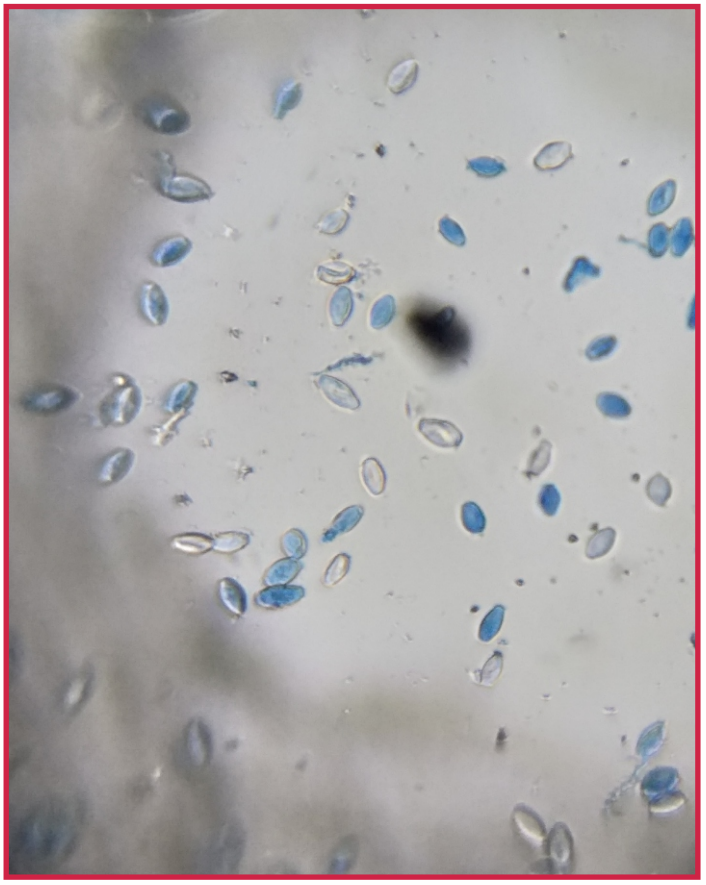


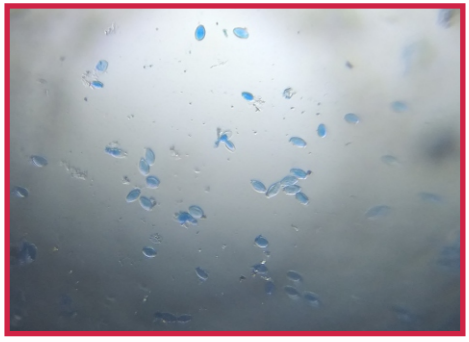


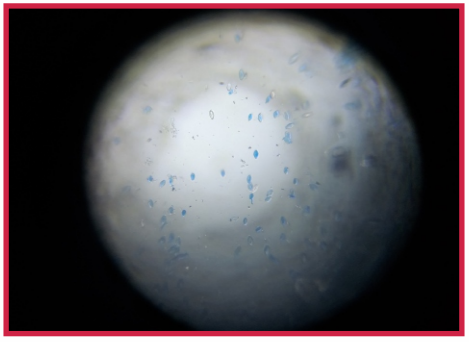


In situ diagnosis of *Botrytis* spp (Botrytis blight of brinjal) under Foldscope

Powdery mildew disease of ber

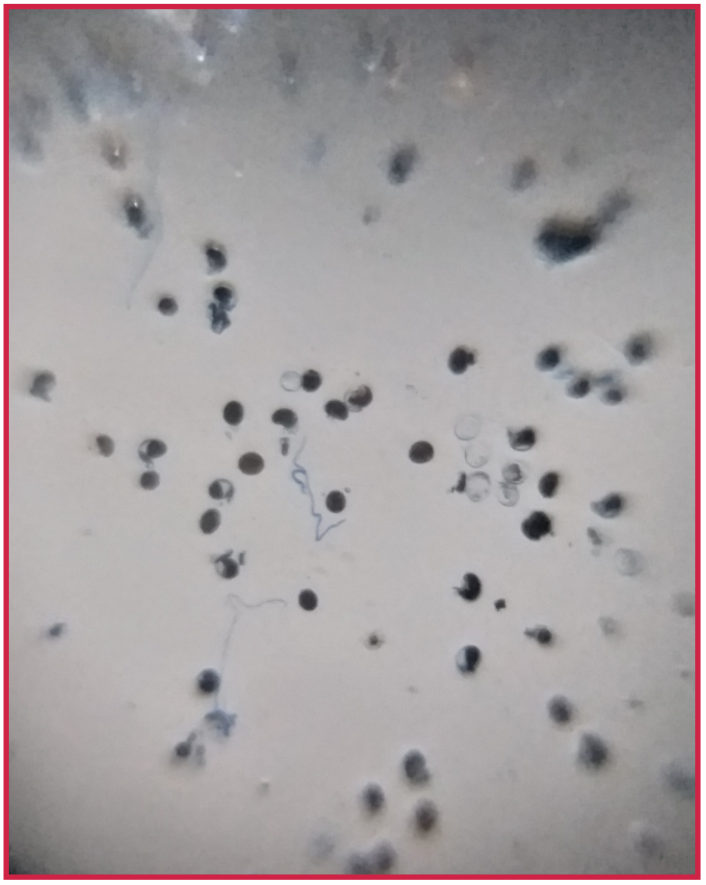


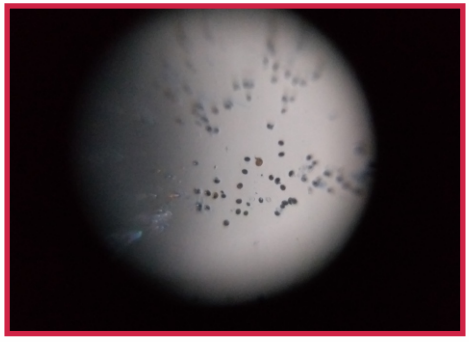


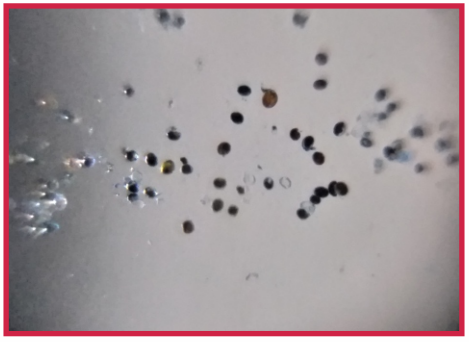


In situ diagnosis of *Oidium erysiphoides* (Powdery mildew disease of ber) under Foldscope

Red rust disease of mango





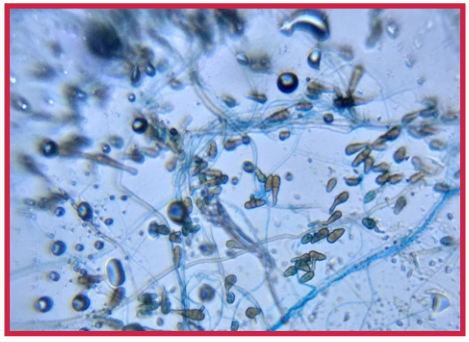


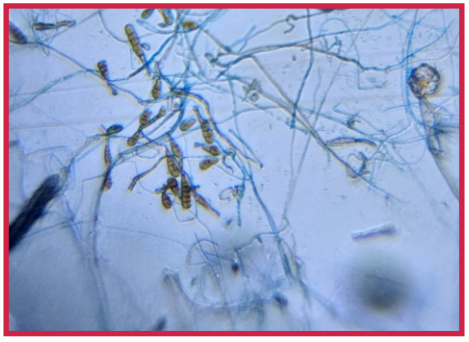
In situ diagnosis of *Cephaleuros virescens* (Red rust disease of mango) under Foldscope

(E) Post-Harvest Disease of Horticultural Crops

S. No.	Name of Disease	Identified Pathogen (Organism)
1	Post-harvest fruit rot disease of mango	*Alternaria* spp
2	Green mould disease of citrus	*Penicillium digitatum*
3	Fruit rot disease of grape	*Aspergillus* spp
4	Black mould disease of onion	*Aspergillus* spp
5	Black mould disease of Garlic	*Aspergillus* spp

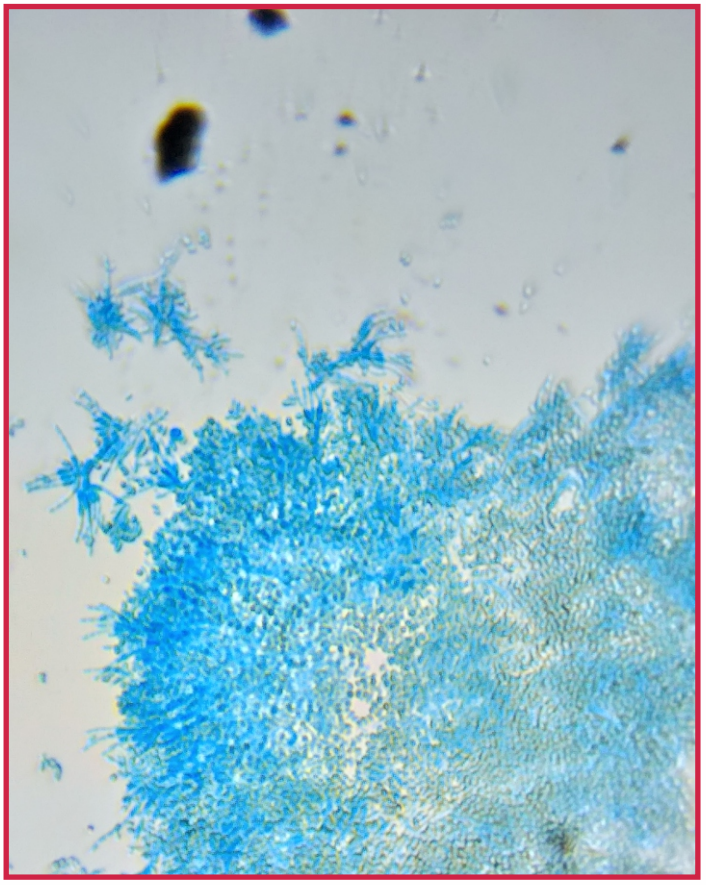
Post-harvest fruit rot disease of mango

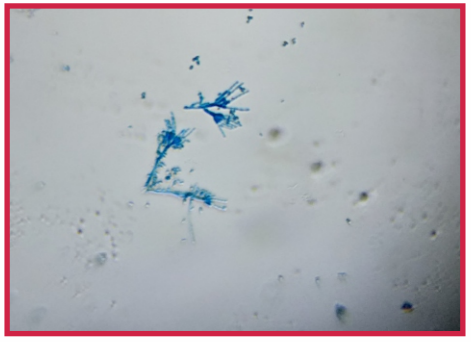


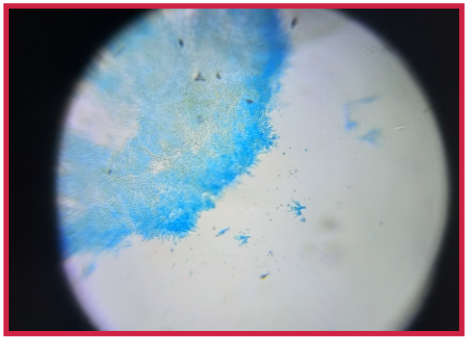


In situ diagnosis of *Alternaria* spp (Post-harvest fruit rot disease of mango) under Foldscope

Green mould disease of citrus

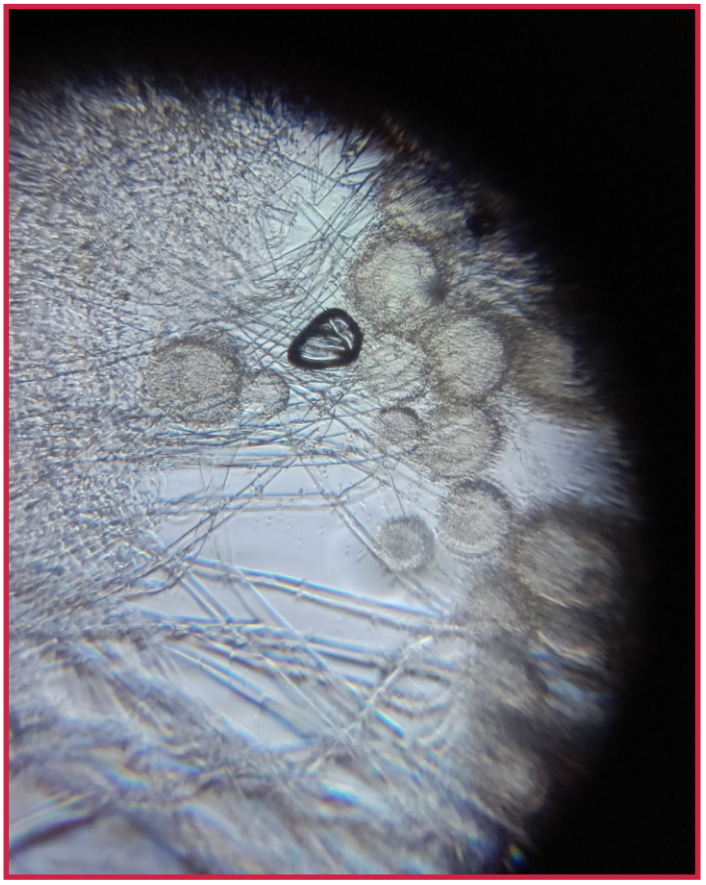


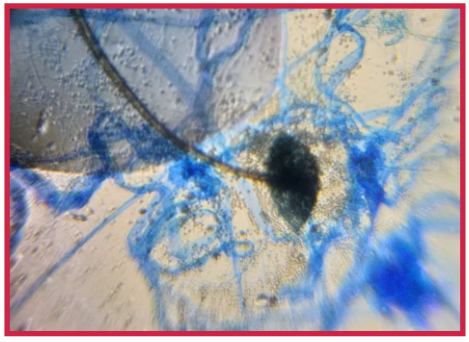


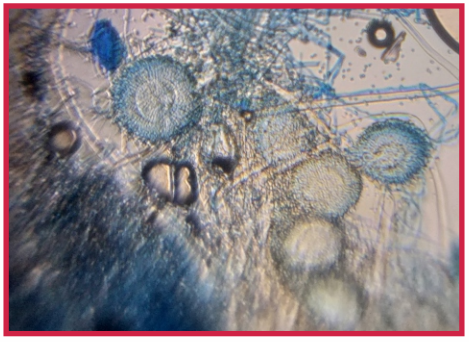


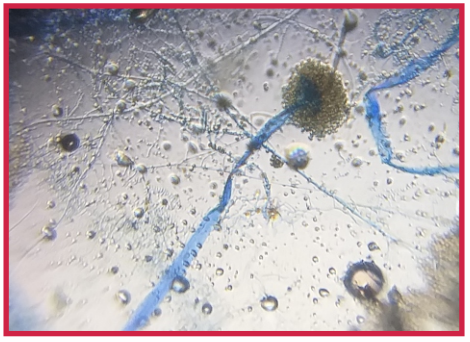
In situ diagnosis of *Penicillium digitatum* (Green mould disease of citrus) under Foldscope

Fruit rot disease of grape



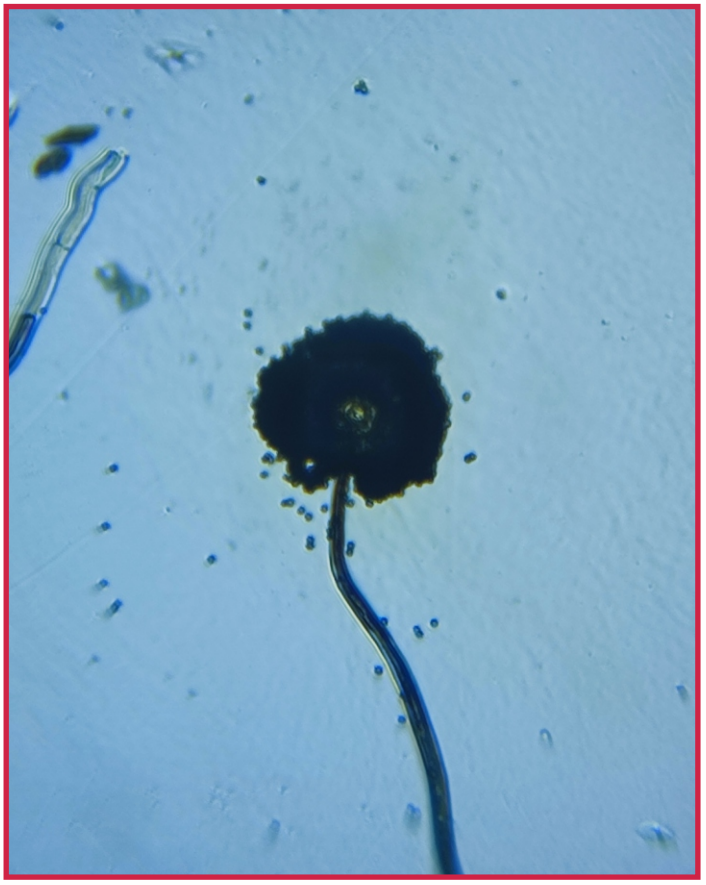


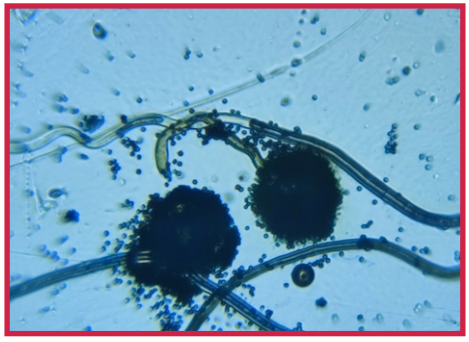




In situ diagnosis of *Aspergillus* spp (Fruit rot disease of grape) under Foldscope

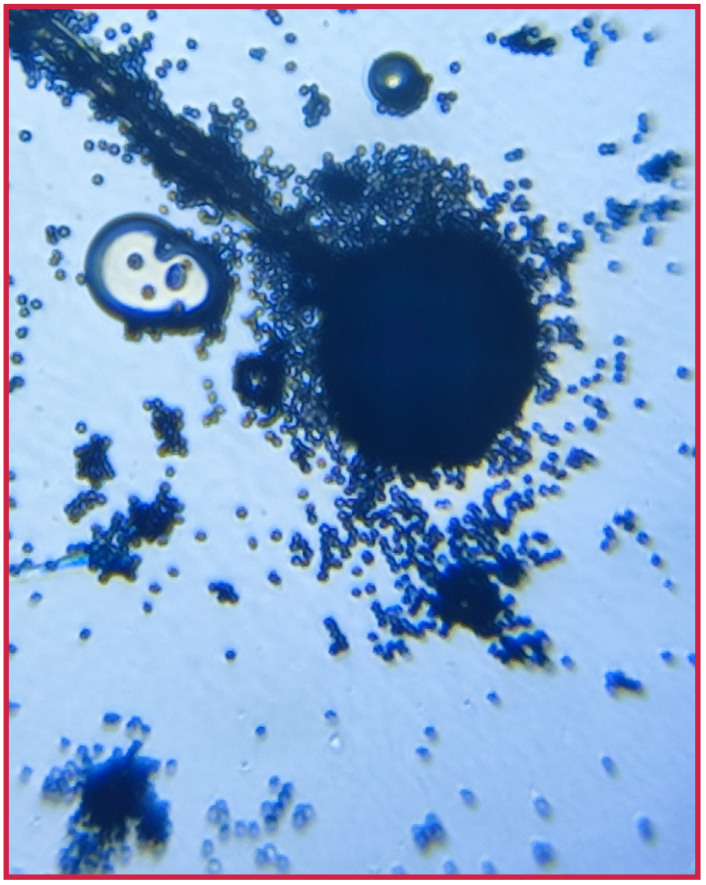
Black mould disease of onion

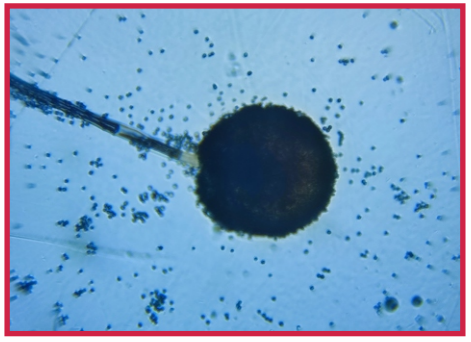


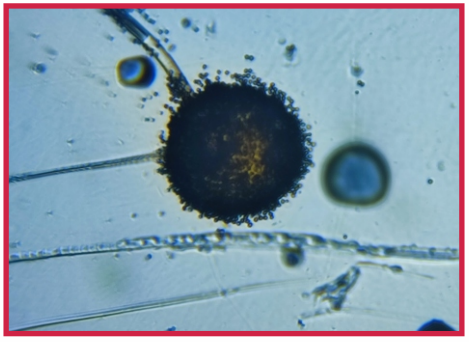


In situ diagnosis of *Aspergillus* spp (Black mould disease of onion) under Foldscope

Black mould disease of garlic



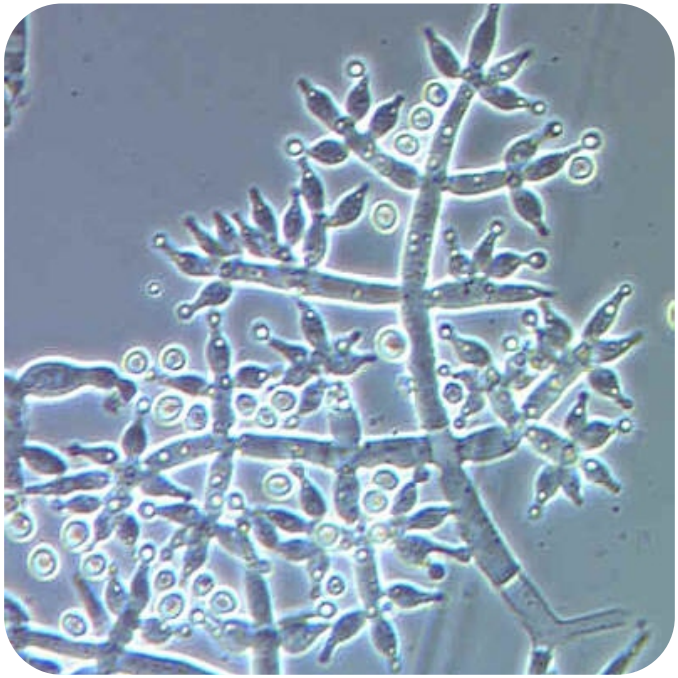




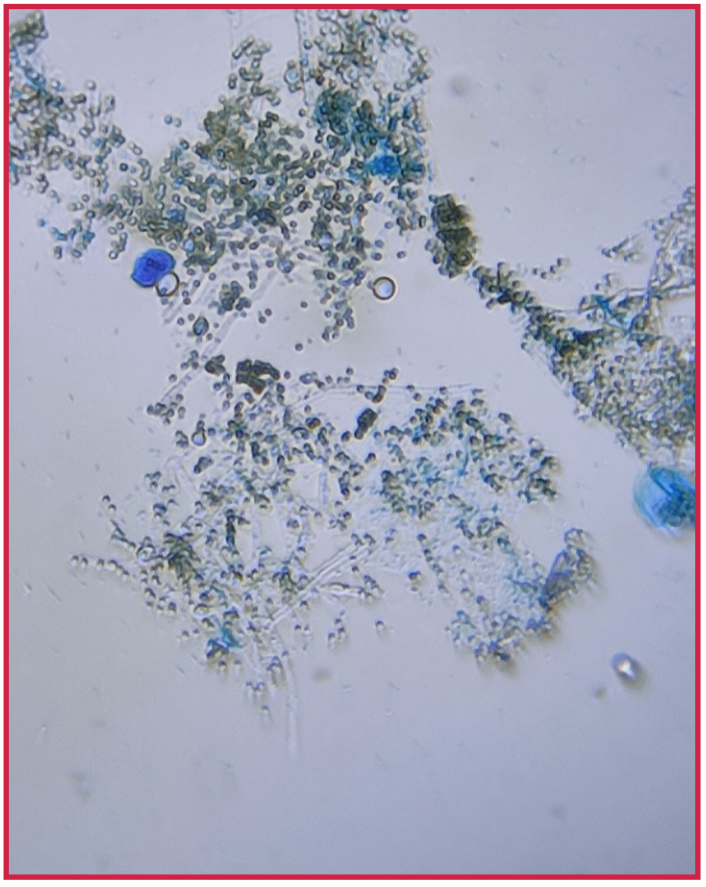
In situ diagnosis of *Aspergillus* spp (Black mould disease of garlic) under Foldscope

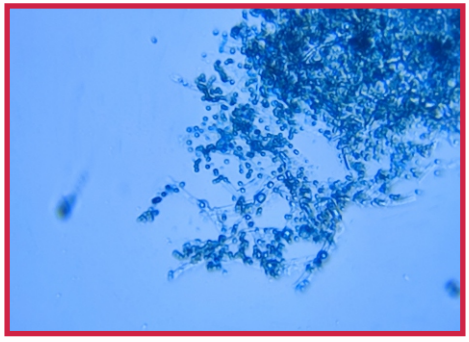
(F) Viability test of Bioagent

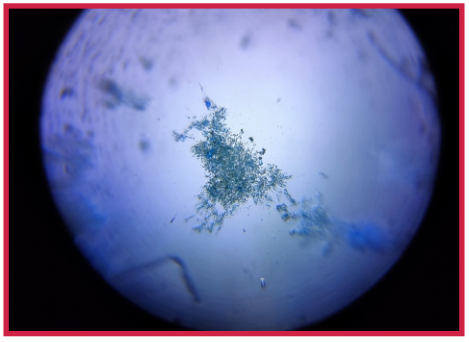
S. No.	Name of Disease	Identified Pathogen (Organism)
1	Indira Trichoderma (Bio fungicide)	*Trichoderma* spp
2	Entomopathogen (Pacelomyces)	*Pacelomyces* spp

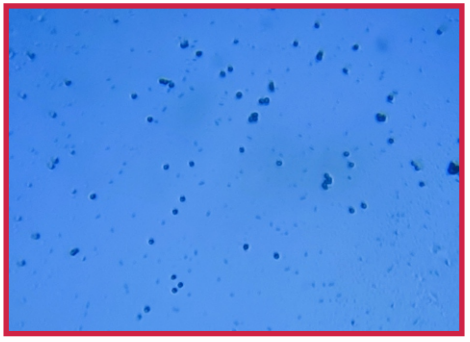


Indira Trichoderma (Bio fungicide)



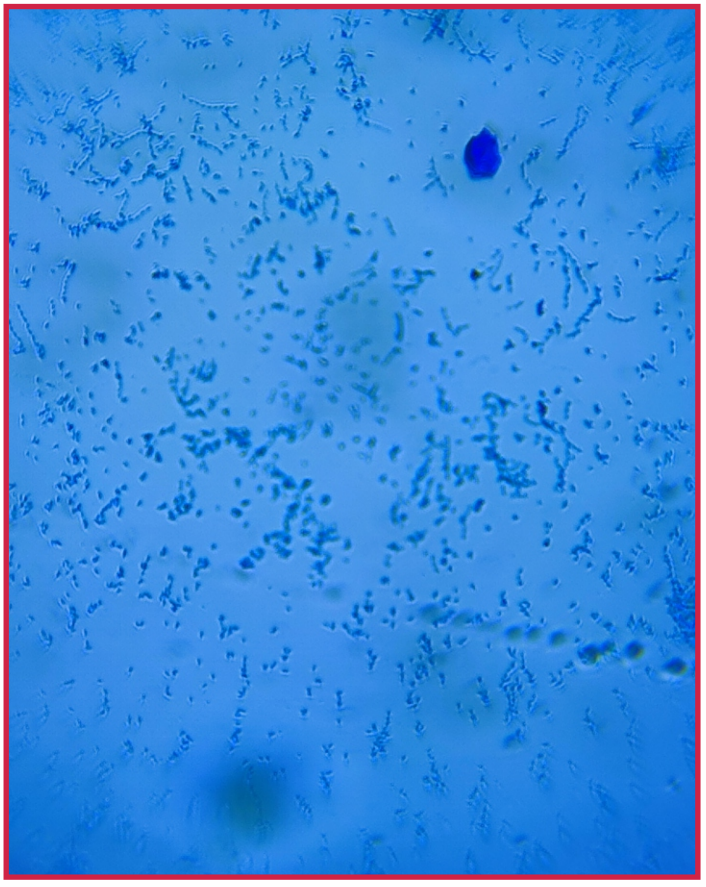


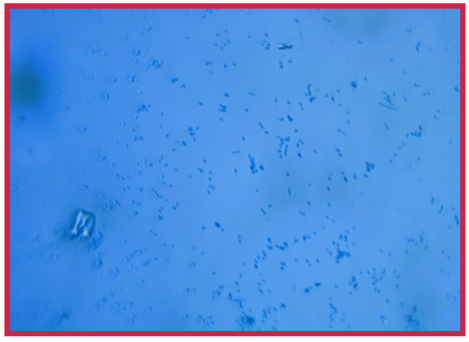


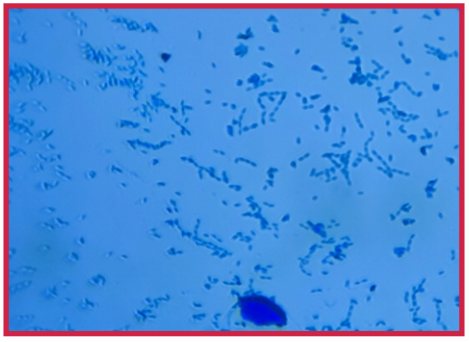


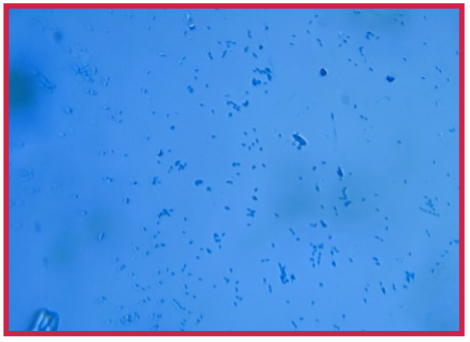
In situ viability test of *Trichoderma* spp (Indira Trichoderma) under Foldscope

Entomopathogen (Pacelomyces)









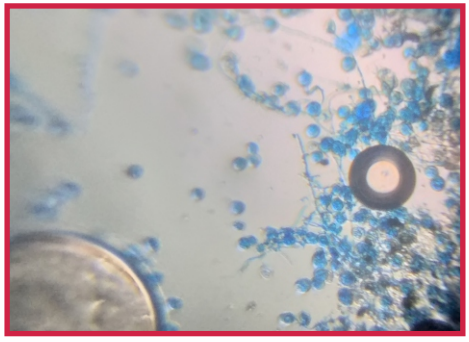
In situ viability test of *Pacelomyces* spp (Entomopathogen) under Foldscope

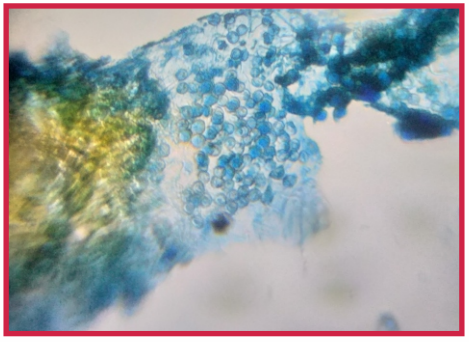
Ex situ diagnosis

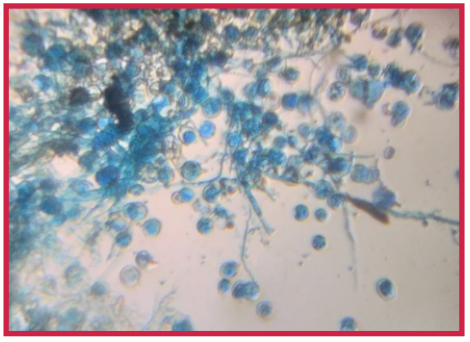
(A) Plant Disease

S. No.	Name of Disease	Identified Pathogen (Organism)
1	White rust of amaranthus	*Albugo bliti*
2	Downy mildew of cauliflower	*Peronospora parasitica*
3	Black spot disease of rose	*Diplocarpon rosae*
4	Powdery mildew disease of shisham	*Ovulariopsis sissoo*
5	Wheat seed (Seed pathogen)	*Rhizopus* spp

White rust of amaranthus

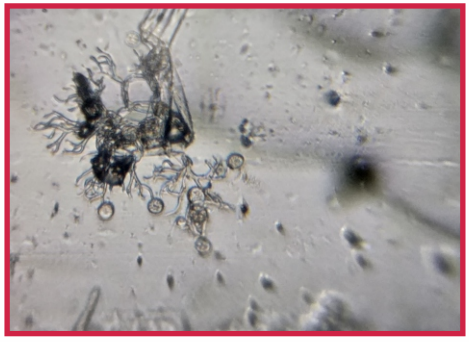


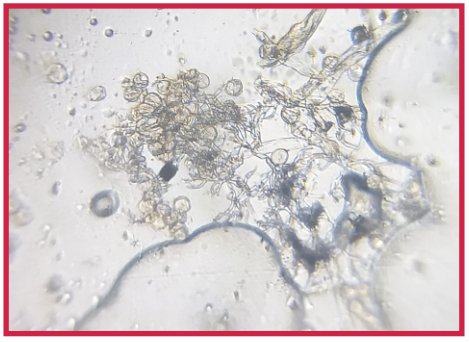


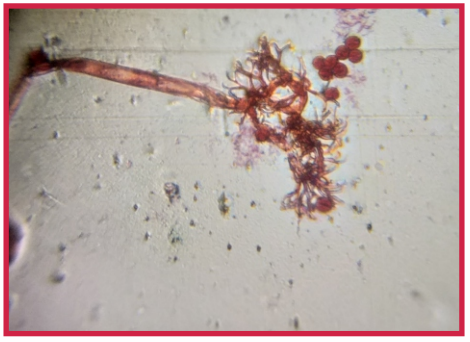


Diagnosis of *Albugo bliti* (White rust of amaranthus) under Foldscope

Downy mildew of cauliflower

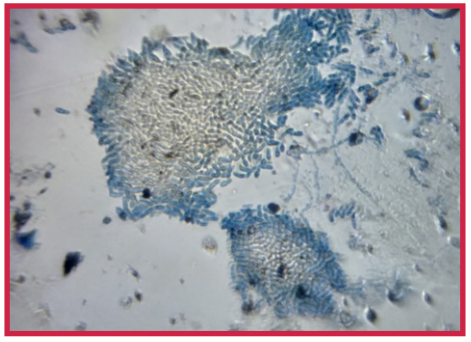


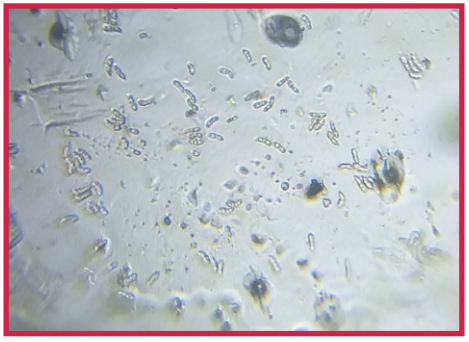


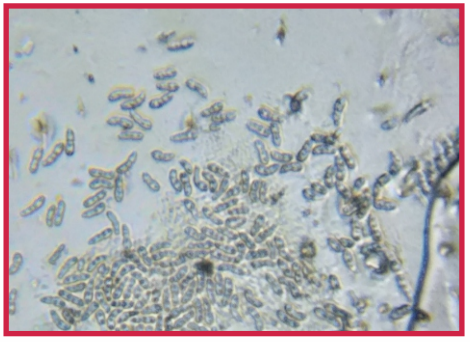


Diagnosis of *Peronospora parasitica* (Downy mildew of cauliflower) under Foldscope

Black spot disease of rose

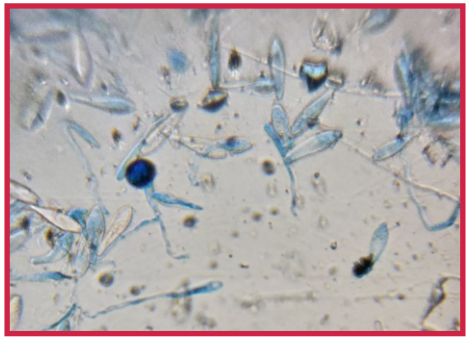


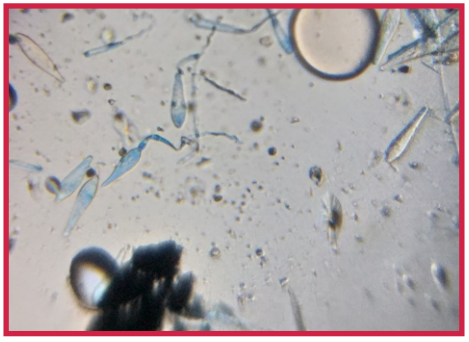


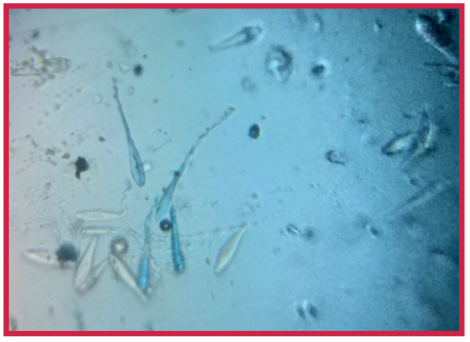


Diagnosis of *Diplocarpon rosae* (Black spot disease of rose) under Foldscope

Powdery mildew disease of shisham

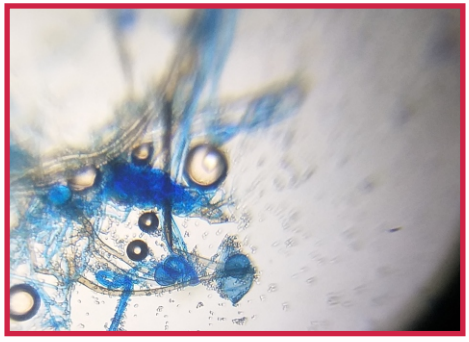


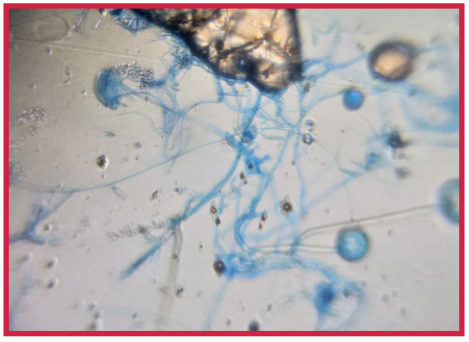


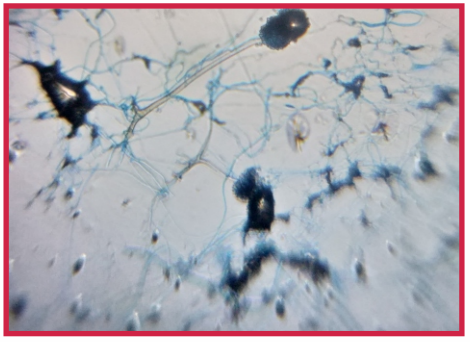


Diagnosis of *Ovulariopsis sissoo* (Powdery mildew disease of shisham) under Foldscope

Wheat seed (Seed pathogen)





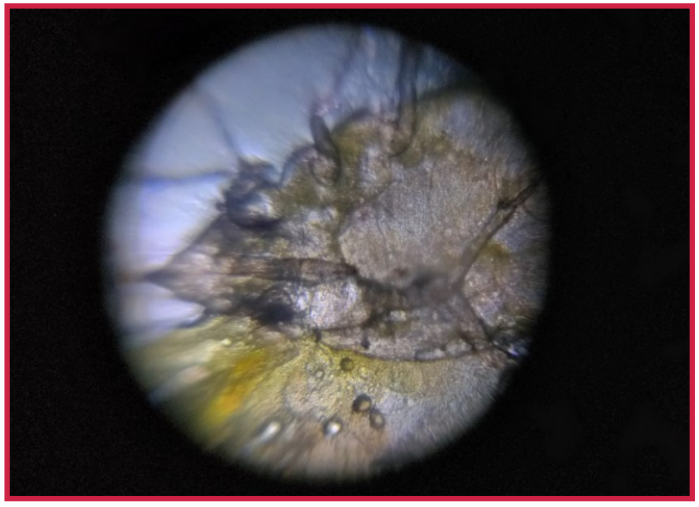


Diagnosis of *Rhizopus* spp (Wheat seed (Seed pathogen)) under Foldscope

(B) Insect and Nematodes

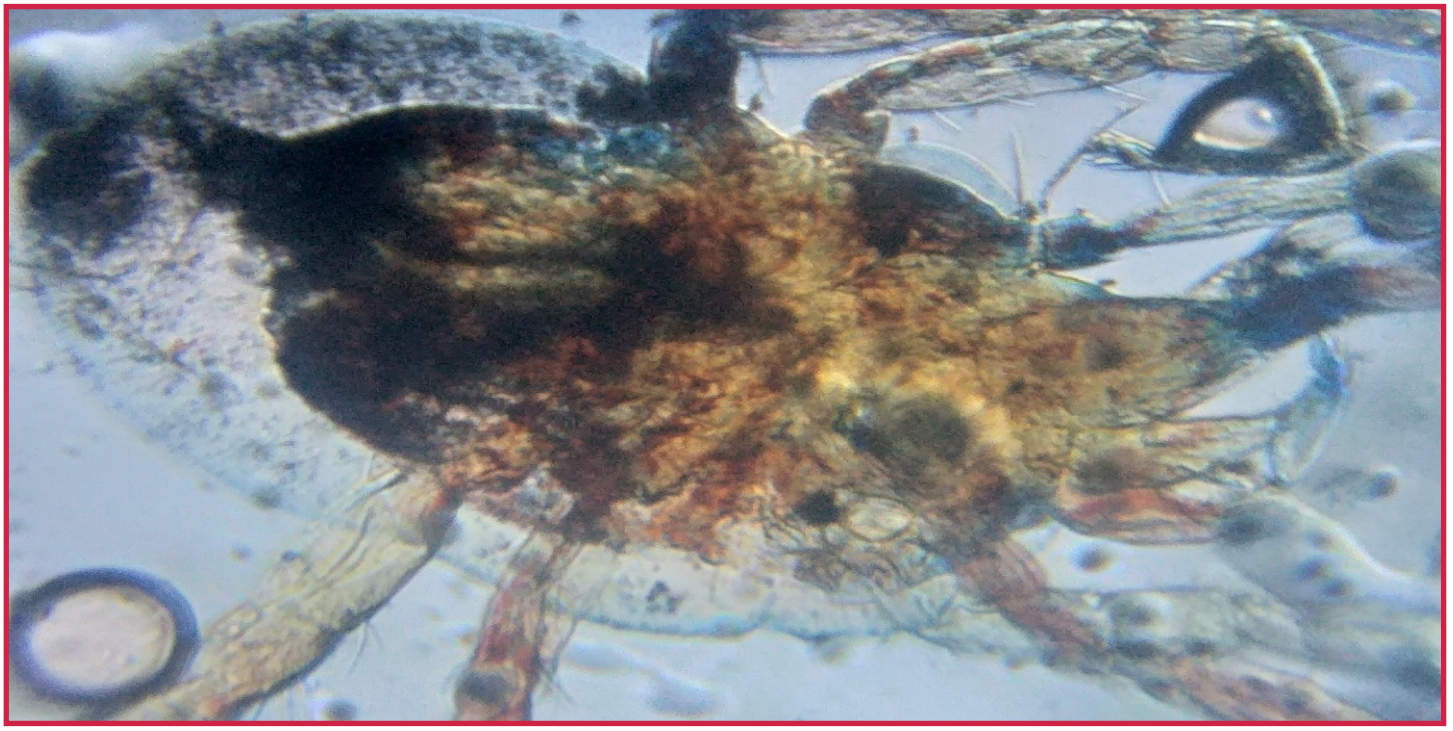
S. No.	Name of Insect/ Pest	Identified Organism (Scientific Name)
1	Aphid	*Aphis gossypii*
2	Leaf mite	*Oligonychus* spp
3	Trichogramma (Parasitoid)	*Trichogramma japonicum*
4	Root knot nematode of brinjal	*Meloidogyne* spp

Aphid



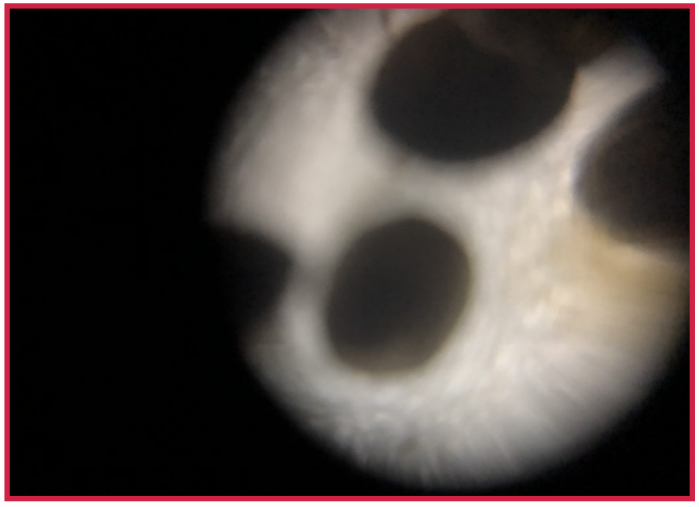
Diagnosis of *Aphis gossypii* (Aphid) under Foldscope

Leaf mite



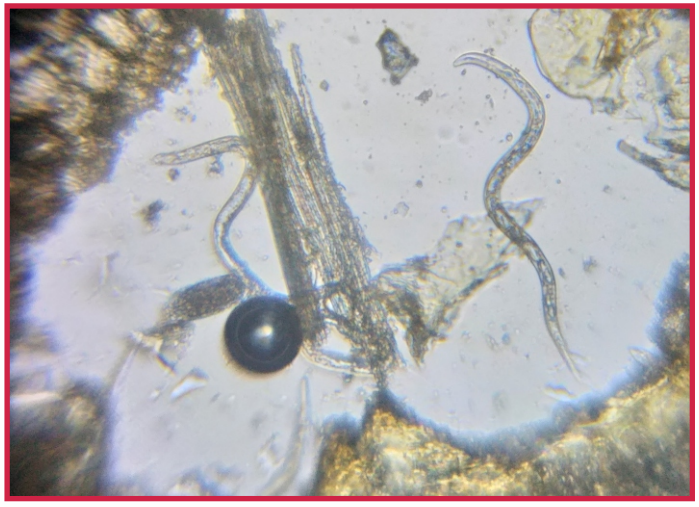
Diagnosis of *Oligonychus* spp (Leaf mite) under Foldscope

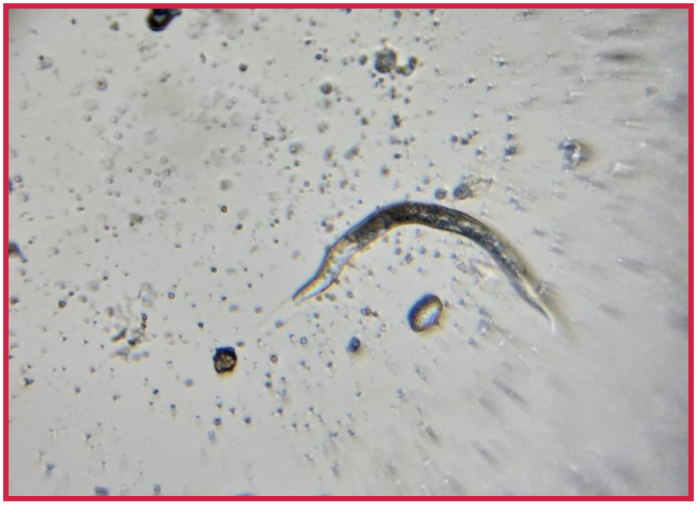
Trichogramma (Parasitoid)



Diagnosis of *Trichogramma japonicum* (Trichogramma (Parasitoid)) under Foldscope

Root knot nematode of brinjal



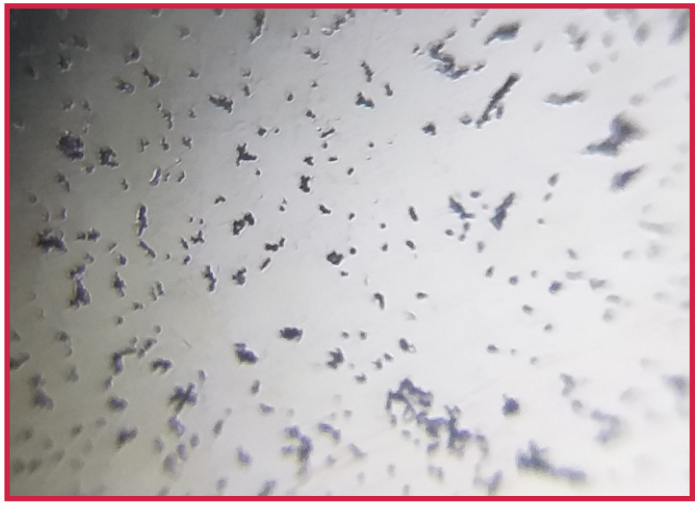


Diagnosis of *Meloidogyne* spp (Root knot nematode of brinjal) under Foldscope

(C) Zoonotic Disease

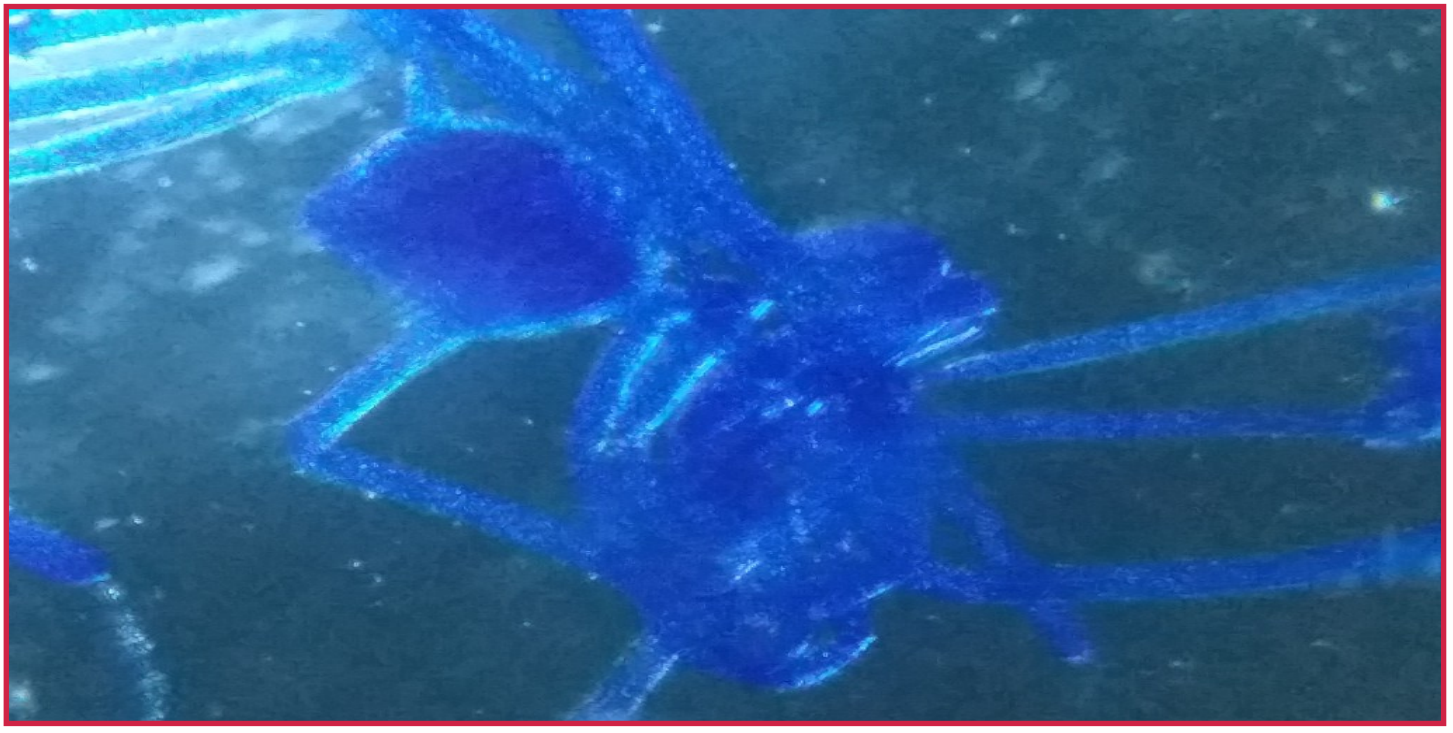
S. No.	Name of Disease	Identified Organism (Scientific Name)
1	Candidiasis disease	*Candida* spp
2	Mastitis milk of cow	*Rhizopus* spp

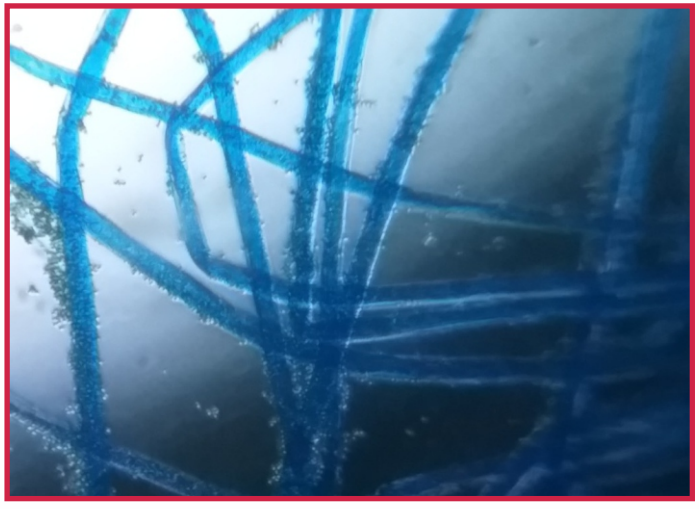
Candidiasis disease

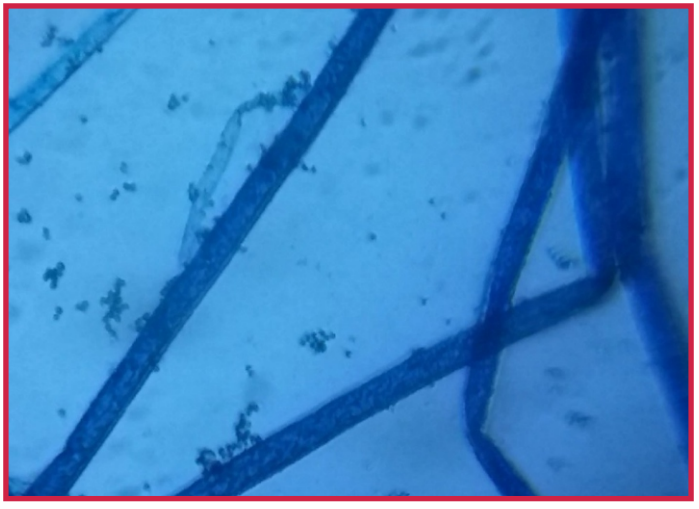


Diagnosis of *Candida* spp (Candidiasis disease) under Foldscope

Mastitis milk of cow



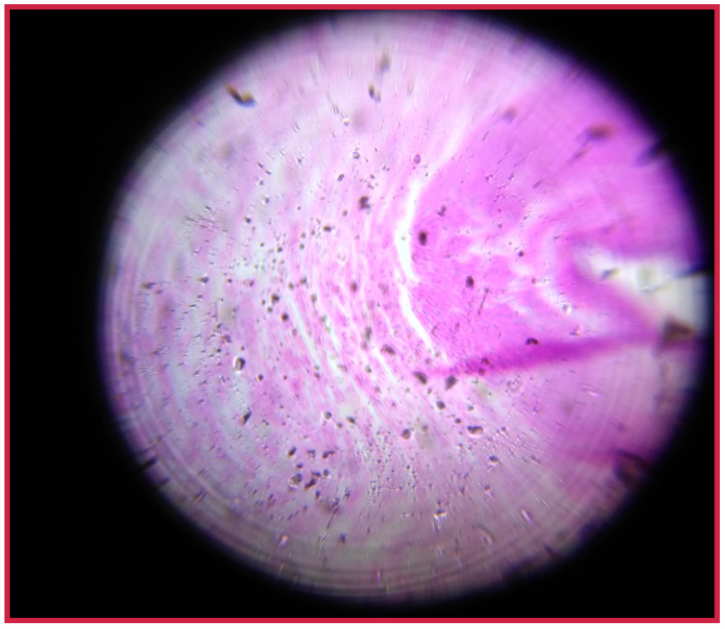




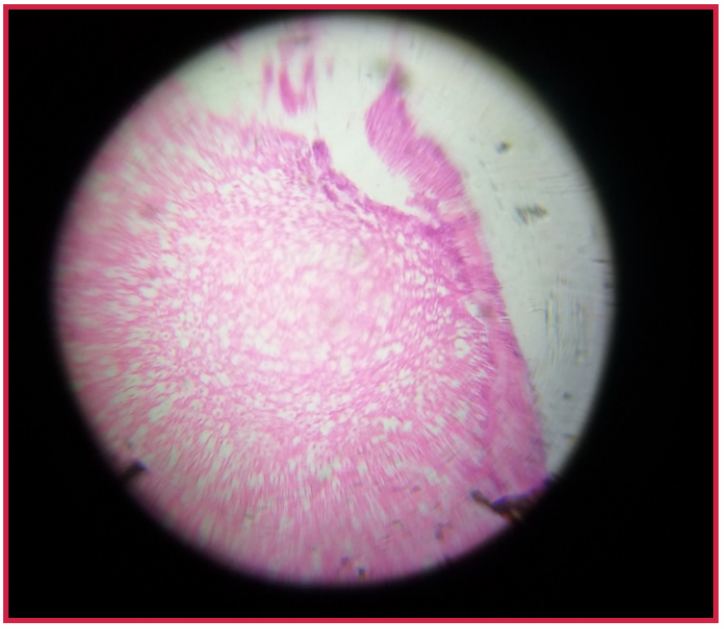
Diagnosis of *Rhizopus* spp (Mastitis milk of cow) under Foldscope

(D) Histology

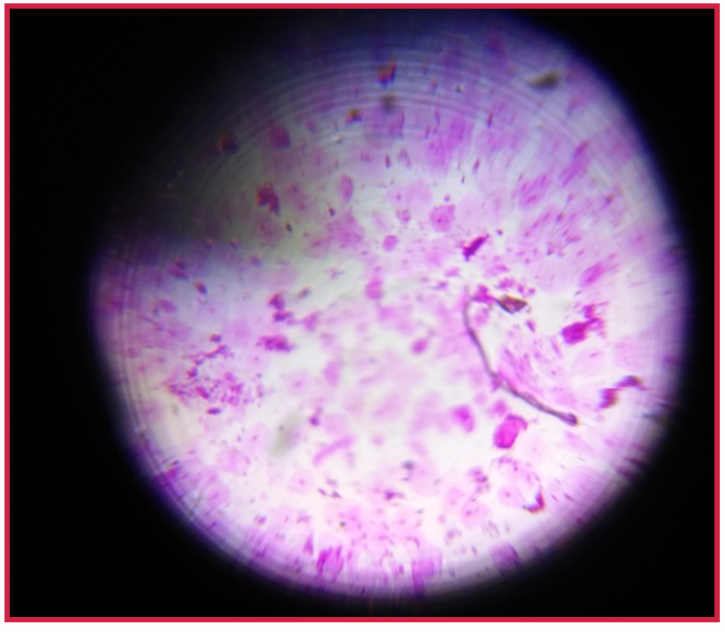
S. No.	Name of tissue	S. No.	Name of tissue
1	Connective Tissue	16	Artery T.S.
2	Nerve Tissue	17	Cuboidal Epithelium
3	Animal Cell	18	Heart T.S.
4	Elastic Cartilage	19	Hyaline Cartilage T.S.
5	Epithelium	20	Smooth Muscles T.S.
6	Large Intestine T. S.	21	Spinal Cord T. S.
7	Mammal Lung T. S.	22	Nerve Cell T.S.
8	Tongue T. S.	23	Large Intestine T. S
9	Uterus T. S.	24	Small Intestine T.S.
10	Cardiac Muscles T. S.	25	Spleen T.S.
11	Kidney T.S.	26	Squamous Epithelium
12	Spinal Cord T. S.	27	Stomach T.S.
13	Skin T.S.	28	Blood smear
14	Colon (Rectum)T.S	29	Mammal Oesophagus T.S.
15	Aorta T.S.	30	Ascaris Male T. S.



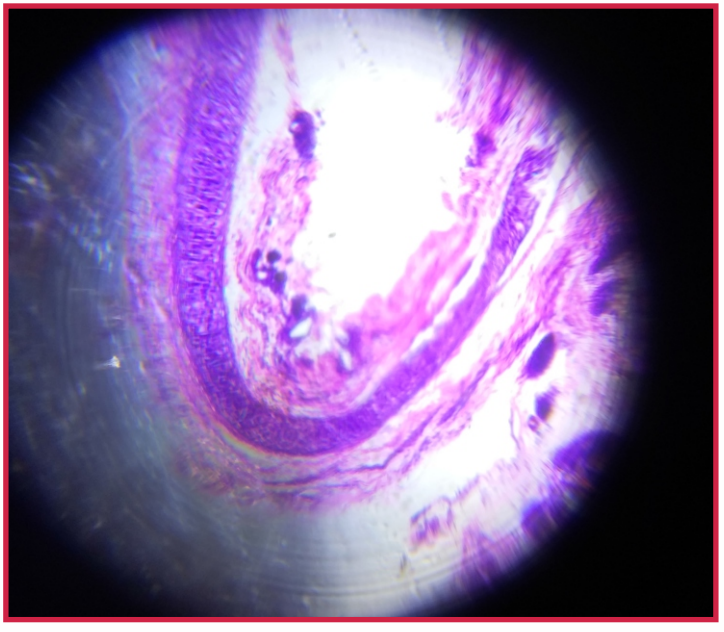
1. Connective Tissue



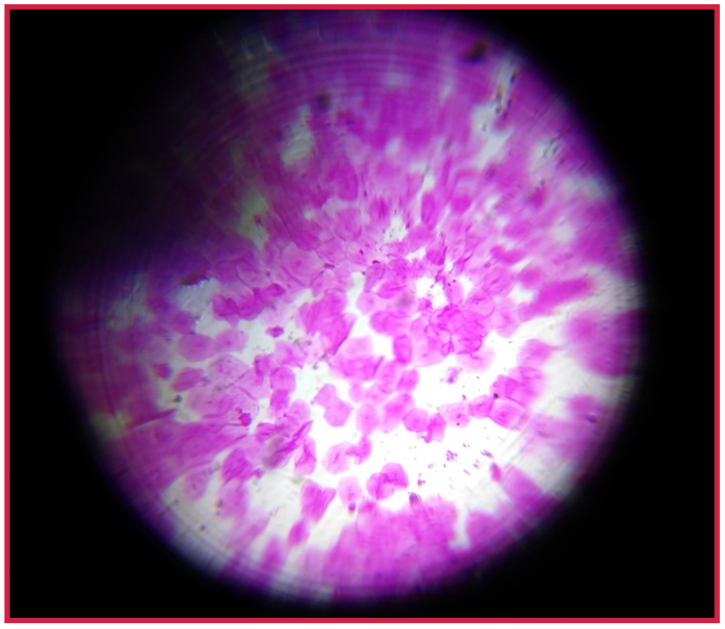
2. Nerve Tissue



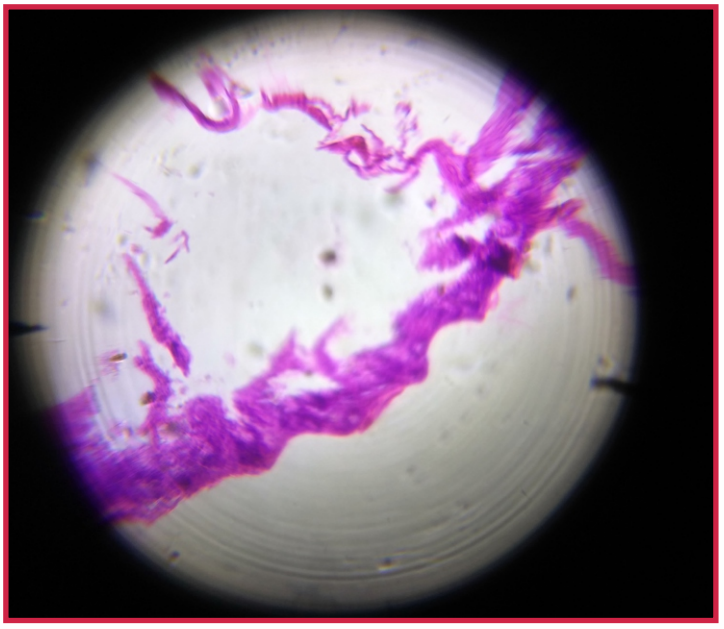
3. Animal Cell



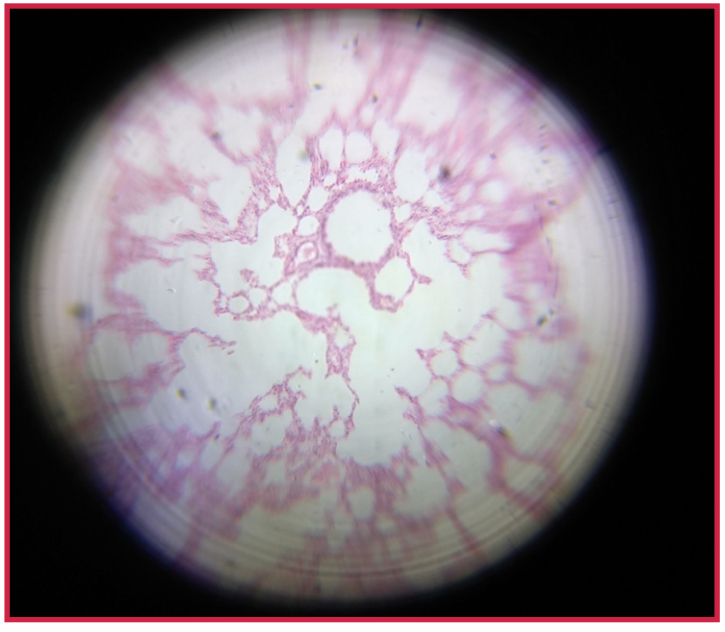
4. Elastic Cartilage



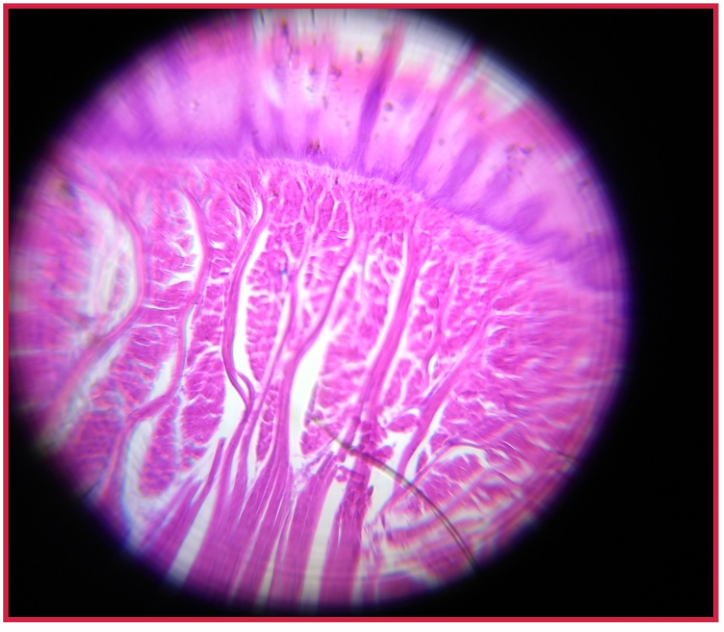
5. Epithelium



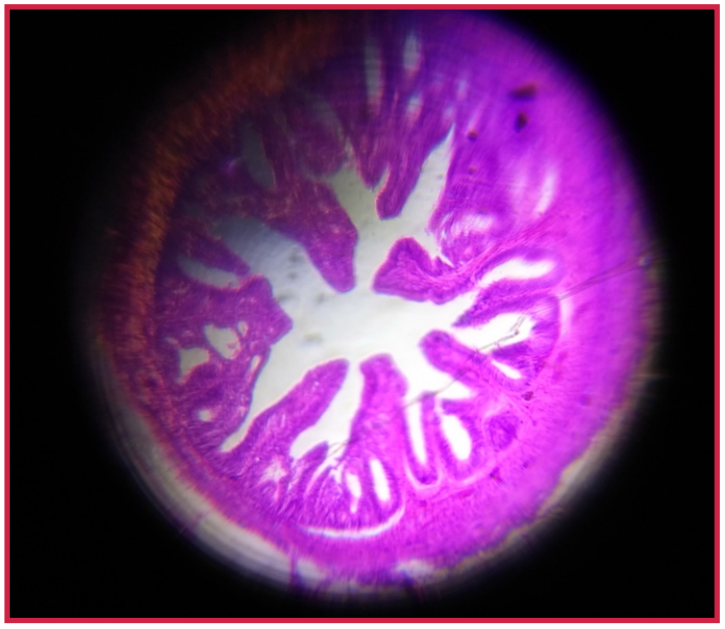
6. Large Intestine T. S.



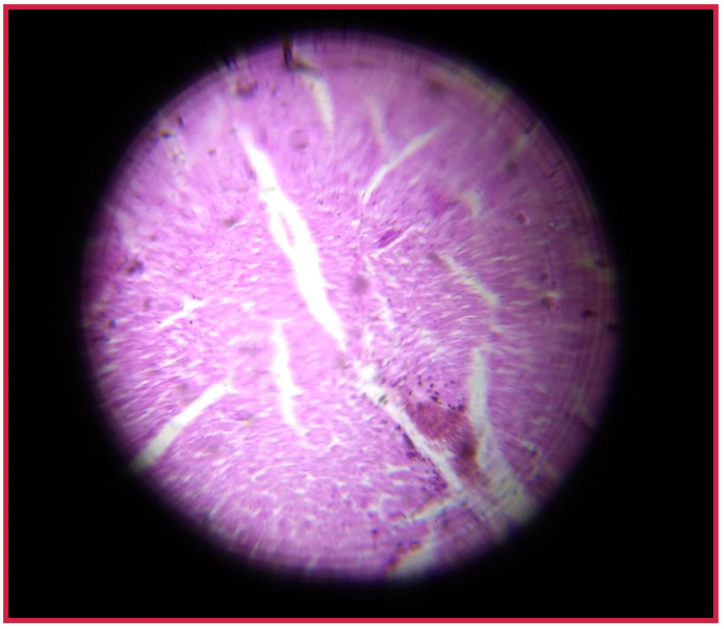
7. Mammal Lung T. S.



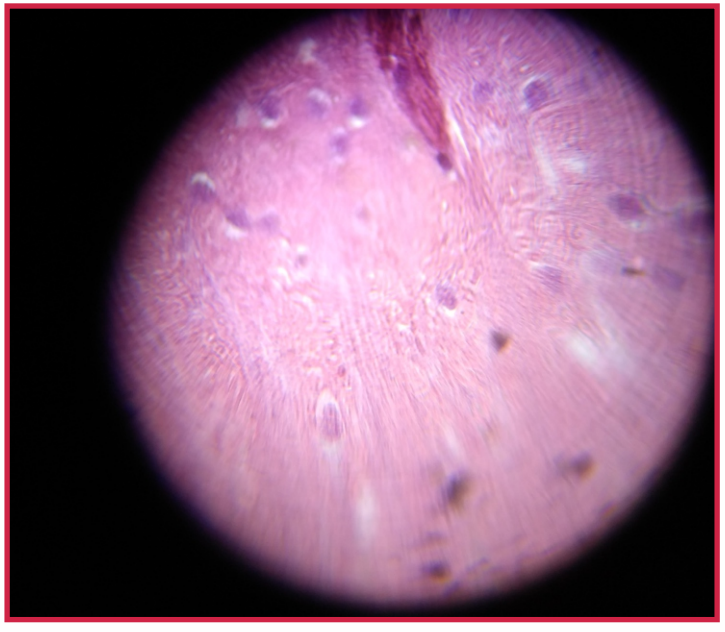
8. Tongue T. S.



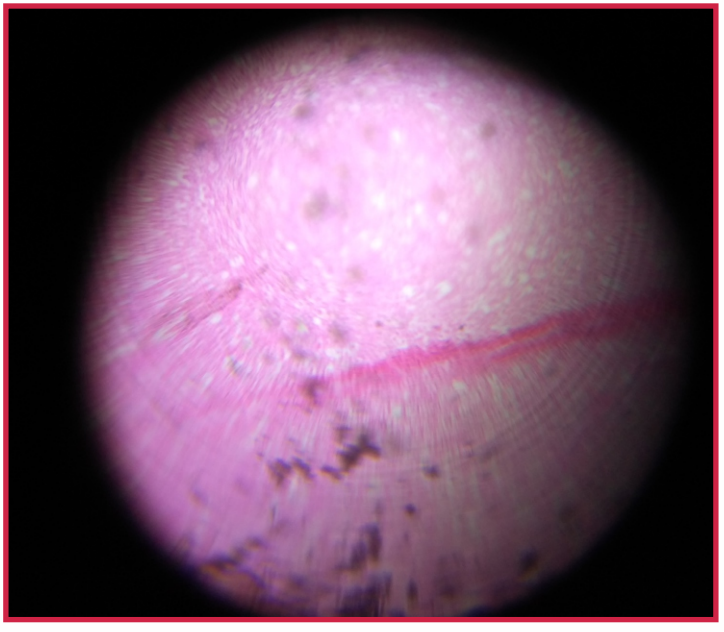
9. Uterus T. S.



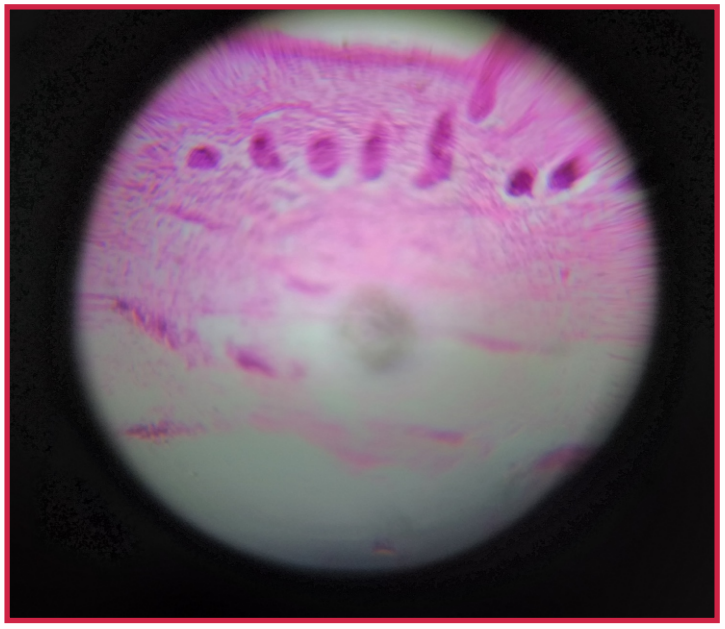
10. Cardiac Muscles T. S.



11. Kidney T.S.

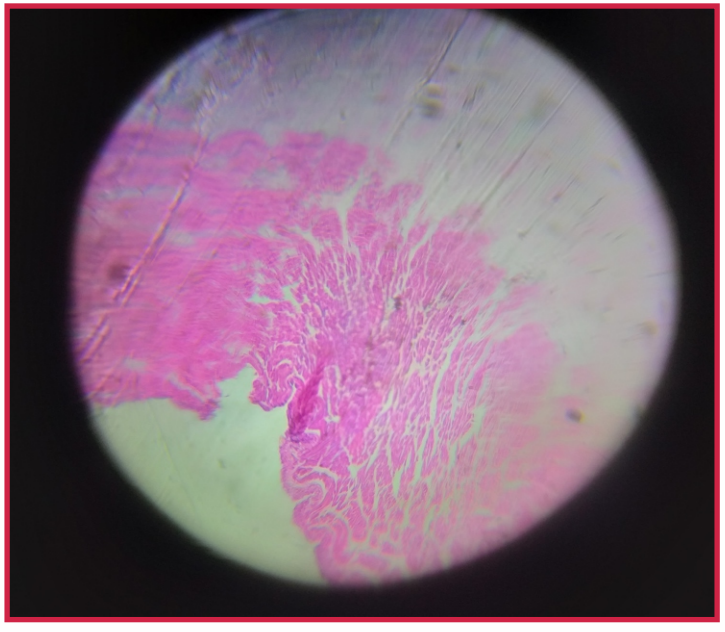


12. Spinal Cord T. S.

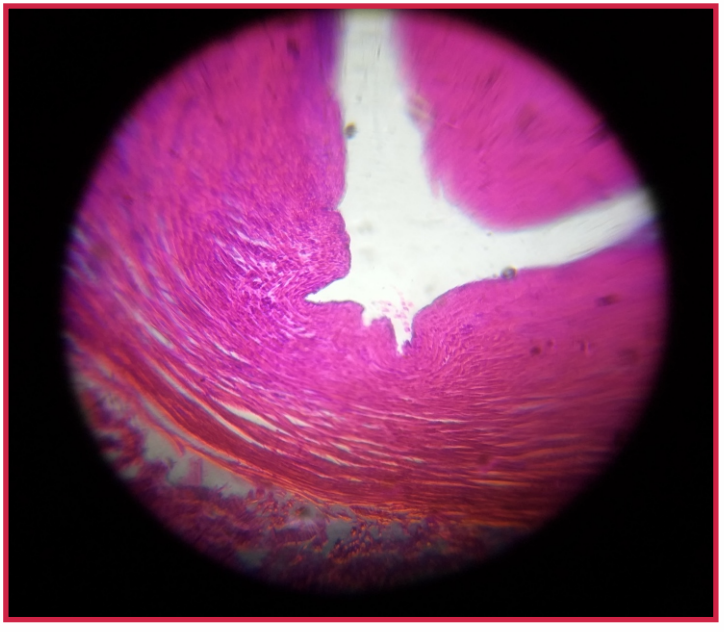


13. Skin T.S.

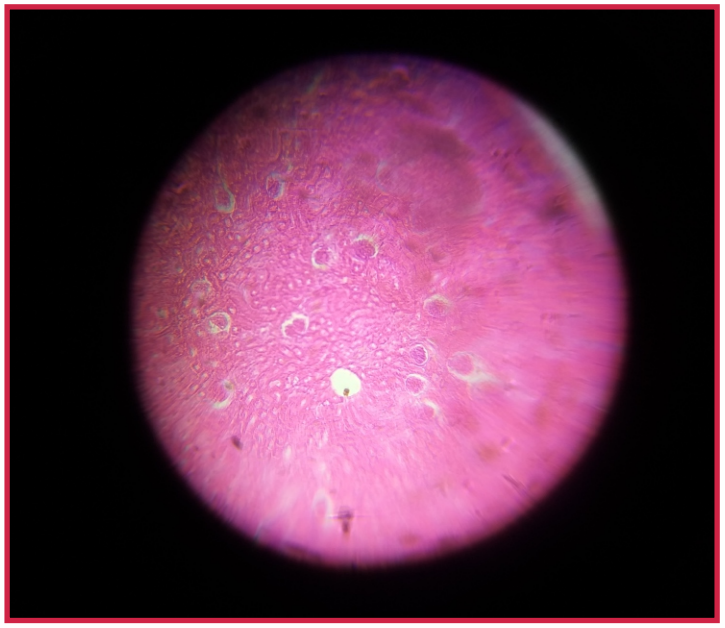
14. Colon (Rectum)T.S



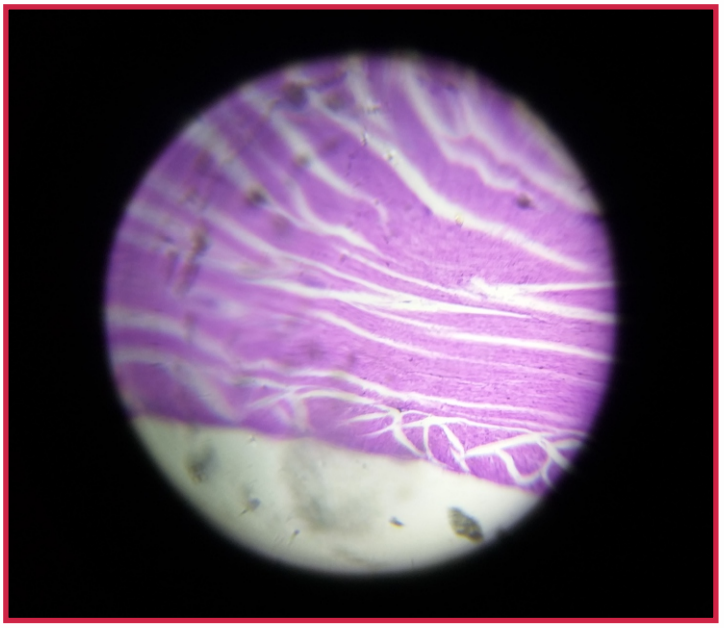
15. Aorta T.S.



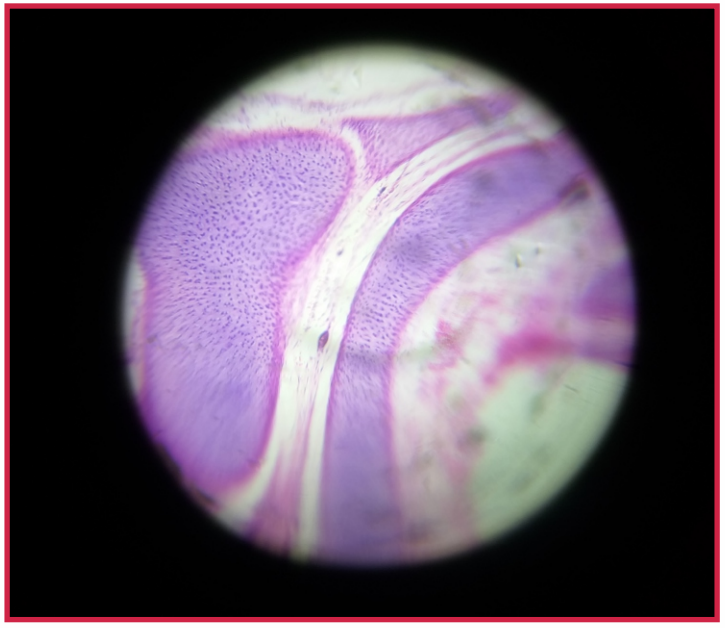
16. Artery T.S.



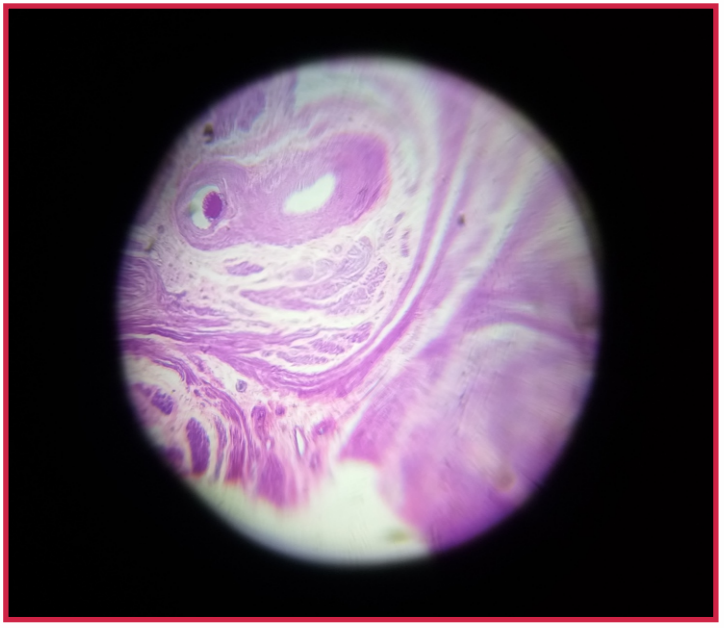
17. Cuboidal Epithelium



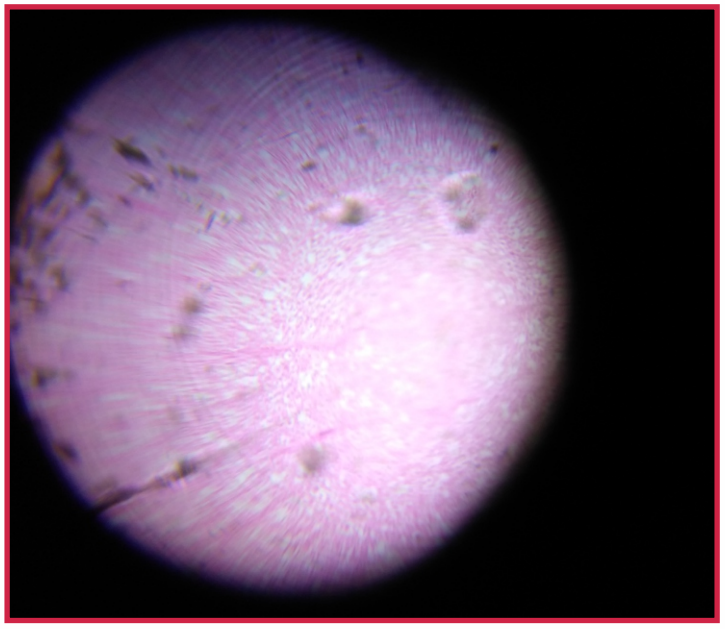
18. Heart T.S.



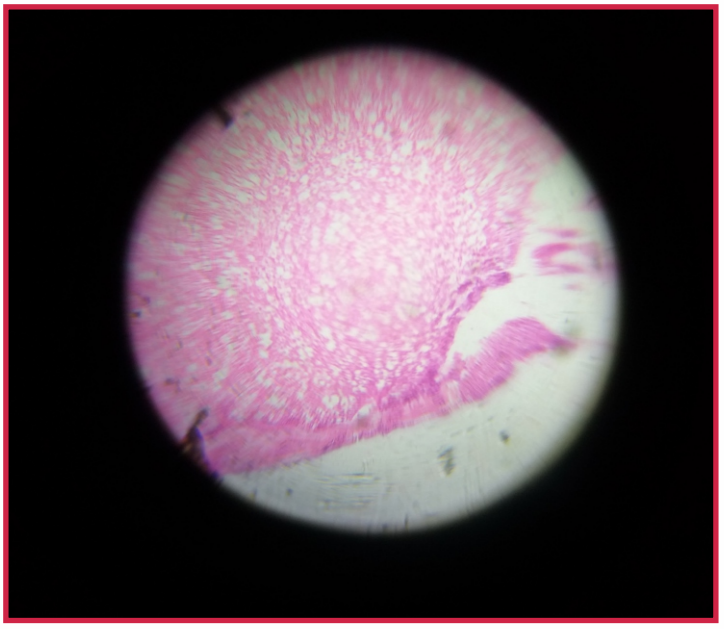
19. Hyaline Cartilage T.S.



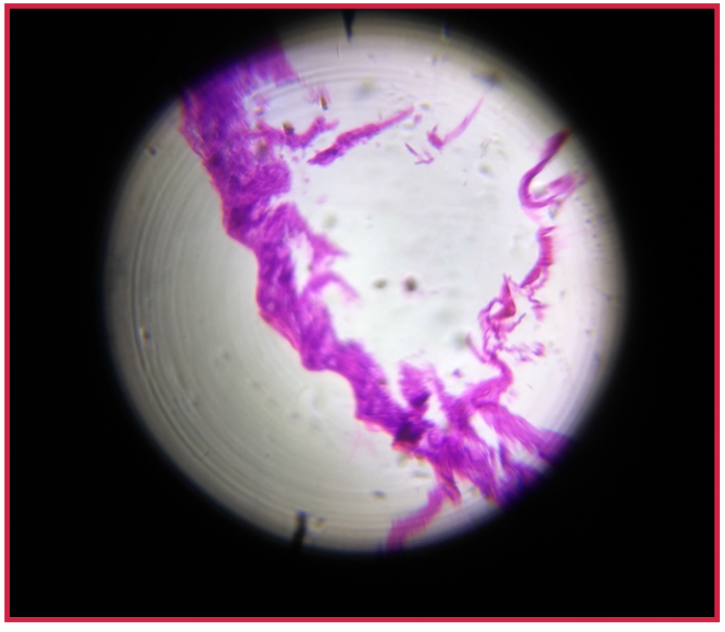
20. Smooth Muscles T.S.



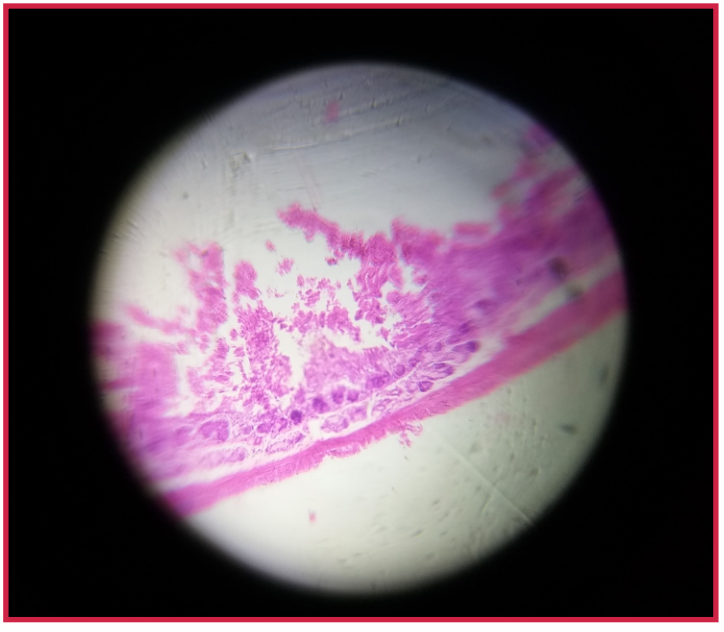
21. Spinal Cord T. S.



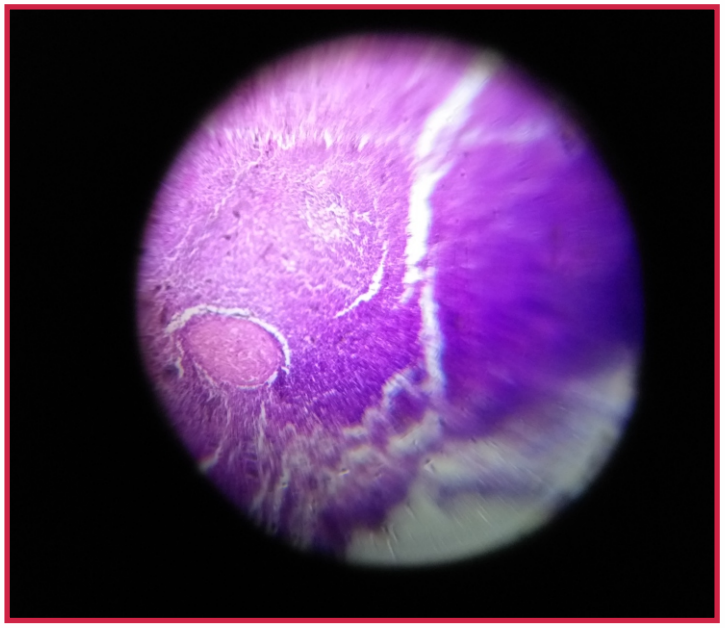
22. Nerve Cell T.S.



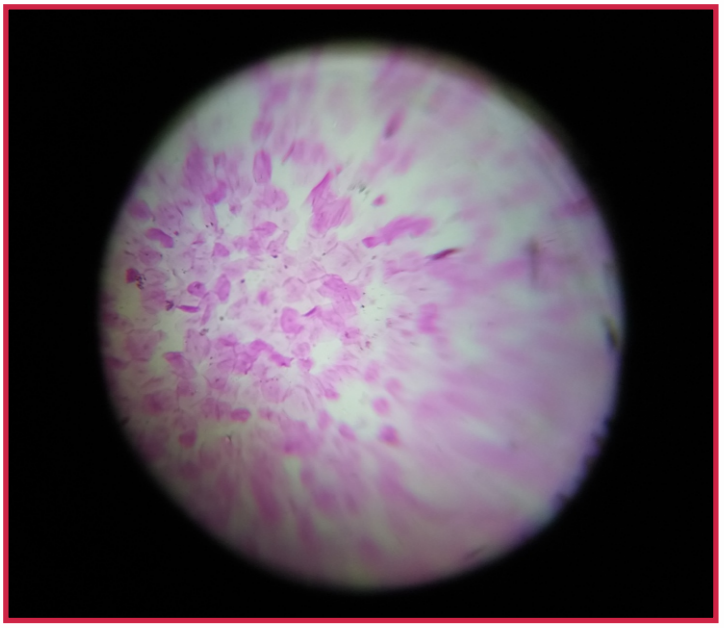
23. Large Intestine T. S



24. Small Intestine T.S.

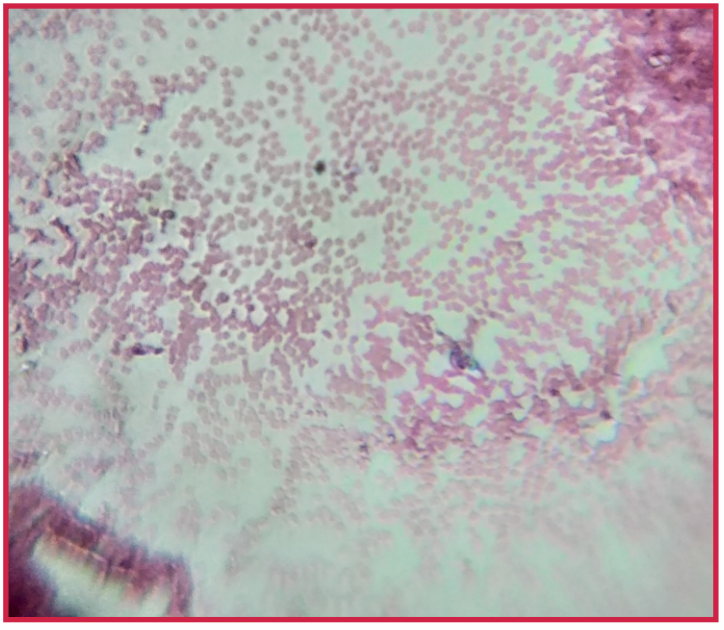


25. Spleen T.S.

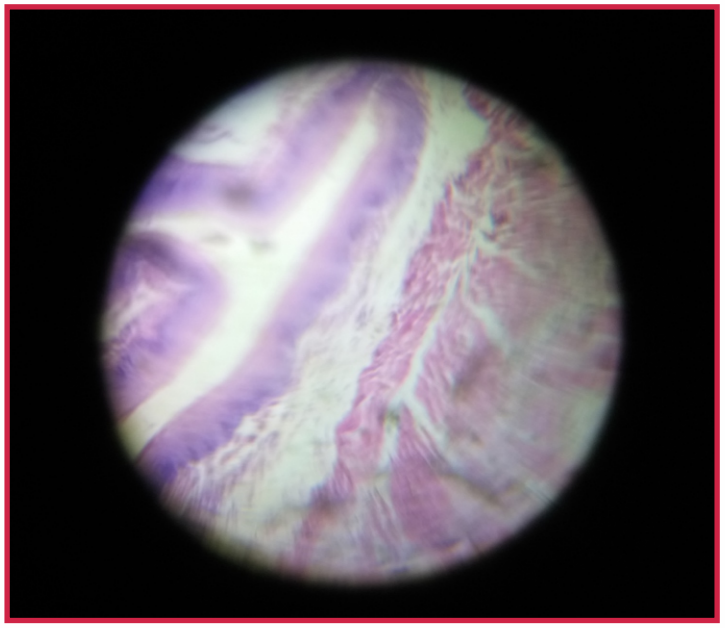


26. Squamous Epithelium

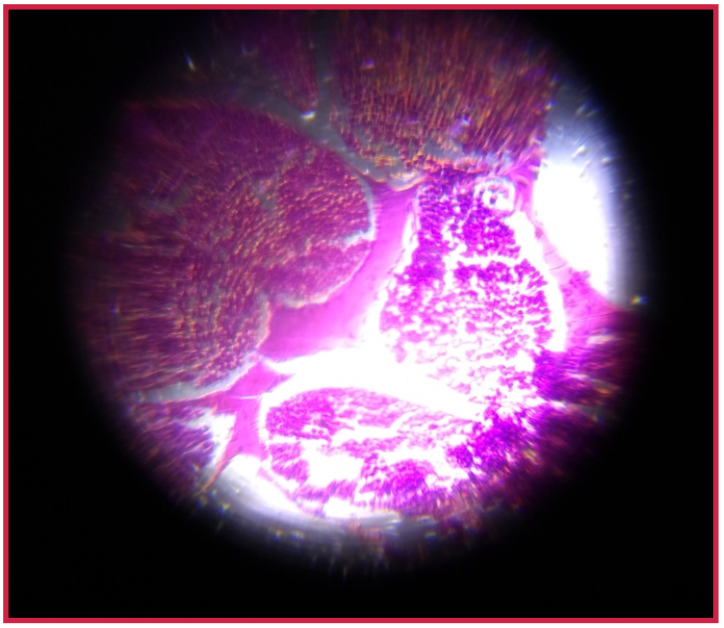
27. Stomach T.S.



28. Blood smear



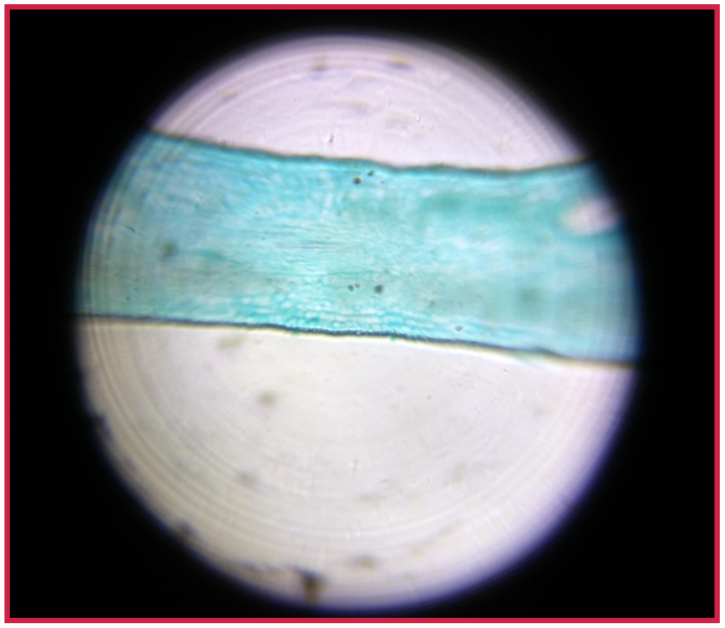
29. Mammal Oesophagus T.S.



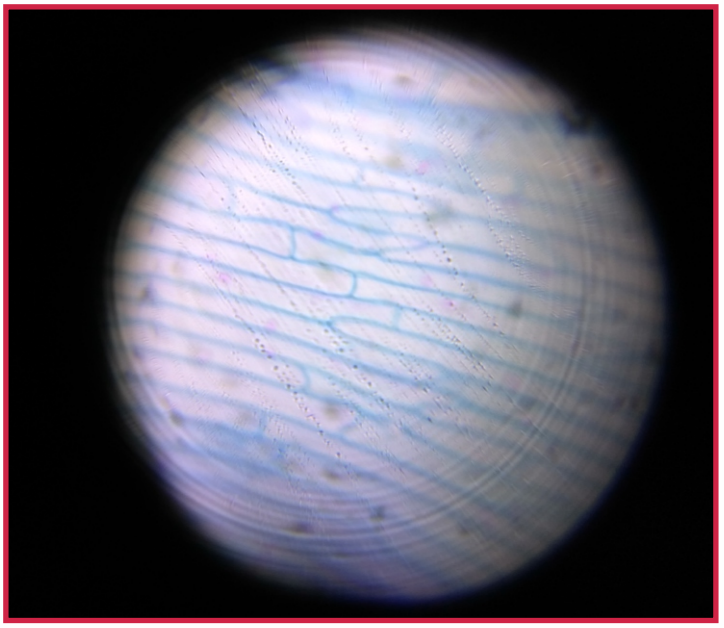
30. Ascaris Male T. S.

(E) Plant tissue

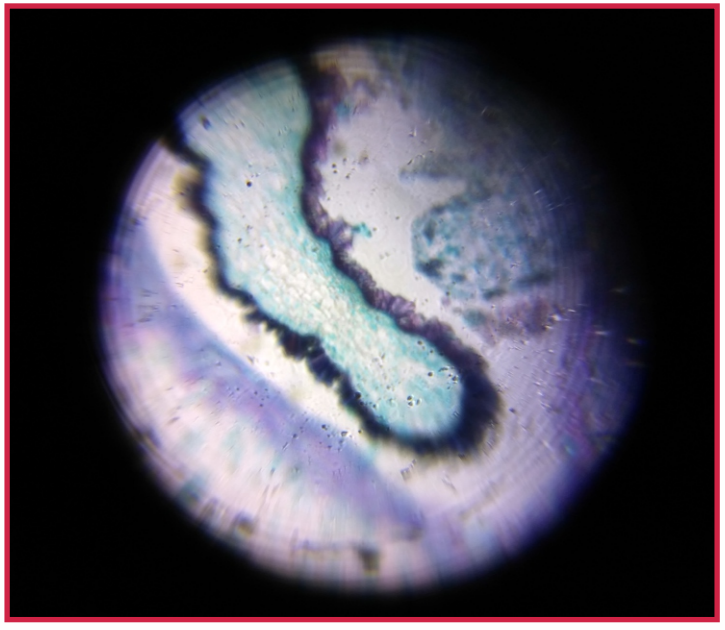
S. No.	Name of tissue	S. No.	Name of tissue
1	Dicot Leaf - T. S	19	Ranunculus stem T.S.
2	Onion Epidermis	20	Pollen grain W.M. Angiosperm
3	Ovule T. S	21	Azolla leaf T.S.
4	Root Nodule	22	Azolla leafs
5	Xylem Tissues - Angiosperm	23	Azolla root
6	Anther T. S. Angiosperm	24	Fern Rachis T.S.
7	Cycas Leaf T. S	25	Dicot stem T.S.
8	Cycas Stem T. S	26	Anther T.S. Angiosperm
9	Dicot Root T. S	27	Leaf stomata W.M. Angiosperm
10	Monocot leaf T. S	28	Lycopodium Cone T.S.
11	Monocot Root T. S	29	Lycopodium cone T.S.
12	Plant Cell w. m. Angiosperm	30	Monocot stem T.S.
13	Riccia sporophyte	31	Nostoc Algae
14	Tissue phloem T.S.	32	Tissue Collen chyma T.S.
15	Porella archegonia V.S.	33	Aquatic Moss
16	Tissue vascular	34	Chlorenchyma tissue Angiosperm
17	Stigmata of rice	35	Netrium spp
18	Pollen grain of rice		



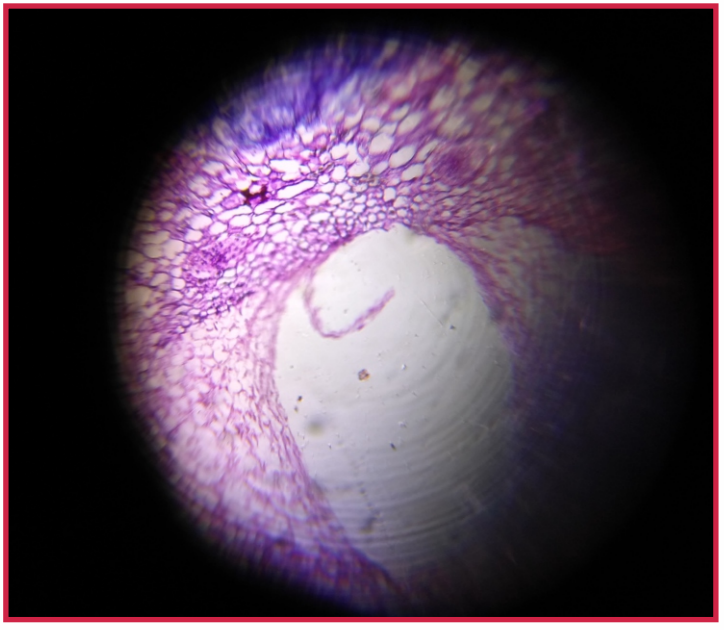
1. Dicot Leaf - T. S



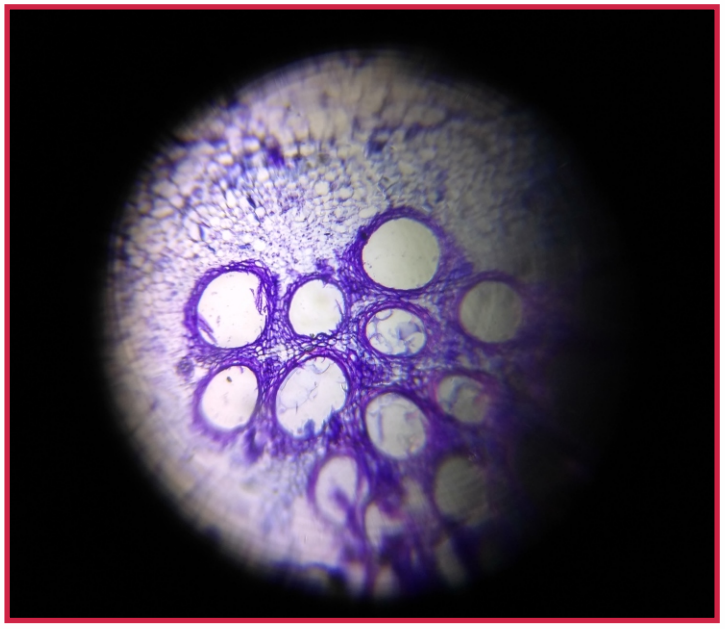
2. Onion Epidermis



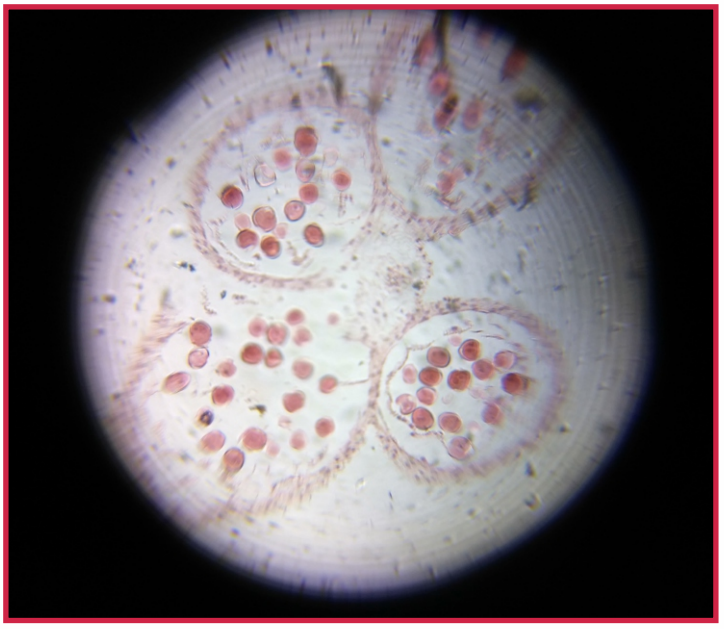
3. Ovule T. S



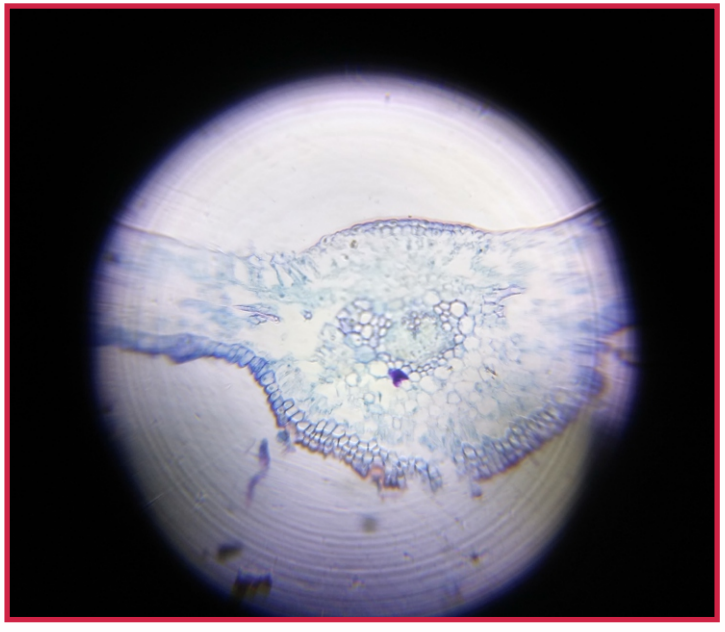
4. Root Nodule



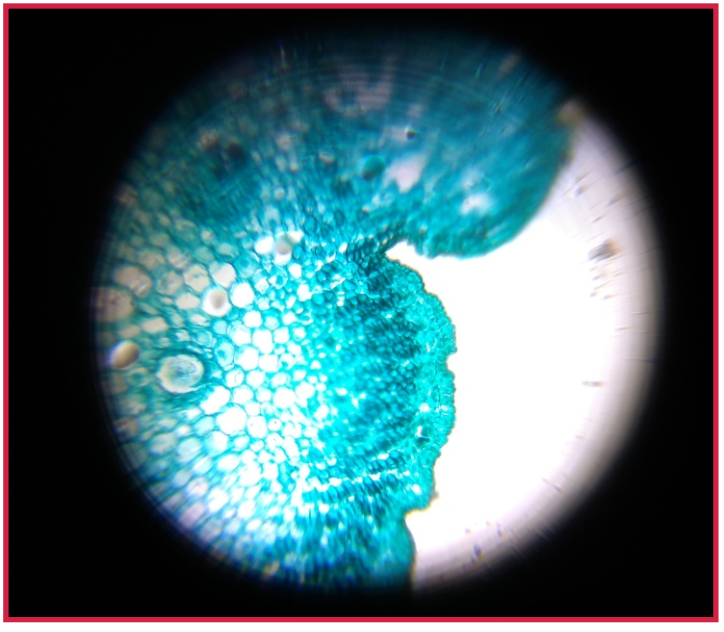
5. Xylem Tissues - Angiosperm



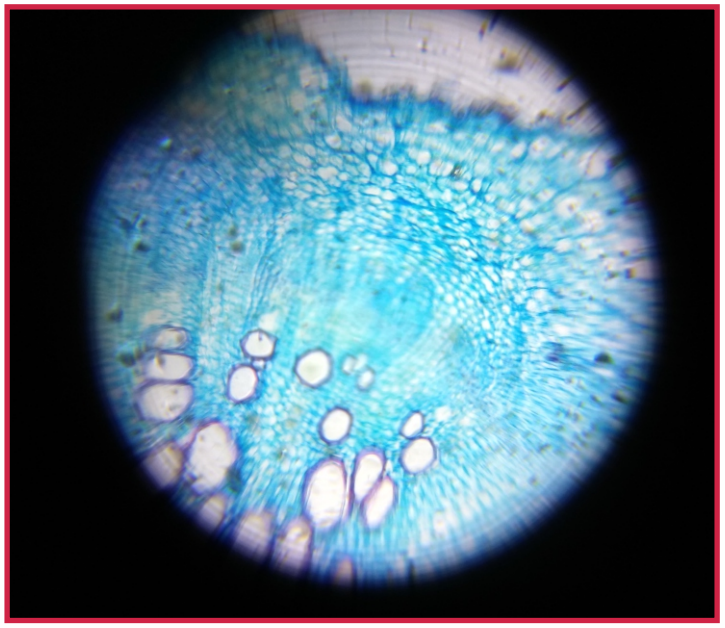
6. Anther T. S. Angiosperm



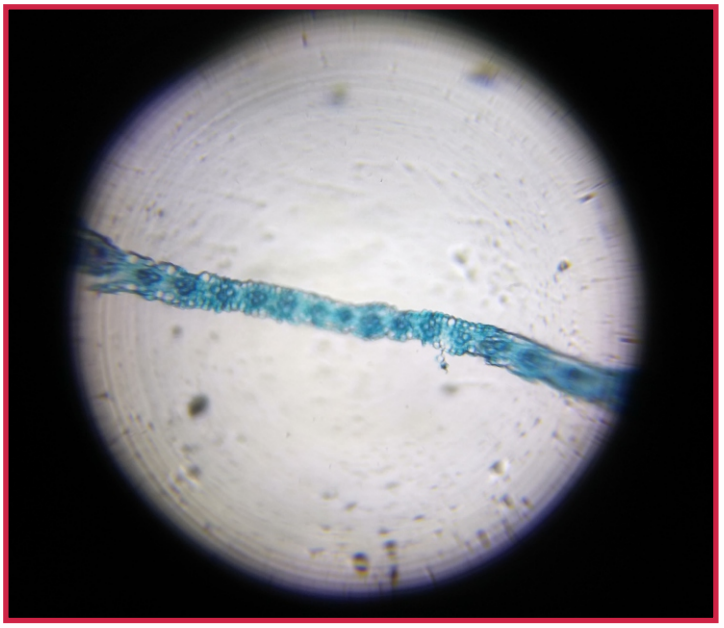
7. Cycas Leaf T. S



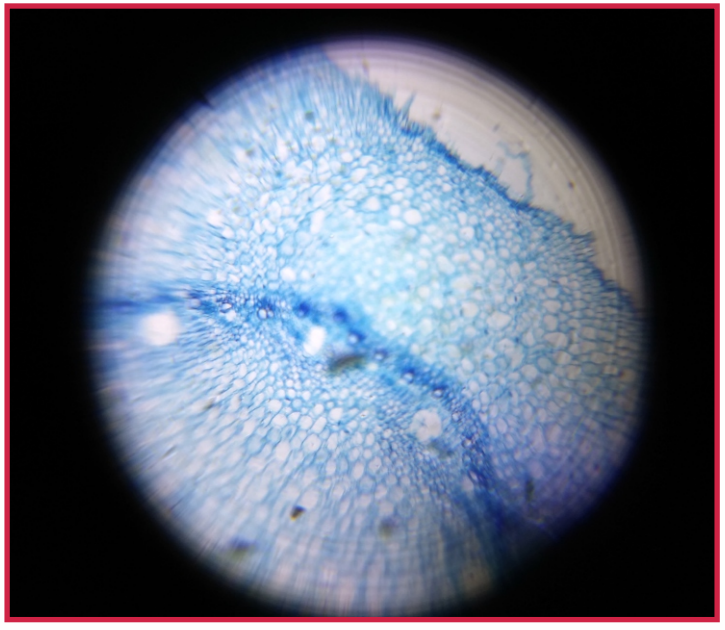
8. Cycas Stem T. S



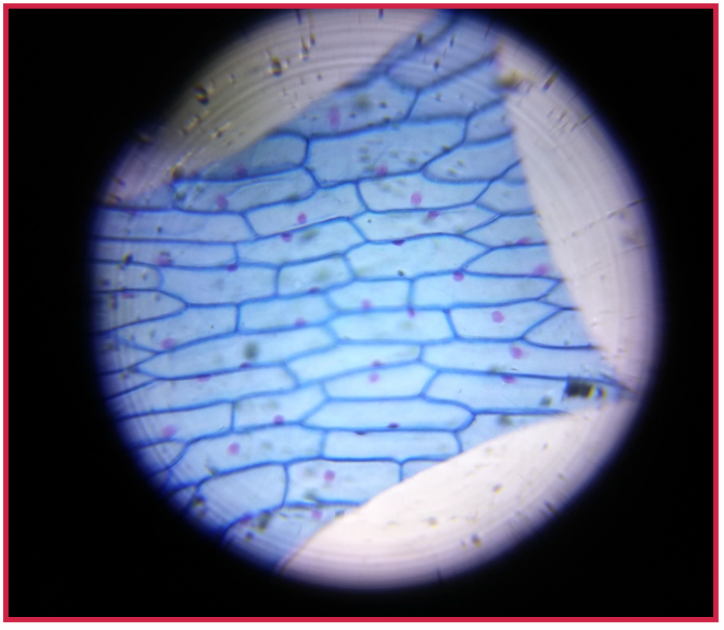
9. Dicot Root T. S



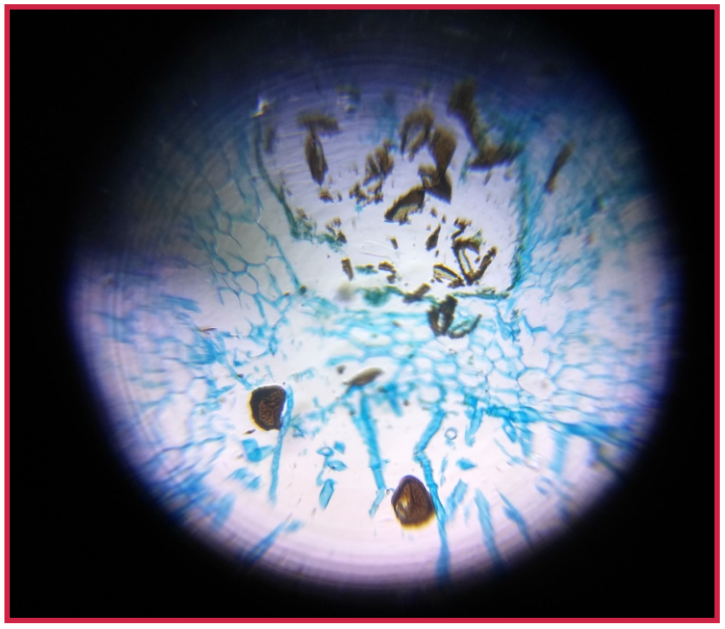
10. Monocot leaf T. S



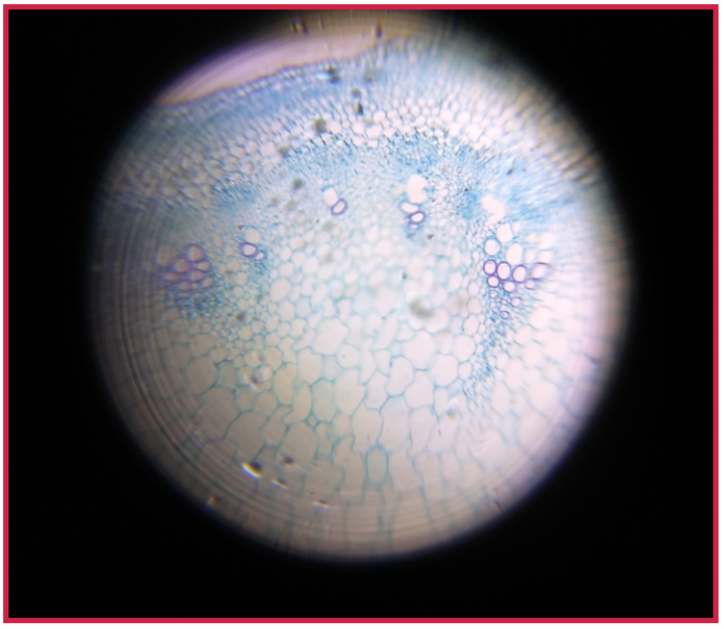
11. Monocot Root T. S



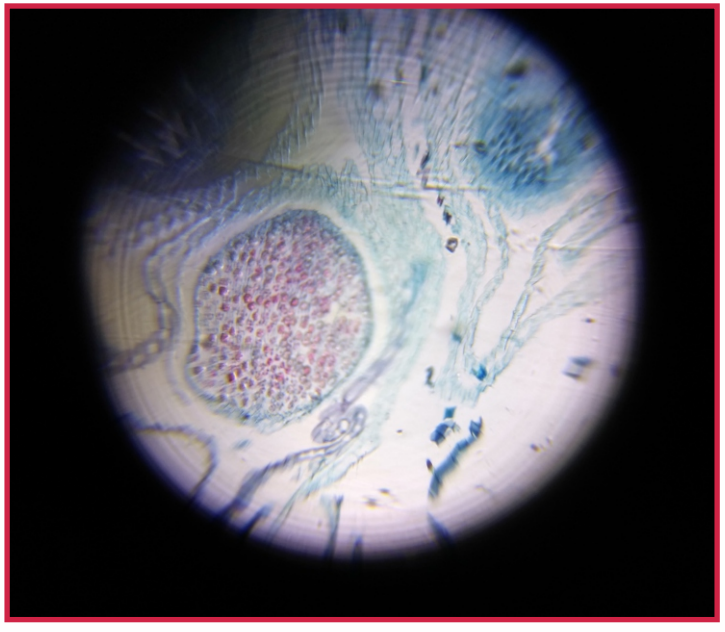
12. Plant Cell w. m. Angiosperm



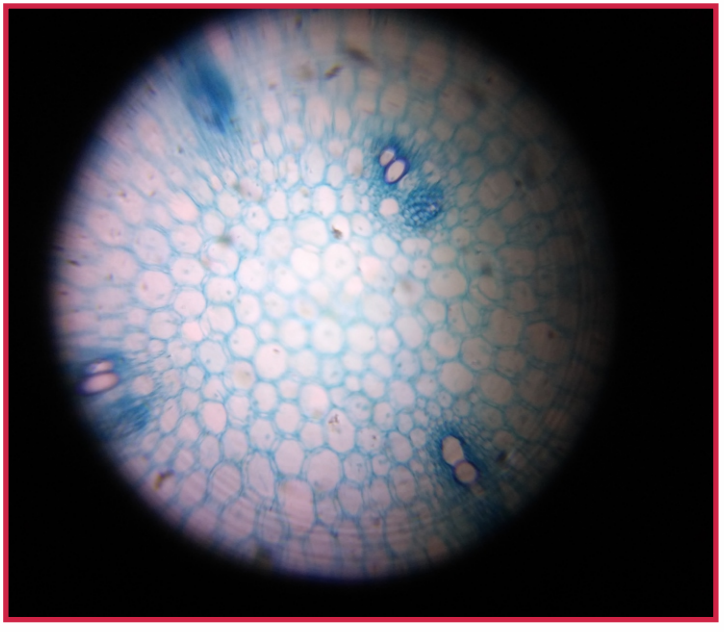
13. Riccia sporophyte



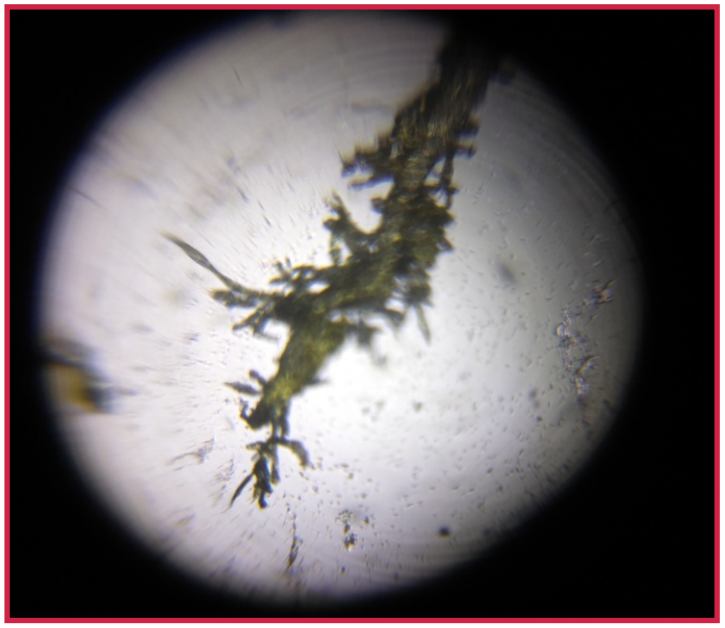
14. Tissue phloem T.S.



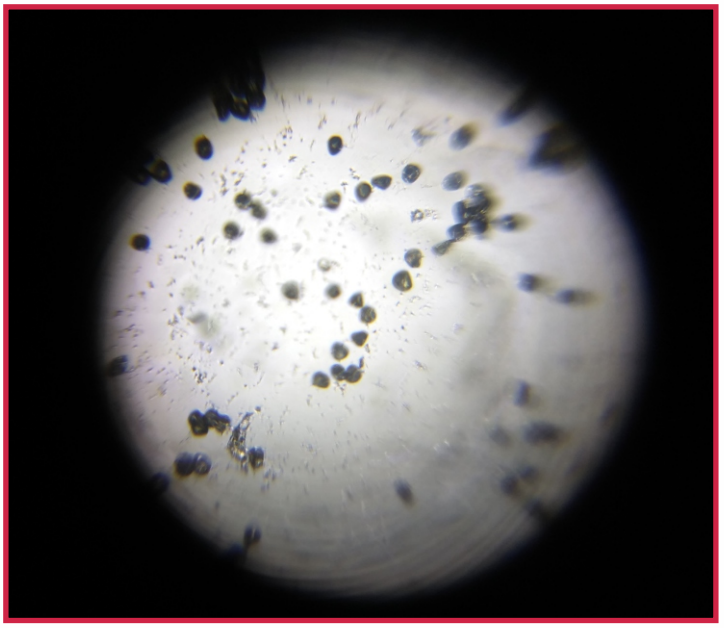
15. Porella archegonia V.S.



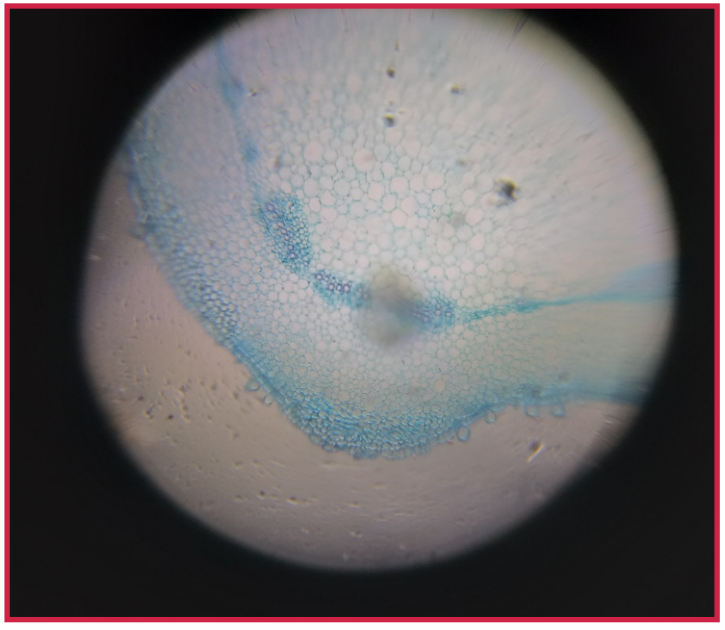
16. Tissue vascular



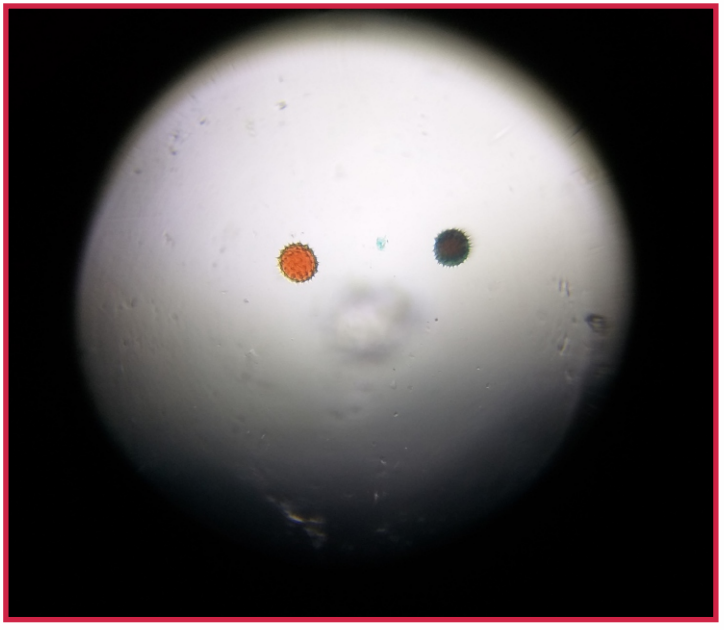
17. Stigmata of rice



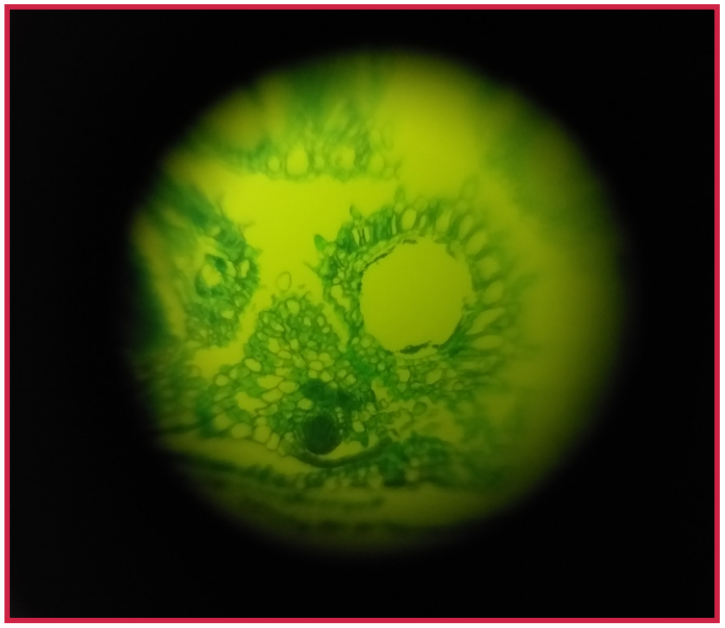
18. Pollen grain of rice



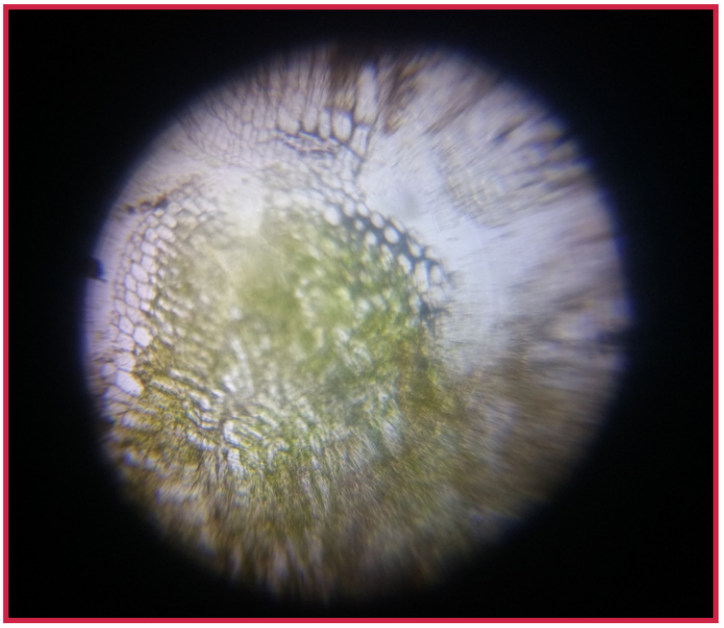
19. Ranunculus stem T.S.



20. Pollen grain W.M. Angiosperm

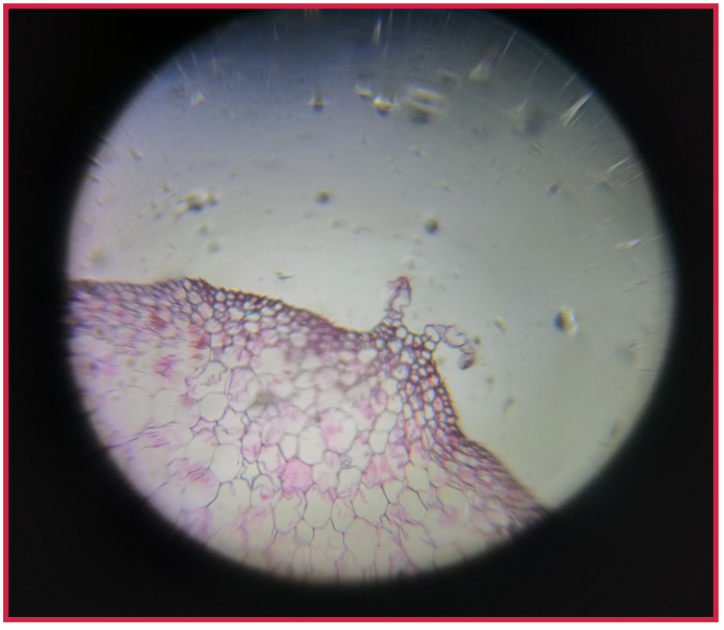


21. Azolla leaf T.S.

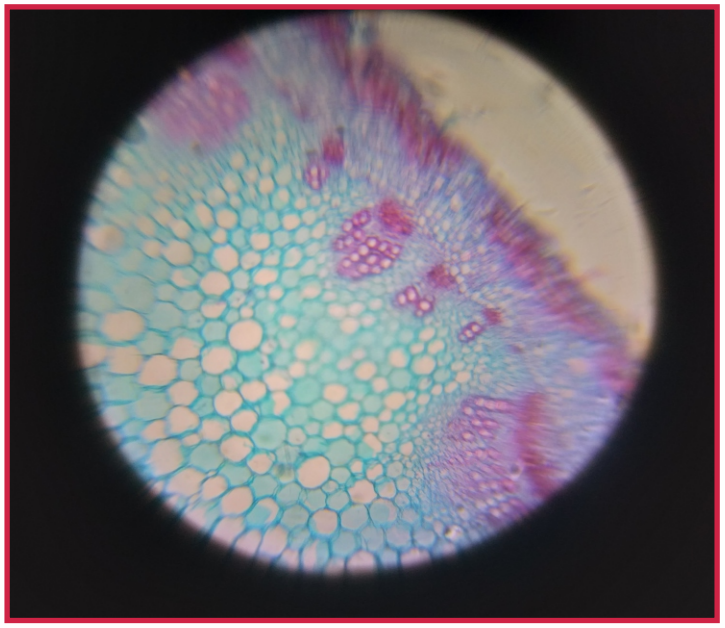


22. Azolla leafs

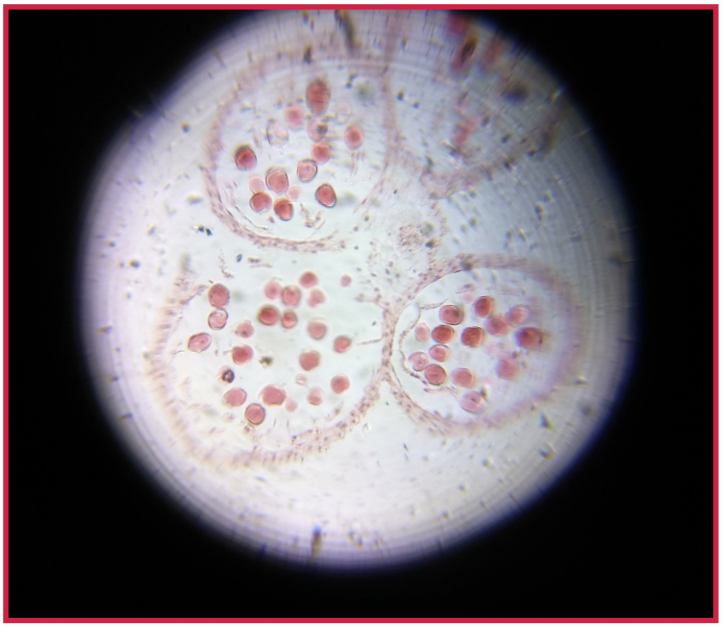
23. Azolla root



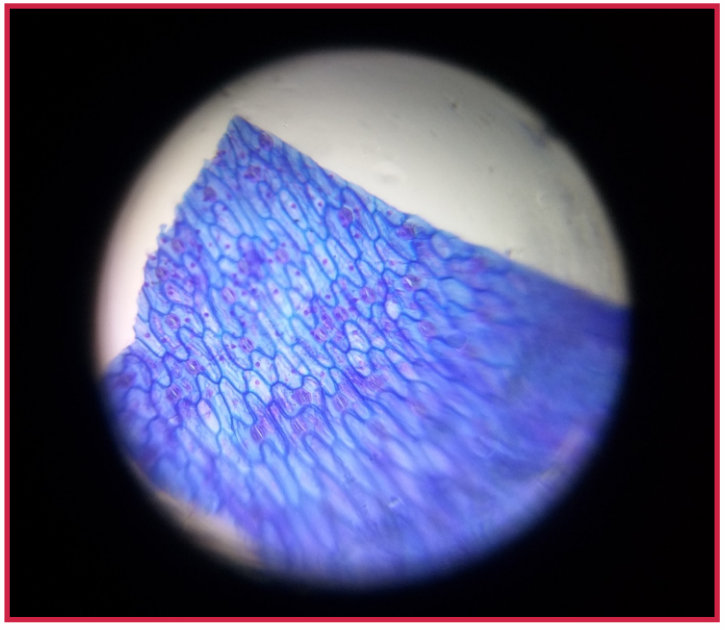
24. Fern Rachis T.S.



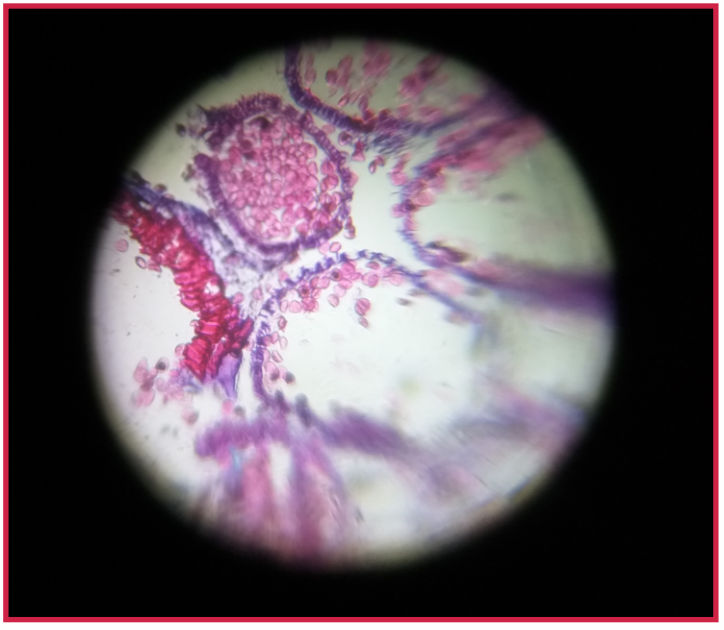
25. Dicot stem T.S.



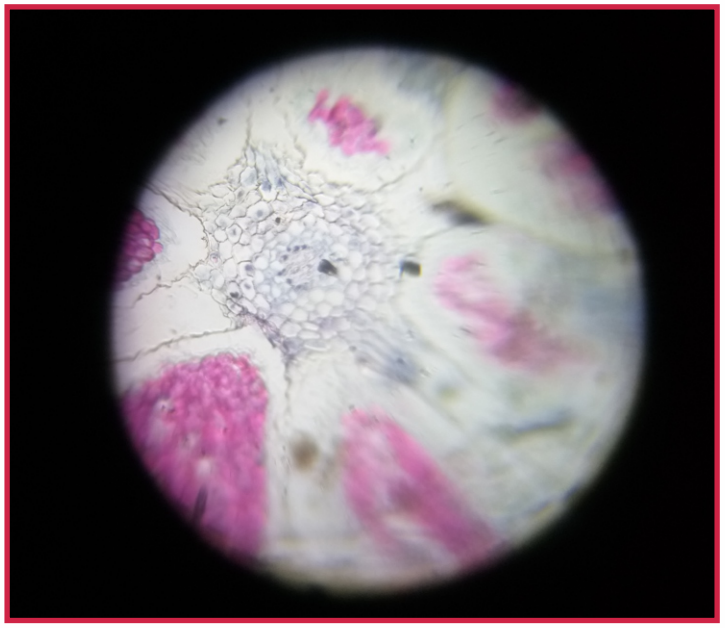
26. Anther T.S. Angiosperm



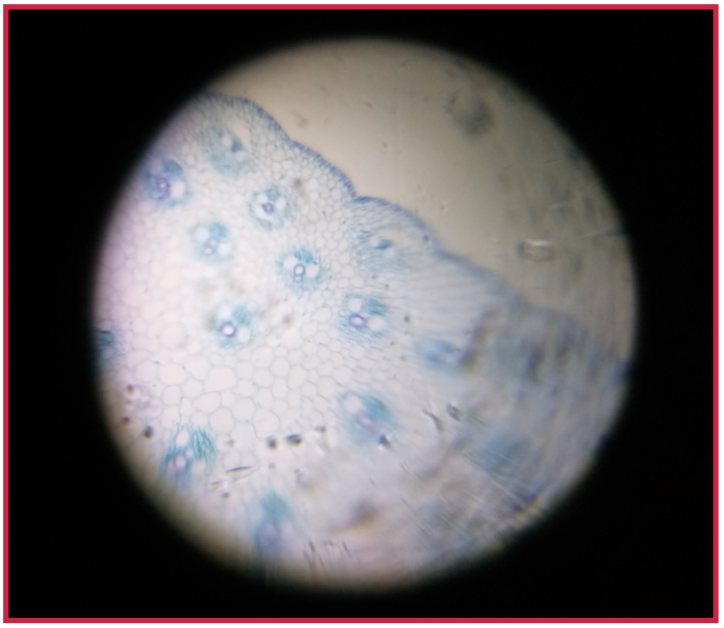
27. Leaf stomata W.M. Angiosperm



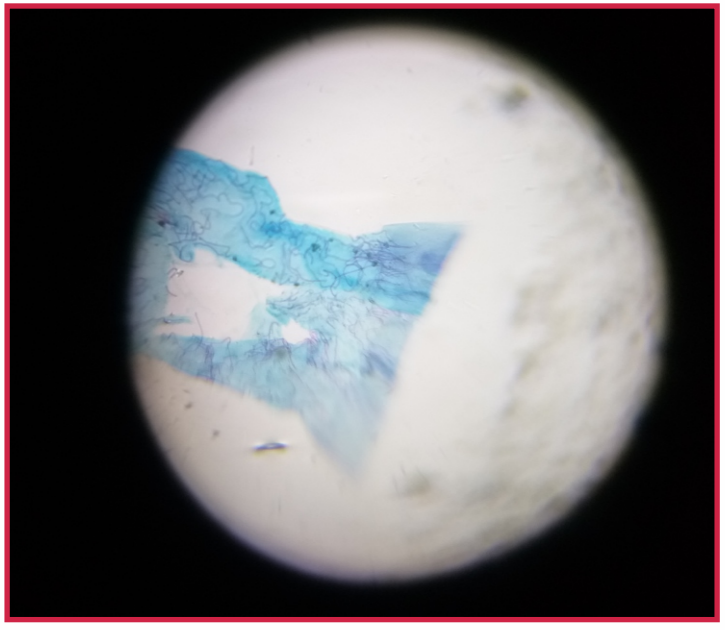
28. Lycopodium Cone T.S.



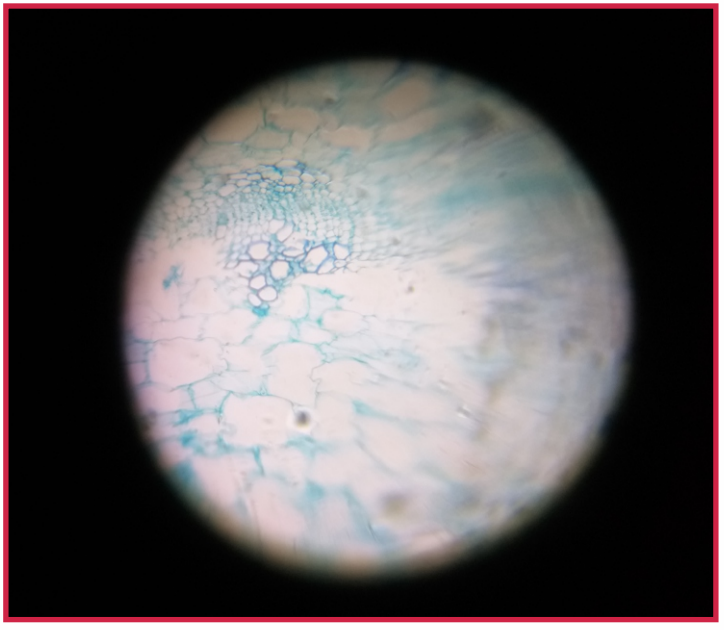
29. Lycopodium cone T.S.



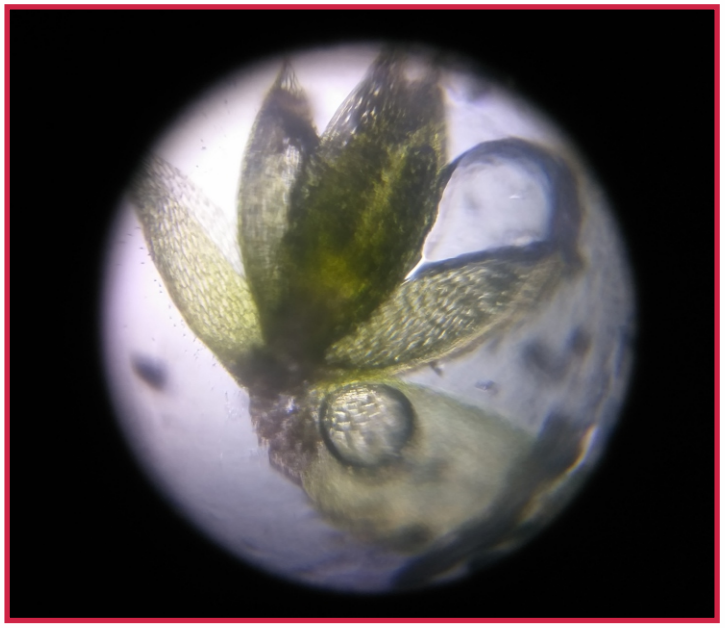
30. Monocot stem T.S.



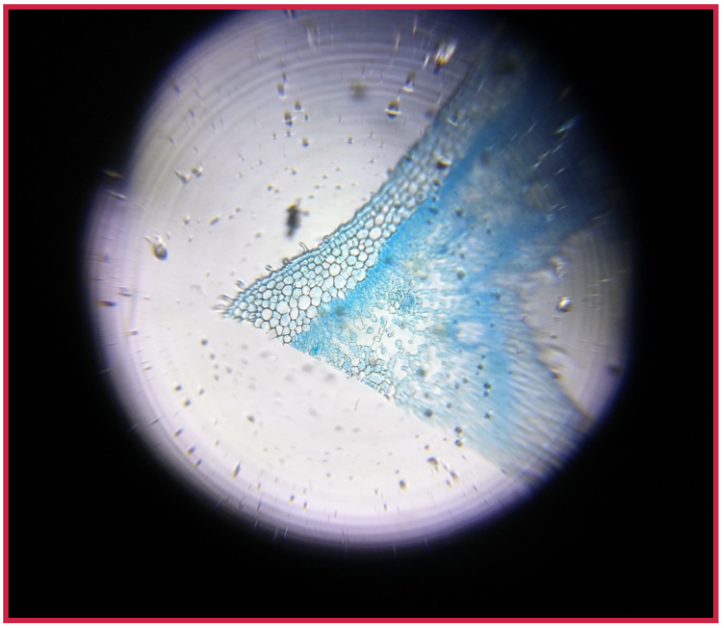
31. Nostoc Algae



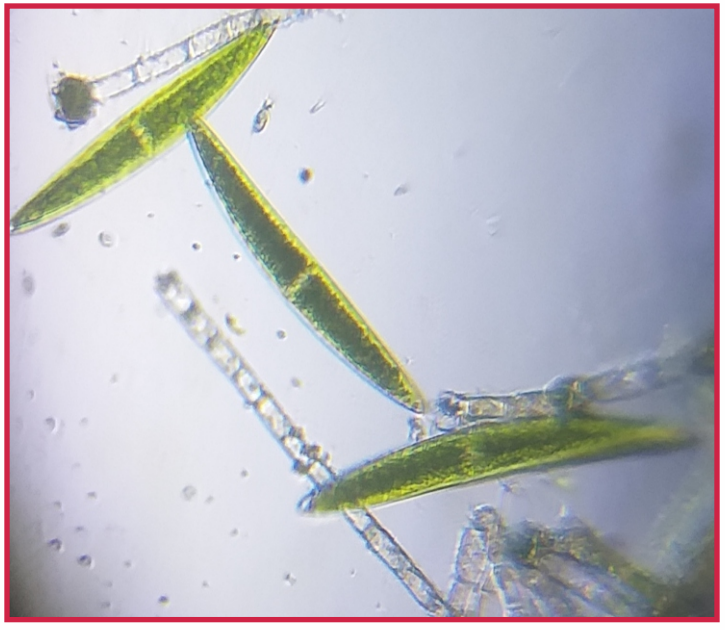
32. Tissue Collen chyma T.S.



33. Aquatic Moss



34. Chlorenchyma tissue Angiosperm

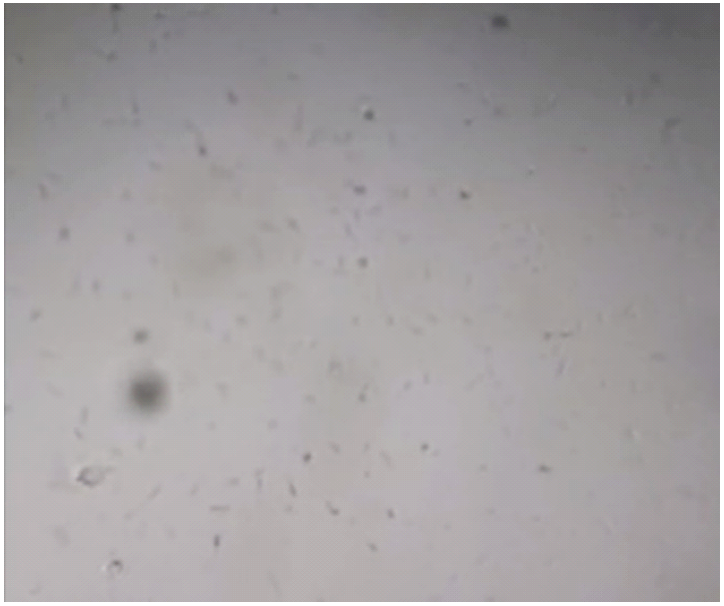


35. Netrium spp

Significant achievement

Assessment of Frozen Semen Quality through Foldscope Microscopy- A Novel Application of Frugal Science to Reduce the Infertility Rate

For Artificial Insemination (AI) of cattle, semen evaluation is of paramount importance as the semen is used to inseminate a number of females. Further, there are more chances for semen straw contamination/low sperm counts due to various biotic, abiotic and storage factors. In field condition, evaluation of semen quality in starw before AI of cattle (mass motility and count) is a bottle neck due to lack of infrastructre. The poor quality semen straw used in AI resulting in low conception rate and repeat breeding cases arise with cost and time constraints. To overcome this barrier, We have used Foldscope to test the semen quality in straw (mass motility) befor AI; the observation was very fruitful and we have seen the mass motility of spermatozoa. Further, we have received the guidance from Dr Manu Prakash is that the counting of live spermatozoa through *ImageJ* software will help to determine the quality of semen before AI.



Research team: Dr. Mamta Choudhary and Dr. P. Mooventhan

Capacity Building Programmes

Awareness and capacity-building programs on the application of foldscope microscope and diagnosis of plant pathogenic disease

S. No.	Activities	No. of Events	Village/ Institute	Male Farmers	Female Farmers	Students	Extension Functionaries	Total Participants
1.	Demonstration	18	17	303	180	37	10	530
2.	Training	23	19	186	71	450	83	790
3.	Workshop	1	1	20	130	0	0	150
Total		42	37	509	381	487	93	1470

Demonstration to Rural Farmers and Youth


DST-SYST Foldscope Project
"In - situ diagnosis of plant pathogenic fungi through Foldscope microscopy"
Training cum Demonstration
प्रशिक्षण सह प्रदर्शन


DST-SYST Foldscope Project
Training cum Demonstration
प्रशिक्षण सह प्रदर्शन

Demonstration to Women Farmers and SHGs

Demonstration to College Students


DST-SYST Foldscope Project
Training cum Demonstration
प्रशिक्षण सह प्रदर्शन


DST-SYST Foldscope Project

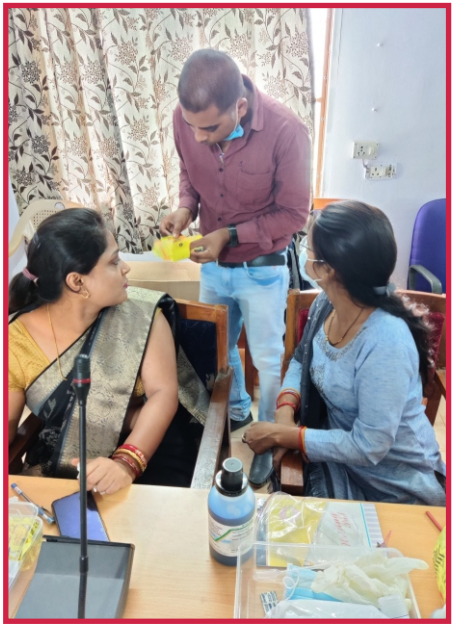

DST-SYST Foldscope Project
"In - situ diagnosis of plant pathogenic fungi through Foldscope microscopy"
Training cum Demonstration
प्रशिक्षण सह प्रदर्शन
Foldscope: An Origami- Based Paper Microscope
दिनांक: 26.03.2022 स्थान: COA, Raipur
ICAR-National Institute of Biotic Stress Management, Baronda, Raipur (C.G.)
भाकृअनुप–राष्ट्रीय जैविक स्ट्रेस प्रबंधन संस्थान, बरोंडा, रायपुर (छ.ग.)


DST-SYST Foldscope Project
Training cum Demonstration
प्रशिक्षण सह प्रदर्शन

Demonstration to School Students

Demonstration to State Extension Functionaries


DST-SYST Foldscope Project
Training cum Demonstration



Demonstration to Delegates of ICAR-NIBSM

Publications

लीक से हटकर

कृषि में नवाचार है पेपर आधारित फोल्डस्कोप माइक्रोस्कोप

पी. मुर्वेन्थन*, मनोज कुमार साहू*, योगिता*, उत्तम सिंह* और एच.के. सिंह*

“जैविक पादप रोगों एवं सूक्ष्म कीटों के कारण फसलों में होने वाली आर्थिक हानि के फलस्वरूप ग्रामीण कृषक परिवारों की आय एवं दुनिया भर में खाद्य सुरक्षा पर एक बड़ा खतरा मंडरा रहा है। कृषि में जैविक एवं अजैविक पादप रोगों की तात्कालिक आधार पर प्रक्षेत्र स्तर पर पहचान करना बहुत ही कठिन कार्य है। इसकी प्रयोगशाला स्तर पर सूक्ष्मदर्शी के माध्यम से सटीक पहचान एवं विश्लेषण करते हैं। फोल्डस्कोप की गति, सटीकता, कम लागत और प्रभावी पहुंच के फलस्वरूप प्रक्षेत्र स्तर पर ही त्वरित गति से सटीक समाधान प्राप्त कर पाना संभव है। इसकी सहायता से किसी सूक्ष्मजीव एवं वस्तु को सुलभता से देख सकते हैं। इससे जैविक कारकों द्वारा, विशेषकर पादप रोग से होने वाले आर्थिक हानि को कम किया जा सकता है।”

फोल्डस्कोप कार्य प्रणाली

- सर्वप्रथम आवश्यक सामग्री जैसे-रबड़ (रंगकारिका), स्लाइड, कवर स्लीप, पेंसिल, टेप, ब्लेड, कई, मार्कर पेन, चिमटी एवं ग्लूकोज इत्यादि की आवश्यकता होती है।
- प्रक्षेत्र में पादप रोग संक्रमित सूक्ष्म नमूने

फोल्डस्कोप का अग्र दृश्य

फोल्डस्कोप का पश्च दृश्य

कृषक द्वारा फोल्डस्कोप में माध्यम से पादप रोग नमूने का अवलोकन

फोल्डस्कोप का आविष्कार डा. मनु प्रकाश और जिम साइकुस्की ने वर्ष 2014 में किया था। स्टेनफोर्ड विश्वविद्यालय स्थित मनु की प्रयोगशाला में जिम पी.एच.डी. के छात्र थे। फोल्डस्कोप बनाने की प्रेरणा उन्हें विश्व के विभिन्न क्षेत्रों के भ्रमण से उत्पन्न हुई, जहाँ वे भारी भरकम सूक्ष्मदर्शी, टूटे हुए सूक्ष्मदर्शी, प्रयोगशाला का अभाव एवं अन्य संसाधनों की कमी का सामना करते थे। जैसा कि हम सबको ज्ञात है कि पारंपरिक सूक्ष्मदर्शी अक्सर बहुत महंगे, भारी एवं बड़े आकार के होते हैं। इन सभी कारणों के फलस्वरूप उन्हें सार्वभौमिक पैमाने, कम लागत एवं त्वरितगति समाधान की आवश्यकता का एहसास हुआ।

खेत-खलिहान, नर्सरी प्रक्षेत्र एवं बगीचे इत्यादि में घूमते-टहलते हुए, जब किसी पादप रोग, सूक्ष्म कीट-पतंगे एवं अन्य लक्षण पौधों में दिखाई पड़ते हैं तो उन्हें सबसीटो से देखते, जानने एवं समझने की जिज्ञासा उत्पन्न होती है। उक्त तात्कालिक आधार पर उसके बारे में गहराई से चिंतन करते हैं कि यह क्या है और किससे संबंधित है। कृषि उपज में जैविक कारकों द्वारा होने वाली कुल वार्षिक हानि में लगभग खरपतवार 45 प्रतिशत, कीट 30 प्रतिशत, रोग 20 प्रतिशत एवं अन्य 5 प्रतिशत का योगदान है।

कृषि में नवाचार पेपर आधारित माइक्रोस्कोप-फोल्डस्कोप

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भा.कृ.अनु.प.-राष्ट्रीय जैविक स्ट्रेस प्रबंधन संस्थान बरौंडा, रायपुर, (छ.ग.)

जैविक पादप रोगों एवं सूक्ष्म कीटों के कारण फसलों में होने वाले आर्थिक हानि के फलस्वरूप ग्रामीण कृषक परिवारों की आय एवं दुनिया भर में खाद्य सुरक्षा पर एक बड़ा खतरा है। कृषि में जैविक एवं अजैविक पादप रोगों की तात्कालिक आधार पर प्रक्षेत्र स्तर पर पहचान करना बहुत ही कठिन कार्य है, परन्तु फोल्डस्कोप माइक्रोस्कोप की गति, सटीकता, कम लागत एवं प्रभावशीलता पहुँच के फलस्वरूप प्रक्षेत्र स्तर पर ही त्वरित एवं अप्रत्याशित समाधान प्राप्त कर पाना संभवनीय है। जैविक पादप प्रबंधन में फोल्डस्कोप तकनीक का कृषि में उपयोग करके जैविक कारकों विशेषकर पादप रोग एवं सूक्ष्म कीट से होने वाले आर्थिक हानि को कम एवं फसलोत्पादन में वृद्धि कर सकते हैं।

फोल्डस्कोप का अविष्कार डॉ. मनु प्रकाश और जिम साइकुस्की ने 2014 में किये थे। स्टेनफोर्ड विश्वविद्यालय स्थित मनु के प्रयोगशाला में जिम पी.एच.डी. के छात्र थे। फोल्डस्कोप बनाने की प्रेरणा उन्हें विश्व के विभिन्न क्षेत्रों के भ्रमण से उत्पन्न हुई, जहाँ वे भारी भरकम सूक्ष्मदर्शी, टूटे हुए सूक्ष्मदर्शी, प्रयोगशाला का अभाव एवं अन्य संसाधनों की कमी का सामना करते थे। यह हम सबको ज्ञात है कि पारंपरिक सूक्ष्मदर्शी अक्सर बहुत महंगे, भारी एवं बड़े आकार के होते हैं। इन सभी कारणों के फलस्वरूप उन्हें सार्वभौमिक पैमाने, कम लागत एवं त्वरितगति समाधान की आवश्यकता का एहसास हुआ।

खेत-खलिहान, नर्सरी प्रक्षेत्र एवं बगीचे इत्यादि में घूमते-टहलते हुए जब किसी पादपरोग, सूक्ष्म कीट-पतंगे एवं अन्य लक्षण पौधों में दिखाई पड़ते हैं तो हमें उसे सबसीटो से देखने, जानने एवं समझने की जिज्ञासा उत्पन्न होता है। उक्त तात्कालिक आधार पर उसके बारे में गहराई से चिंतन करते हैं कि यह क्या है किससे संबंधित है। कृषि उपज में जैविक कारकों द्वारा होने वाली कुल वार्षिक हानि में लगभग खरपतवार 45 प्रतिशत, कीट 30 प्रतिशत, रोग 20 प्रतिशत एवं अन्य 5 प्रतिशत का योगदान है।

फोल्डस्कोप माइक्रोस्कोप संरचना

- वास्तव में यह एक सस्ता का सहायीय माइक्रोस्कोप है, जो पेपर क्लीपिंग की एक मुड़ंसना से बनाया जाता है। इसे बनाने में बहुत ही सरल घटकों जैसे-कागज की शीट, लेंस, गोंद, टेप, चुम्बकीय युग्मक (कपलर) एवं एल.ई.डी. बैग्लोकार इत्यादि से मिलाकर बनाया जाता है।
- फोल्डस्कोप माइक्रोस्कोप की एक अन्य विशेषता यह है कि इसे पूरा; विभिन्न घटकों में आसानी से पृथक कर सकते हैं, इसी आधार पर ही इसको नाम फोल्डस्कोप रखा गया है।
- फोल्डस्कोप में किसी नमूने को चित्र प्राप्त करने हेतु मोबाइल फोन का उपयोग किया जाता है। मोबाइल फोन के कैमरे में चुम्बकीय युग्मक को गोंद या टेप के माध्यम से संलग्न करके फोल्डस्कोप पर स्थापित किया जा सकता है।

फोल्डस्कोप माइक्रोस्कोपः फसलों के रोगों के पहचान में महत्वपूर्ण भूमिका

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भा.कृ.अनु.प.-राष्ट्रीय जैविक स्ट्रेस प्रबंधन संस्थान बरौंडा, रायपुर, (छ.ग.)

फोल्डस्कोप माइक्रोस्कोप का आविष्कार स्टैनफोर्ड स्थित जॉन मैकॉलिस में कार्नेजीमेलिन के सहायक प्रोफेसर डॉ. मनु प्रकाश एवं टीम के द्वारा वर्ष 2014 में किया गया था। वास्तव में यह एक सस्ता का आप्टिकल माइक्रोस्कोप है। यह वजन में बहुत हल्का लगभग 8 ग्राम का होता है, और यह एक किट में आता है, जिसमे लेंस होते हैं जो 140 गुना आवर्धन प्रदान करते हैं। यह एक किफायती माइक्रोस्कोप है जो क्षेत्र की परिस्थितियों में काम करने के लिए बहुतसुही और पर्याप्त है। यह उपकरण (फोल्डस्कोप) बहुत ही सस्ते होने के कारण इसे आमजन बहुत आसानी से खरीद सकते है एवं स्थायी स्थानिय प्राप्त कर सकते हैं एवं अपने उपयोग के अनुसार प्रयोग कर सकते हैं।

फोल्डस्कोप का अग्र दृश्य

फोल्डस्कोप का पश्च दृश्य

भारत एक कृषि प्रधान देश है, जहाँ लगभग 70 प्रतिशत आबादी का मुख्य आजीविका कृषि है। भारत में मुख्यतः खाद्यान्न, दालहर, तिलहर, सब्जी एवं फलों का खेती बहुतायत में किया जाता है, परन्तु इसमें लगने वाले जीवाणु एवं फफूँद जनित रोगों के कारण कृषकों एवं उत्पादकों को भारी नुकसान उठाना पड़ता है, क्योंकि इसके रोगजनकों को पहचान सटीकता से नहीं हो पाता है। भारतीय शोधकर्ताओं के द्वारा इस पर निरंतर शोध जारी है एवं आधुनिक पैमाने पर विश्लेषण किया जाता है। फफूँद जनित रोगों के पहचान शीघ्र एवं सटीकता से हो इसके लिए फोल्डस्कोप माइक्रोस्कोप के माध्यम से जीवाणु के लक्षण से फफूँद का पहचान शीघ्र एवं आसानी से प्राप्त होता है। इसके लिए संक्रमित रोग जनित पौधों के नमूने का स्लाइड तैयार करके फोल्डस्कोप माइक्रोस्कोप से परीक्षण किया जाता है। फफूँद जनित रोगों में विशेषकर लीफ ब्लाइट, लीफ स्पाट, भभूतीया रोग, डाउनी मिल्ड्यू एवं पर्णीय रोगों के परीक्षण एवं पहचान आसानी से किया जा सकता है।

मोबाइल फोन आधारित फोल्डस्कोप से लक्षण के फोटो लेते हुये छात्र

मोबाइल फोन से तादृढ़

फोल्डस्कोप एक सस्ता का फील्ड माइक्रोस्कोप है। शोध कार्यों में उपयोग होने वाले पारंपरिक अनुसंधान सूक्ष्मदर्शी की तरह इसे आप्टिकल गुणवत्ता देने के लिए विशेष रूप से डिजाइन किया गया है। फोल्डस्कोप में लेंस स्थापित करते हैं, जिसके माध्यम से किसी रोगजनक को 140 गुना तक आवर्धित करने की क्षमता होता है। मोबाइल फोन के कैमरे में चुम्बकीय युग्मक को गोंद या टेप के माध्यम से संलग्न करके फोल्डस्कोप माइक्रोस्कोप के प्रतिबिंब भेजें के प्रभाग से चिली, जहां वे भारी-भरकम सूक्ष्मदर्शी, टूटे हुए सूक्ष्मदर्शी, प्रयोगशाला का अभाव एवं अन्य संसाधनों की कमी का सामना करते थे। यह हम सबको ज्ञात है कि पारंपरिक सूक्ष्मदर्शी अक्सर बहुत महंगे, भारी एवं बड़े आकार के होते हैं। इन सभी कारणों के फलस्वरूप उन्हें सार्वभौमिक पैमाने, कम लागत एवं त्वरितगति समाधान की आवश्यकता का एहसास हुआ।

गेहूँ का लूज स्मट :

रोग लक्षण – इस बीमारी में लक्षण फूल खिलने के चरण से पहले या फूल खिलने के दौरान उपज होते हैं। संक्रमित पौधो में सामान्य बालों के स्थान पर अण्डाशयों में काले पाउडर जैसे स्मट स्पोर्स भर जाते हैं जिसके कारण बालियां भी काले पौधित होते हैं और विकासशील दानों की जगह कवक अपना स्थान ले लेता है फलस्वरूप संक्रमित बालियों में अनाज नहीं बन पाता है। भारत के साथ ही दुनिया भर के गेहूँ उत्पादक क्षेत्रो में यह एक आम रोग है। रोग की उप अवस्था में संक्रमित बालियां में सम्पूर्ण उपज की हानि देखी जा सकती है।

रोग जनक – गेहूँ के लूज स्मट का रोग जनक *अस्टिलागो ट्रिटिसाई* है जो कि फफूँद जनित है। यह टिलियोस्पोर या टिलियाटोस्पोर बनाता है जिसे स्पोरेमाइडोस्पोर्स भी कहते हैं, जो बहुत ही सूक्ष्म होते हैं। जिन्हें नग्न आंखो से नहीं देखा जा सकता है। इनका रंग गहरा – भूरा पीला होता है और इनकी बाहरी भित्ती मोटी तथा कटिली होता है। जो एक्जोस्पोर कहलाता है। बीजाणु आकार में गोलाकार से सवल्लोबोज होते हैं। टिलियोस्पोर भारी संख्या में उपज होते हैं। फोल्डस्कोप माइक्रोस्कोप के माध्यम से इस रोग जनक के बीजाणु आकारिकी एवं मेजबान (होस्ट) प्रजातियों के आधार पर प्रक्षेत्र स्तर पर ही पहचान किया जा सकता है।

गेहूँ का लूज स्मट रोग

रोगजनक : *अस्टिलागो ट्रिटिसाई*

गोबाइल फोन से संबंध :

फोल्डस्कोप एक तरह का फील्ड माइक्रोस्कोप है। शोध कार्यों में उपयोग होने वाले पारंपरिक अनुसंधान सूक्ष्मदर्शी की तरह इसे आप्टिकल गुणवत्ता देने के लिए विशेष रूप से डिजाइन किया गया है। फोल्डस्कोप में लेंस स्थापित करते हैं, जिसके माध्यम से किसी रोगजनक को 140 गुना तक आवर्धित करने की क्षमता होता है। गोबाइल फोन के कैमरे में चुम्बकीय युग्मक को गोंद या टेप के माध्यम से संलग्न करके फोल्डस्कोप पर स्थापित किया जाता है। नमूने के चित्र को गोबाइल के माध्यम से जूम फंक्शन का उपयोग करके बड़ा कर सकते हैं एवं चित्र को गोबाइल में संरक्षित भी कर सकते हैं।

दूरस्थ अंचलो तक पहुँच एवं रोग नियंत्रण में योगदान :

शोधकर्ताओं के अनुसार यह बहुत सस्ती एवं साथ ही पोर्टेबल तकनीक है जिसे दूरस्थ इलाकों एवं गांवो तक आसानी से पहुँचाया जा सकता है, जिसका लाभ स्थानीय लोगों को प्रत्यक्ष प्राप्त हो सकता है। उत्पादन की मात्रा और गुणवत्ता कई कारकों पर निर्भर करता है। कवक (फफूँद) रोगों के कारण होने वाले फसल नुकसान भी उनमें से एक है। बीमारियों के रोकथाम के लिए रोगों एवं रोगजनकों के पहचान के साथ-साथ रोगजनकों को पृथक करना भी अत्यन्त महत्वपूर्ण होता है। फोल्डस्कोप माइक्रोस्कोप के शामीन क्षेत्रों तक पहुँच के फलस्वरूप आगे यह फसलों के रोग नियंत्रण में महत्वपूर्ण योगदान स्थापित करेंगा।

गोबाइल फोन आधारित फोल्डस्कोप के माध्यम से पादप रोगजनकों का पहचान

संक्रमित रोगजनक चित्र – *पेनिसिलियम क्रिसिटेटम*

प्रस्तुतकर्ता :

पी. मुर्वेन्थन, मनोज कुमार साहू, योगिता, उत्तम सिंह, रेवेन्द्र कुमार साहू एवं एच.के. सिंह।

प्रकाशक :

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फोन – 0771–2277333
वेबसाईट – https://nibsm.icar.gov.in/

Publications released under Foldscope

Media Coverage

प्रदर्शन कृषि विज्ञान केंद्र सुरगी में फोल्ड माइक्रोस्कोप का प्रदर्शन कर किसानों को दी गई जरूरी जानकारी

खेत में रोगों व कीटों की पहचान में उपयोगी है फोल्डस्कोप माइक्रोस्कोप

रायपुर, शुक्रवार 25 मार्च 2022 2

उद्यानिकी महाविद्यालय एवं अनुसंधान केंद्र सांकरा में फोल्डो स्कोप का किया गया प्रदर्शन

समवेत शिखर संवाददाता

पाटन। विकास खण्ड के ग्राम सांकरा के उद्यानिकी महाविद्यालय एवँ अनुसन्धान केंद्र में फेलडोस्कोप (पेपर सूक्ष्म दर्शी) परियोजना पीआर (वैज्ञानिक) डॉ. पी भुवेन्ध्म के सानिध्य में सीनियर रिसर्च फैलो डॉ मनोज साहू द्वारा प्रदर्शन किया गया

कार्यकम के मुख्य अतिथि अधिष्ठाता उद्यानिकी कालेज डॉ. अमित दीक्षित ने किया फोल्डो स्कोप प्रदर्शन एवं जानकारी के समय माइक्रोबायलॉजी विषय के तहत सहायक प्राध्यापक डॉ मिमेश्वरी साहू के द्वारा आयोजित किया गया जिसमें उद्यानिकी महाविद्यालय के प्रथम वर्ष एवँ शासकीय हाई स्कूल सांकरा के लगभग 40 विद्यार्थी शामिल हुए विद्यर्थियों को टी. एल. साहू ने फ़ेल्डो स्कोप, माइक्रोस्कोप की बारीकी एवँ उपयोग के बारे में जानकारी दिया प्रदर्शन एवँ प्रशिक्षण में बताया गया कि फ़ेल्डोस्कोप एक तरह का पेपर को फेल्ड करके बनाया गया सूक्ष्मदर्शी है जिसका अविष्कार डॉ मनु प्रकाश ने किया है जो कि भारतीय है और वर्तमान में स्टेन फोर्ड विश्वविद्यालय कैलिफोर्निया में कार्यरत है पारम्परिक सूक्ष्मदर्शी भारी एवँ खर्चीला होने के कारण रखरखाव एवँ आर्थिक दृष्टि से सहज नहीं है।

TheHitavada **CityLine** EXCLUSIVE FOR THE READERS IN RAIPUR, DURG & BHILAI

WEDNESDAY, May 20, 2020

ICAR-NIBSM brings 'Foldscope' to C'garh

■ Microscopy at tribals' doorstep may prevent zoonotic diseases

■ Staff Reporter
RAIPUR, May 19

Woman farmers using Foldscop microscopy.

INDIAN Council of Agricultural Research (ICAR)- National Institute of Biotic Stress Management (NIBSM), Raipur is providing diagnosis training for biotic stress management to tribal farmers of State.

The ICAR- NIBSM, Raipur has launched a project 'Surveillance and minimising the risk of zoonotic diseases among tribal farmers through Foldscope microscopy (paper microscope)'. Department of Biotechnology, Ministry of Science and Technology, Government of India has granted the project to the ICAR- NIBSM, Raipur for a period of two years.

Foldscope is an ultra-affordable paper microscope designed by Dr Manu Prakash, Professor of Bioengineering at Stanford University, California, USA. Foldscope is origami-based paper microscope which utilises principal of optics and is printed on a standard A4 sheet of paper, weighing only 8 gm and can be assembled in 7 minutes. It is designed to be extremely portable, durable, and to give optical quality similar to conventional research microscopes (magnification from 140X to 2000X), sufficient enough to spot organisms such as Leishmania donovani and Escherichia coli, as well as malarial parasites. The kit also includes magnets that can be stuck onto the Foldscope to attach it to a smartphone, allowing the user to take pictures and live videos of the magnification. Surprisingly, it is designed to cost less than US$1 to build. Considering the instruments optical quality, durability in the field, price, and versatility make it a powerful scientific tool, the Department of Biotechnology, Ministry of Science and Technology, Government of India, included foldscope microscopy as one of the tools to promote educational, training or research tool, partnering with Foldscope Instruments Inc. and Prakash Lab (Stanford), in the year 2017. As a capacity building initiatives, the NIBSM, Raipur has organised 20 foldscope demonstration cum hands-on training awareness campaign on personal hygiene and zoonotic diseases to tribal farmers ultimately benefiting about 900 individuals including farmers, rural women health workers (Mitanin), school and college students. To maintain the chain, seven rural youths are specially trained at field level to emonstrate the foldscope microscopy to targets.

Project Investigator of the NIBSM, Dr P Mooventhan said that tribal farmers of Chhattisgarh have access to microscopy, especially aimed at disease diagnosis for biotic stress management.

Dr P Mooventhan mentioned that conventional microscopy using specialised combination of hardware and lenses requires trained personnel and laboratory space for their diverse usage in the field of analysis and diagnosis. As a part of 'Frugal Science' movement, many such equipments are modified or restructured to make it cheaper, easily available and used by masses, in the developing world.

Under this initiative, the team lead by Dr P Mooventhan and Scientist (Veterinary Pathology) Dr Mamta Choudhary are providing training to rural youth and farmers in handling the foldscope and its utilisation for rapid and in-situ observation of the microorganisms in their environment: plants, animals and water. About 450 diverse samples from different sources were screened for zoonotic and other prevalent pathogens. Clinical samples were processed further and microorganisms such as Fungi (Aspergillus fumigatus, Penicillium sp., and Rhizopus spp.), pathogenic yeast (Candida spp.), Bacteria (E. coli, Pseudomonas spp., Aeromonas spp. and Proteus spp.) were isolated and observed through foldscope microscopy at various sample sites by tribal youths. Interestingly, foldscope proved as a very helpful tool in adjudging the semen quality in straws prior to applications such as Artificial Insemination (AI) of cattle. This intervention has the significant scope to increase the conception rate in cattle; which will pave the way for successful grading up of indigenous cattle. In addition, total 146 samples from plant, animal, microorganism and insect origin also observed and more than 30 types of micro-organism were documented through foldscope microscopy.

Joint Director (Research) NIBSM, Raipur Dr P Kaushal said that the foldscope microscopy has tremendous potential to reach upto the tribal populations, including farmers, for rapid diagnosis leading to rapid information transfer and timely remedial measures.

Principal Scientist of the NIBSM Raipur Dr Anil Dixit helped to disseminate the Foldscope microscopy to various stakeholders through Mera Gaon Mera Gaurav (MGMG).

Director and Vice-Chancellor of the NIBSM, Raipur Dr P K Ghosh has widely appreciated success and potential of Foldscope and assured to take the concept and the frugal science to grass-root levels of Indian rural.

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CENTRAL CHRONICLE, RAIPUR, WEDNESDAY, MAY 20, 2020

Microscopy at farmer's doorstep: ICAR-NIBSM brings 'Foldscope' to Chh'garh

Raipur, May 19:

"The tribal farmers of the Chhattisgarh have access to microscopy, especially aimed at disease diagnosis for biotic stress management", tells Dr. P. Mooventhan, Scientist (Agriculture Extension) at ICAR-NIBSM, Raipur, highlighting the options and opportunities of using Foldscope microscopy. He further mentioned - Conventional microscopy using specialised combination of hardware and lenses requires trained personnel and laboratory space for their diverse usage in the field of analysis and diagnosis. As a part of "Frugal Science" movement, many such equipments are modified or restructured to make it cheaper, easily available and used by masses, in the developing world. Considering the instruments optical quality, durability in the field, price, and versatility make it a powerful scientific tool, the Department of Biotechnology, Ministry of Science and Technology, Government of India, included foldscope microscopy as one of the tools to promote educational, training or research tool, partnering with Foldscope Instruments Inc. and Prakash Lab (Stanford), in the year 2017. Consequently, a project "Surveillance and minimising the risk of zoonotic diseases among tribal farmers through Foldscope microscopy" was granted to ICAR-NIBSM, Raipur in 2018 for a period of two years.

"The foldscope microscopy has tremendous potential to reach upto the tribal populations, including farmers, for rapid diagnosis leading to rapid information transfer and timely remedial measures" tells Dr. P. Kaushal, Joint Director (Research) at NIBSM, Raipur. As a capacity- building initiatives, about 20 events were organized on foldscope demonstration cum hands-on training awareness campaign on personal hygiene and zoonotic diseases to tribal farmers ultimately benefiting about 900 individuals including farmers, rural women health workers (Mitanin), school and college students. To maintain the chain, seven rural youths are specially trained at field level to demonstrate the foldscope microscopy to targets.

In addition, Dr. Anil Dixit, Principal Scientist, PRO of this institute helped to disseminate the Foldscope microscopy to various stakeholders through Mera Gaon Mera Gaurav (MGMG). Success and potential of Foldscope has been widely appreciated by Dr P. K. Ghosh, Director and Vice-Chancellor, NIBSM Raipur, assuring to take the concept and the frugal science to grass root levels of Indian rural. A next phase of the concept is in negotiation with the Department of Science and Technology, Govt. of India.

नांदगांव टाइम्स राजनांदगांव • शुक्रवार • 03 सितंबर 2021 •

फोल्डस्कोप माइक्रोस्कोप खेत में ही रोगों व कीटों की पहचान में उपयोगी

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छत्तीसगढ़ जनसंपर्क

मुख्य पृष्ठ | समाचार | राज्यपाल परिचय | मुख्यमंत्री परिचय | अन्य परिचय | राज्य के अंग | निर्णय | फोटो गैलेरी | वीडियो गैलेरी | हमारे बारे में | हमसे संपर्क करें

महत्वपूर्ण लिंक

- आज के समाचार
- जिला परिक्रमा
- लोकवाणी (आपकी बात - मुख्यमंत्री श्री भूपेश बघेल के साथ)
- विशेष लेख
- जिलों के आलेख
- सफलता की कहानियां
- फ्लैगशिप योजनाओं के परिपत्र
- कोविड -19
- गोधन न्याय योजना

02 सितंबर 2021

सोशल मीडिया इस लेख को शेयर करें

राजनांदगांव : फोल्डस्कोप माइक्रोस्कोप खेत में ही रोगों व कीटों की पहचान में उपयोगी

राजनांदगांव 02 सितम्बर 2021

कृषि विज्ञान केंद्र राजनांदगांव एवं भारतीय कृषि अनुसंधान परिषद राष्ट्रीय जैविक स्ट्रेस प्रबंधन संस्थान बरौंडा रायपुर द्वारा 1 सितम्बर 2021 को कृषि विज्ञान केंद्र सुरगी में फोल्ड माइक्रोस्कोप का प्रदर्शन किया गया। कृषि विज्ञान केंद्र राजनांदगांव के वरिष्ठ वैज्ञानिक एवं प्रमुख डॉ. बीएस राजपूत एवं इस परियोजना की प्रभारी श्रीमती गुंजन झा (विषय वस्तु विशेषज्ञ उद्यानिकी) ने बताया कि पेपर आधारित माइक्रोस्कोप जिसे फोल्डस्कोप के नाम से जाना जाता है। जो माइक्रोस्कोप की तरह कार्य करने वाले उपकरण किसानों के लिए उपयोगी यंत्र है। यह कागज से बनने के कारण सस्ता व हल्का तथा आसानी से फोल्ड हो जाने वाला होता है, जिसे किसान आसानी से जेब में रखकर खेत में जा सकते हैं। फोल्डस्कोप माइक्रोस्कोप का आविष्कार स्टैनफोर्ड स्कूल ऑफ मेडिसिन में बायोइंजीनियरिंग में सहायक प्रोफेसर डॉ. मनु प्रकाश एवं टीम द्वारा वर्ष 2014 में किया गया था। वास्तव में यह एक तरह का आप्टिकल माइक्रोस्कोप है, यह वजन में बहुत हल्का लगभग 8 ग्राम होता है और यह एक किट में आता है। जिसमें लेंस होते हैं जो 140 गुना आवर्धन प्रदान करते हैं।

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Major Achievements of Foldscope Initiatives

- Explored the socio-economic status, knowledge level of tribal farmers and college students on zoonotic diseases, plant disease, diagnosis, and tribal farmers' attitude/perception towards foldscope microscopy.
- Total 407 samples were collected from different sources to screen the zoonotic, plant disease and other relevant pathogens from the farmer's fields, research centers, and agricultural universities at different locations in Chhattisgarh.
- Total 171 samples were diagnosed in-situ/ex-situ through the help of Foldscope microscopy.
- Mostly foliar fungal diseases were in-situ diagnostic *viz. Ustilaginoidea virens*, *Magnaporthe grisea*, *Alternaria* spp, *Cercospora* spp, *Erysiphe* spp, *Golovinomyces* spp, *Leveillula taurica, Cephaleuros virescens*, *Penicillium digitatum, Botrytis* spp, *Oidium erysiphoides*, *Albugo bliti*, *Puccinia* spp, *Rhizopus* spp and *Ustilago tritici*.
- Under Ex situ diagnosis the clinical samples were processed and Fungi (*Aspergillus fumigatus, Penicillium* spp*,* and *Rhizopus* spp.), pathogenic yeast (*Candida* spp.), Bacteria (*E. coli, Pseudomonas* spp., *Aeromonas* spp. and *Proteus* spp.) were isolated and observed through foldscope microscopy.
- In situ viability test of bioagent *viz. Trichoderma* spp and *Pacelomyces* spp has successfully observed under Foldscope.
- In Foldscope project we have covered more than 56 organisms/tissue such as fungi, bacteria, yeast, algae pathogens, zoonotic pathogen, histology and plant tissue.
- As a field application, foldscope was identified as a novel tool to test the semen quality in straw provided for Artificial Insemination (AI) of cattle. This intervention has the significant scope to increase cattle's conception rate, which will pave the way for successfully grading indigenous cattle.

- As a part of the capacity-building initiative 42 events such as training, demonstration, workshop and awareness campaign on the in-situ diagnosis of plant pathogenic fungi and zoonotic disease through Foldscope microscope to farmers, rural youth, college students, agriculture extension officers, horticulture extension officers, veterinary officers and teaching faculty of the institute.
- Total 1470 participants benefitted from this initiative, in which 509 are male farmers, 381 are female farmers, 487 are collage and school students and 93 are extension functionaries.
- Thirty-one rural youths as well as students are trained at the field level to demonstrate the foldscope microscopy to needy people.
- **Area Covered:** All capacity building programme conducted in eight district of Chhattisgarh state viz. Janjgir-Champa, Raigarh, Balodabazar-Bhantapara, Rajnandgaon, Mohala Manpur Ambagarh Chowki, Dhamtari, Durg and Raipur.
- Samples were collected from fifteen district of Chhattisgarh state viz. Surguja, Koriya, Jashpur, Korba, Raigarh, Sakti, Bilaspur, Mungeli, Kabirdham, Bemetara, Mahasamund, Balodabazar-Bhatapara, Kanker, Baster and Raipur.
- Training and demonstration programme has done in various agricultural and educational institute of Chhattisgarh state.
- In the online platform, total 297 (images/videos) were published in the MICROCOSMOS (https://microcosmos.foldscope.com/) Foldscope Community under both projects.
- Diagnosis of crop diseases at the initial level, it's very helpful to minimize the crop yield losses of farmers and also reduces the input cost, foldscope microscopy has proved the best solution for this.
- AI-powered Fungus Diagnostic Model using Foldscope Microscopy is in progress with Centre for Development of Advanced Computing (C-DAC), Chennai, Ministry of Electronics and Information Technology (MeitY), GoI.

Visit of Dr. Manu Prakash (Inventor of Foldscope Microscope) to Raipur (C.G.)

Acknowledgment and Thanks to

Stanford University

FOLDSCOPE INSTRUMENTS

Reaching the Unreached...

भाकृअनुप
ICAR

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GOVERNMENT OF INDIA

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DEPARTMENT OF SCIENCE AND TECHNOLOGY
GOVERNMENT OF INDIA

रा जै स्ट्रे प्र सं
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