

Plant Pathology Division



Plant Pathology Division

Mandate

- Epidemiological studies.
- Population biology and Host-pathogen interactions.
- Disease resistance and Integrated management.
- Climate change and Disease forecasting model.
- Precision agriculture and Nano technologies.
- Establishment collaboration with GO's, NGO's and institutions.
- Provide advisor and clinical services.

Transformation of Plant Pathological Research

Transformation of disease status

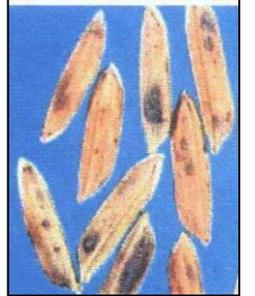
1970

(BRRI Establishment)

Major: Brown spot, Ufra
Minor: False smut, Blast, Tungro, Sheath blight (ShB), BLB



Ufra



Brown spot

1990

Major: Sheath blight, Tungro, Ufra, BLB
Minor: Brown spot, False smut, Blast



ShB



Tungro

2020

Major: Blast, Sheath blight (ShB), BLB, False smut, Tungro
Minor: Brown spot, Ufra



False smut



Neck blast

Transformation of Plant Pathological Research

Transformation of research activities

1970

(BRRI Establishment)

- ✓ Epidemiological studies
- ✓ Disease management
- ✓ Screening germplasm



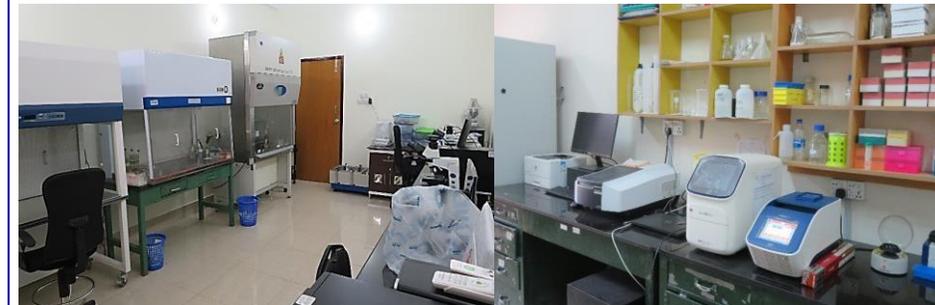
1990

- ✓ Integrated management
- ✓ Population biology
- ✓ Seed pathology



2020

- ✓ Resistant breeding
- ✓ Genome editing
- ✓ Bioinformatics
- ✓ Artificial Intelligence
- ✓ Nano technology



Integrated Management of Rice Blast

Blast resistance



Honorable Agriculture Minister
visiting blast research activities

- ❖ Identified effective blast resistant genes *Pi9*, *Pita-2* and *Pish* for Bangladesh.
- ❖ Blast resistant genes pyramided in popular varieties.

Designation	Disease score (0-9)	Yield (t/ha)
BR(Path)12452-BC3-42	0	6.1
BR(Path)12452-BC6-53	3	7.5
BR(Path)13748-BC3-61	1	6.5
BR(Path)13748-BC3-63	1	6.7
BRRI dhan28	9	5.7

Blast management

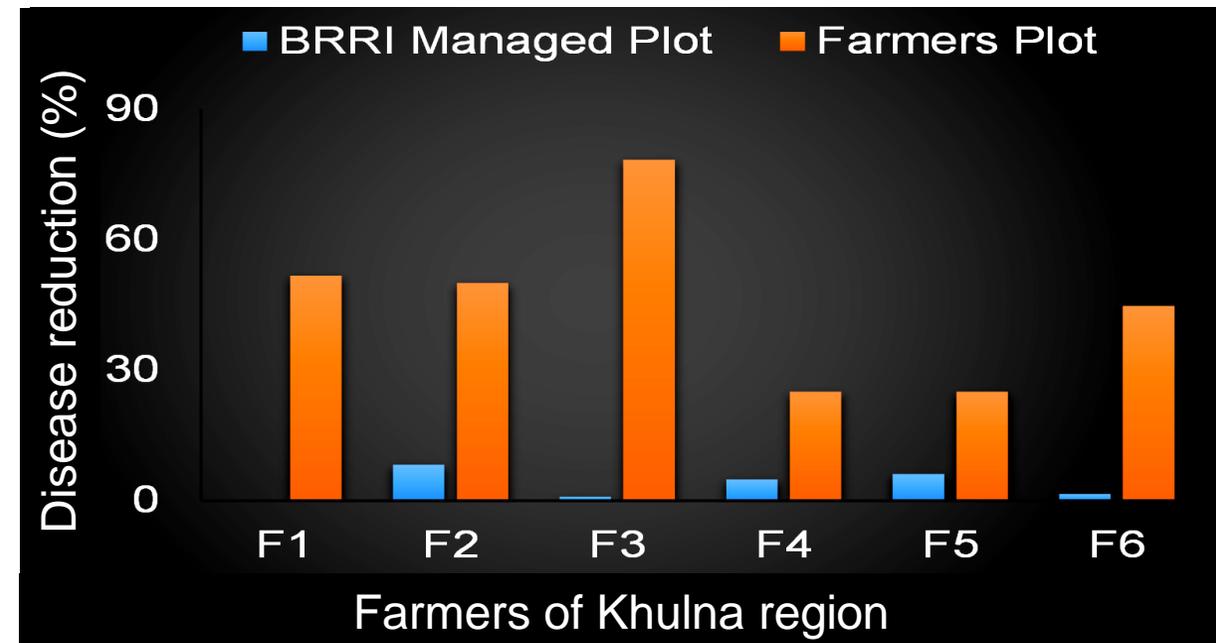


Severe leaf blast infection

❖ More than 80% neck blast disease was controlled following BRRi management practices.

BRRi Management options for Neck blast disease:

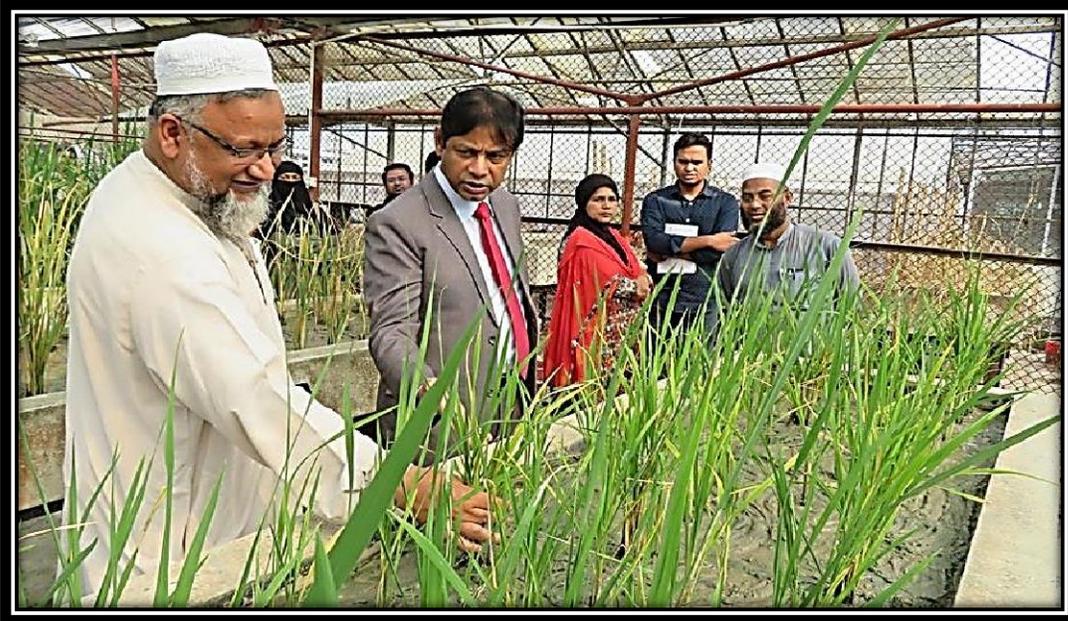
- ✓ Keep standing water in field
- ✓ Apply additional MoP @ 5kg/bigha
- ✓ Twice application of tricyclazole/strobilin fungicides during split booting and heading stages at afternoon.



Disease reduction following BRRi practices

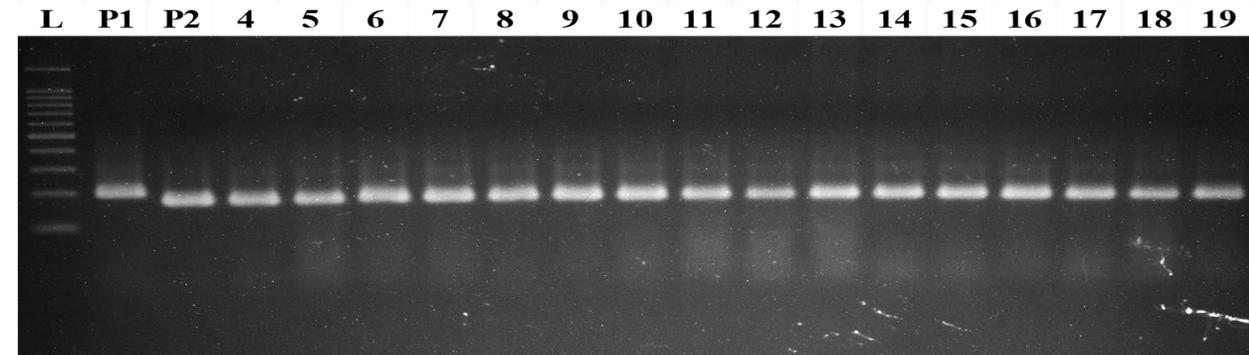
Integrated Management of Tungro

Tungro resistance



Honourable DG, BIRRI visiting Tungro research activities.

- ❖ Effective Tungro resistant gene *tsv-1* was identified for Bangladesh.
- ❖ Introgressed Tungro resistant gene in BIRRI varieties.



Desire plant selection using DNA markers

Tungro management



❖ In terms of money, BIRRI practices saved Tk. 17280/bigha by controlling tungro.

BIRRI Management options for Tungro disease:

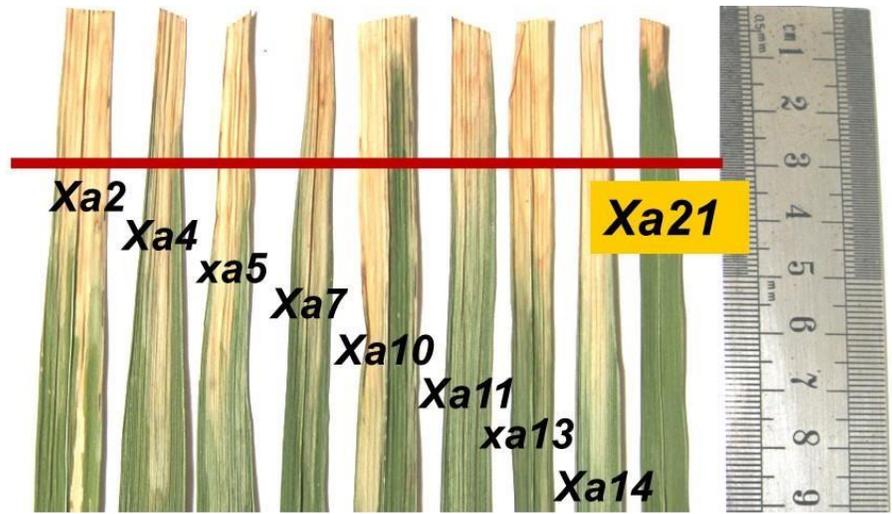
- ✓ Destroy infected plants
- ✓ Control GLH in seedbed or field by hand sweeping/light trap/recommended insecticides (MIPC@2.6g, Cartap@2.4g in 1 L of water.



Tungro disease management at Cumilla

Integrated Management of Bacterial Blight (BB)

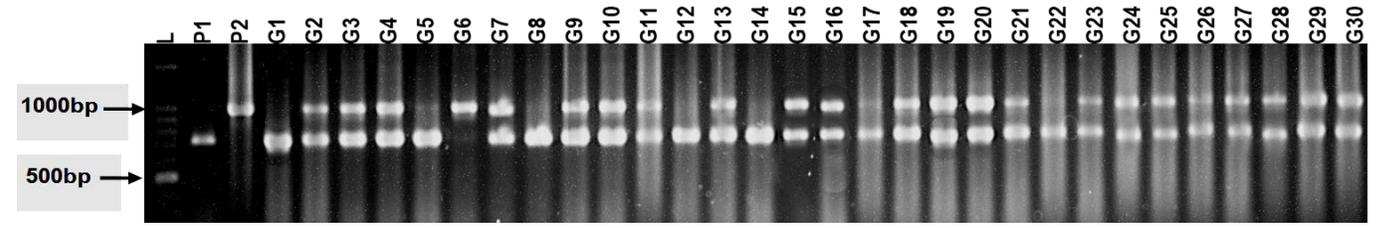
BB resistance



S S S S S S S S S R

Reaction of resistant genes to the major race of BB pathogen

- ❖ Effective BB resistant genes *Xa21*, *xa13*, *xa5* and *Xa27* was identified for Bangladesh.
- ❖ Pyramided BB resistant genes in popular BRRI varieties.



Confirmation of *Xa21* gene using DNA markers

BB management



BB infected field

BIRRI management options for Bacterial blight disease:

- ✓ Avoid application of N fertilizer immediately after stormy
- ✓ Apply MoP 60g, Thiovit 60g and Zinc 20g in 10L of water for 5 decimals of land

❖ Two times spray of this solution immediately stop the bacterial blight severity and incidence in farmer's field.

Integrated Management of Sheath Blight

ShB management



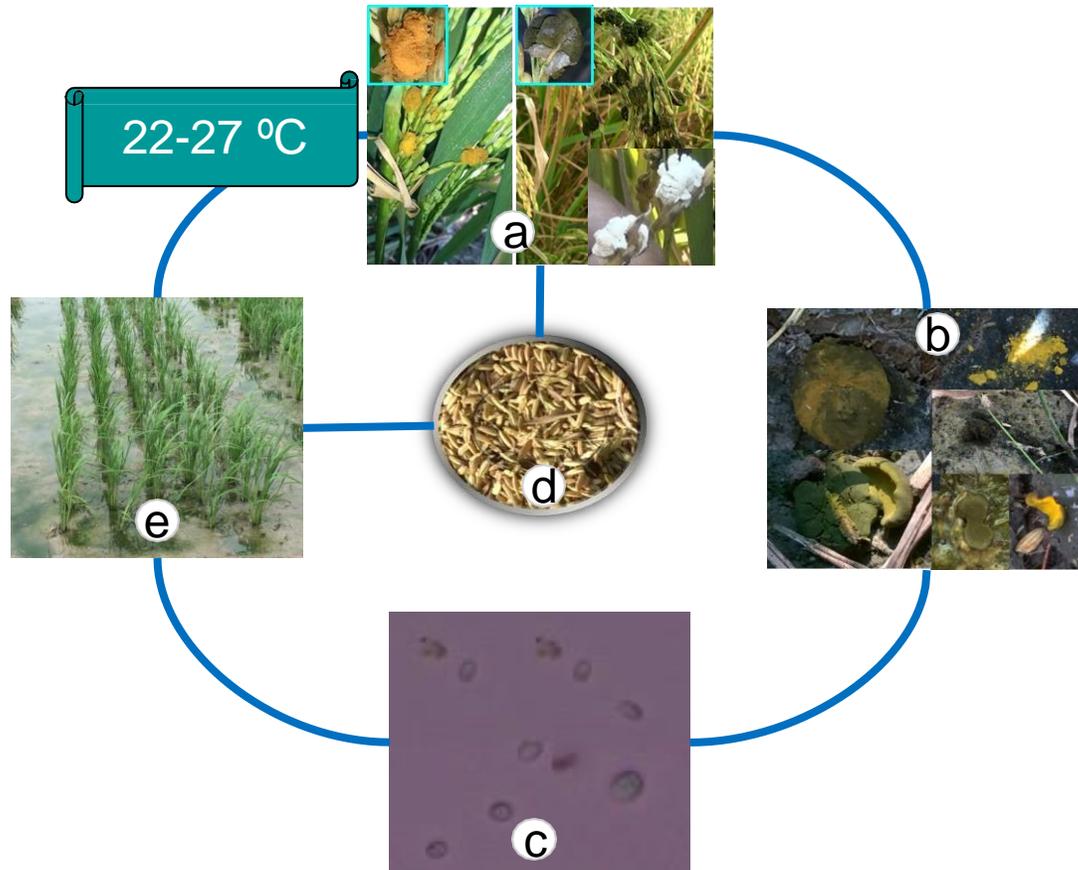
Sheath blight infection

BIRRI management options for Sheath blight disease:

- ✓ Removal of floating debris
- ✓ Split application of MOP
- ✓ Wider spacing 25 cm x 15 cm
- ✓ Judicial application of fungicides viz. Amistar top @ 500 ml/ha

❖ Integrated management practices reduced sheath blight disease and increased grain yield significantly.

Integrated Management of Rice False Smut



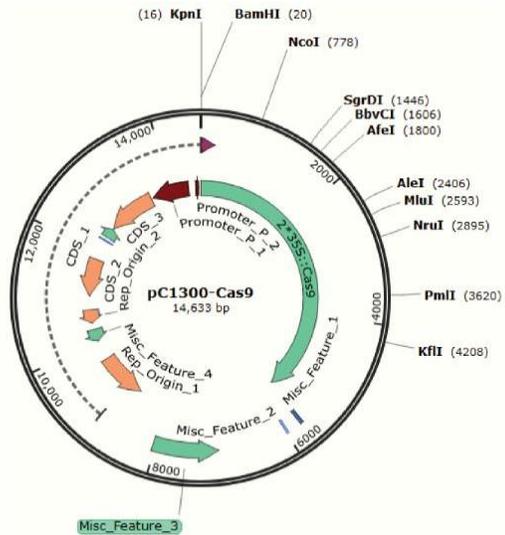
Disease cycle of rice false smut disease

The fungus attacks the host plant ± 1 week of panicle emergence. Favourable conditions during panicle emergence are: Day hot- night cold and Average temp. 22-27 °C.

Integrated Management package

- ✓ Avoid susceptible varieties in historical diseased area.
- ✓ Early planting i.e. emergence of panicle before mid-October.
- ✓ Avoid seeds from last year infected field.

Development of Blast Resistance Rice by CRISPR/Cas9-Targeted Mutagenesis of the *OsERF922* gene

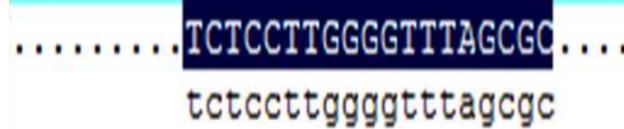


Vector pC1300-Cas9.

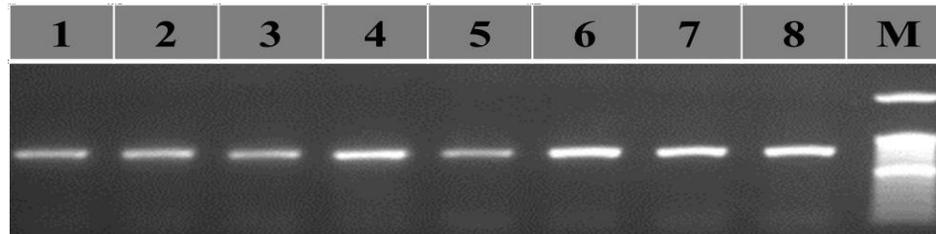
Sk-gRNA + *ERF922* target



ERF922 target



Alignment of the target site of *ERF922*



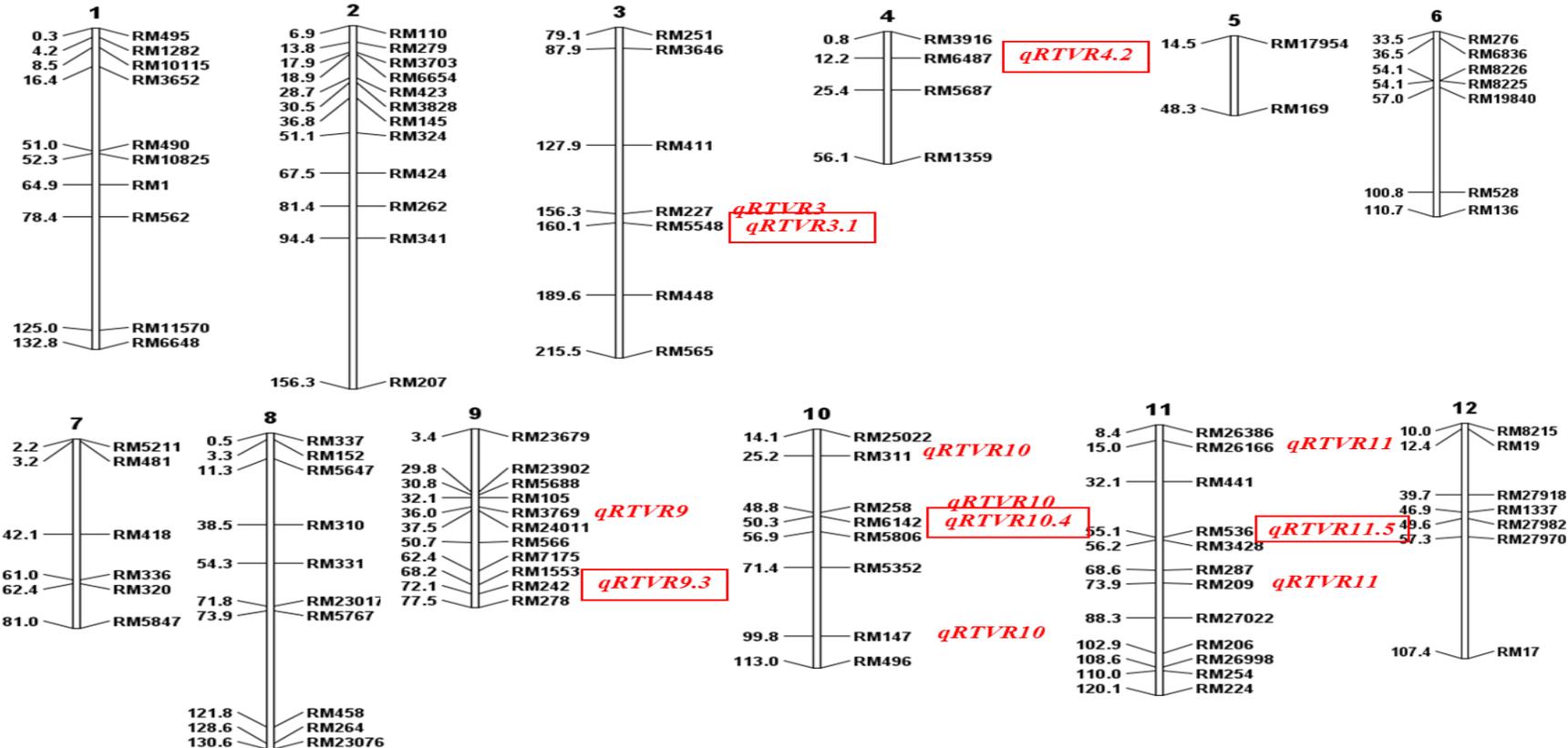
Confirmation of *Agrobacterium* transformation.



Regenerated plants at flowering stage.

❖ Developing blast resistant variety by targeted mutagenesis of *OsERF922* gene through CRISPR/Cas9.

QTL mapping of Kumragoir for Tungro resistance



Linkage map constructed based on selected individuals of a cross between Kumragoir and BRRRI dhan48.

❖ Five resistance QTL, *qRTVR3.1*, *qRTVR4.2*, *qRTVR9.3*, *qRTVR10.4* and *qRTVR11.5*, were identified in chromosomes 3, 4, 9, 10 and 11, respectively of Kumragoir.

High-throughput Screening for Blast, Tungro and Bacterial Blight Disease Resistance

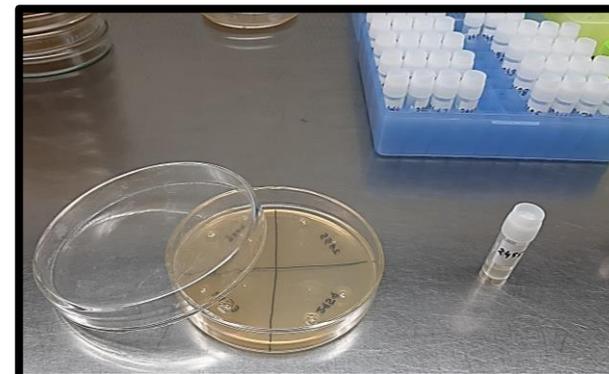
Blast



Tungro



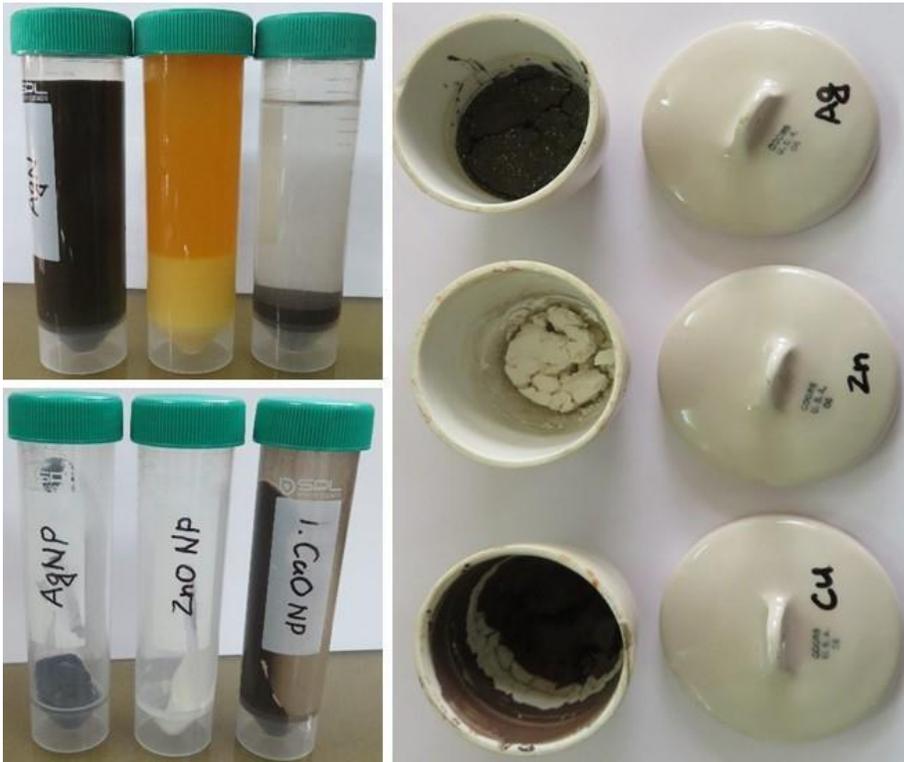
Bacterial blight



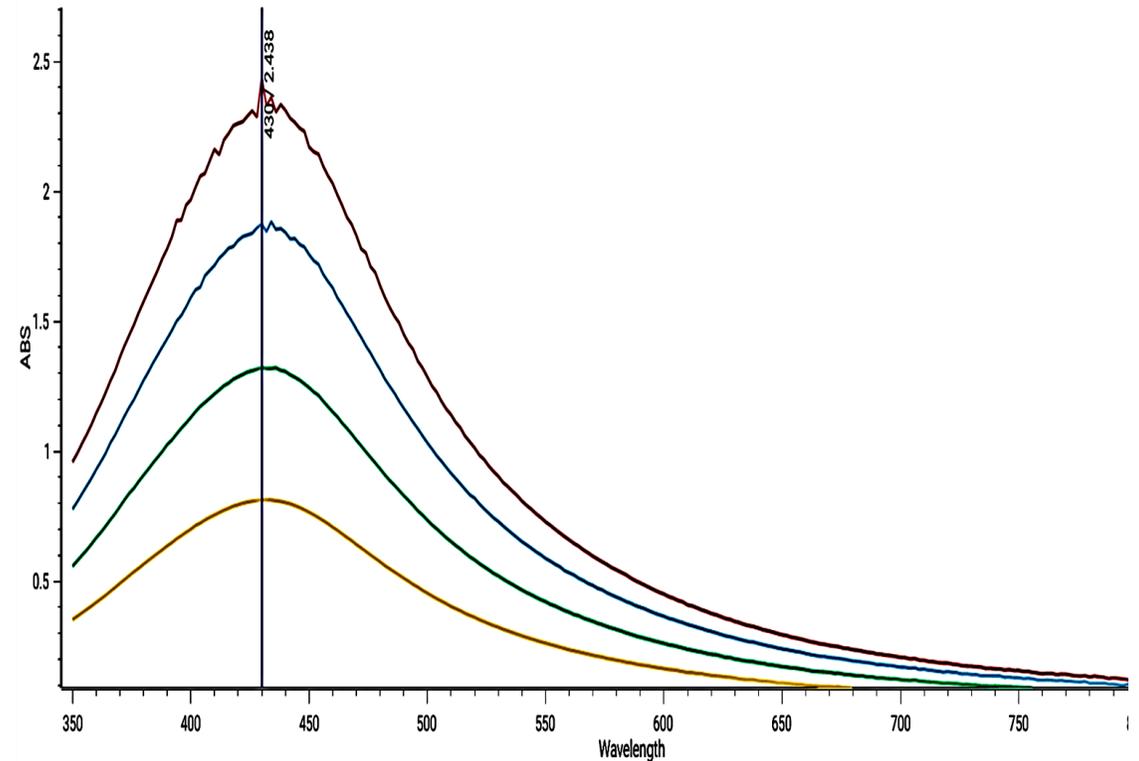
Virulence pattern of ref. isolates	BB resistance gene	Disease expression
S	Xa2	
S	Xa4	
S	xa5	
S	Xa7	
S	Xa10	
S	Xa11	
S	xa13	
S	Xa14	
R	Xa21	

✓ Pathogen race specific disease screening facilities have already developed. In addition, thousands of materials are now able to screen in a short time.

Biosynthesis and Application of Nano-particles in Rice Disease Management



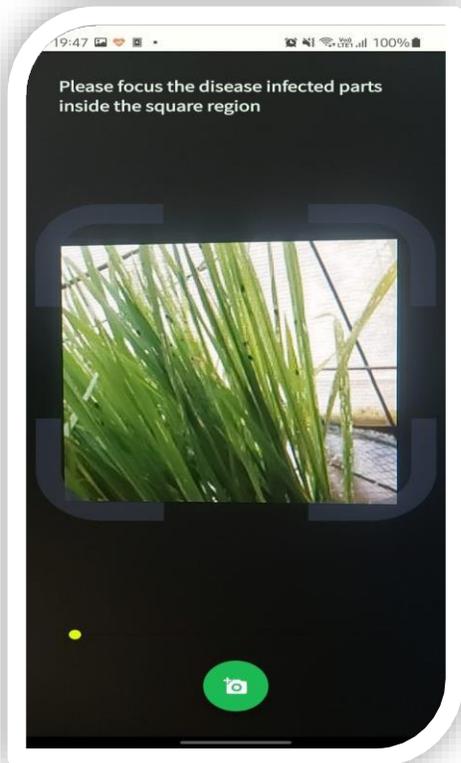
Synthesized nano-particles



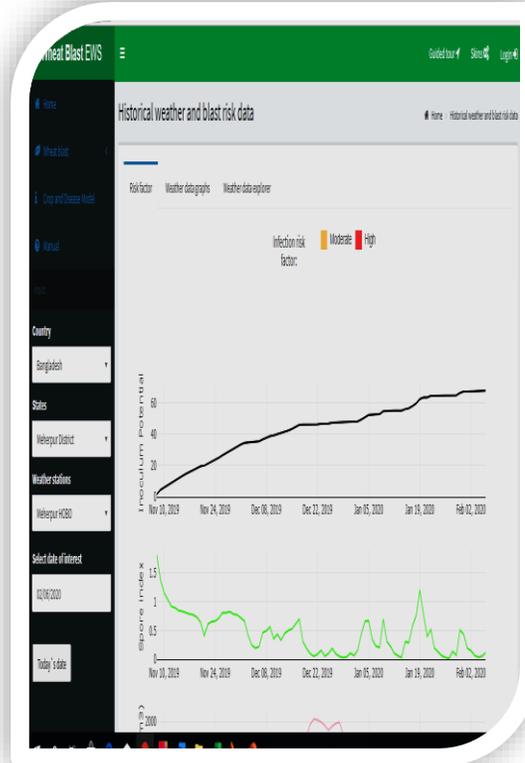
UV-Vis spectra of silver nano-particles

- ❖ Silver, Zinc oxide, Manganese oxide, Silicon dioxide, Potassium and Copper oxide nano-particles were synthesized. Antipathogenic activities of these particles are going on against rice pathogens.

Enabling Farmers in Combating Diseases in Rice: Artificial Intelligence (AI) for Food Security



Disease identification and management



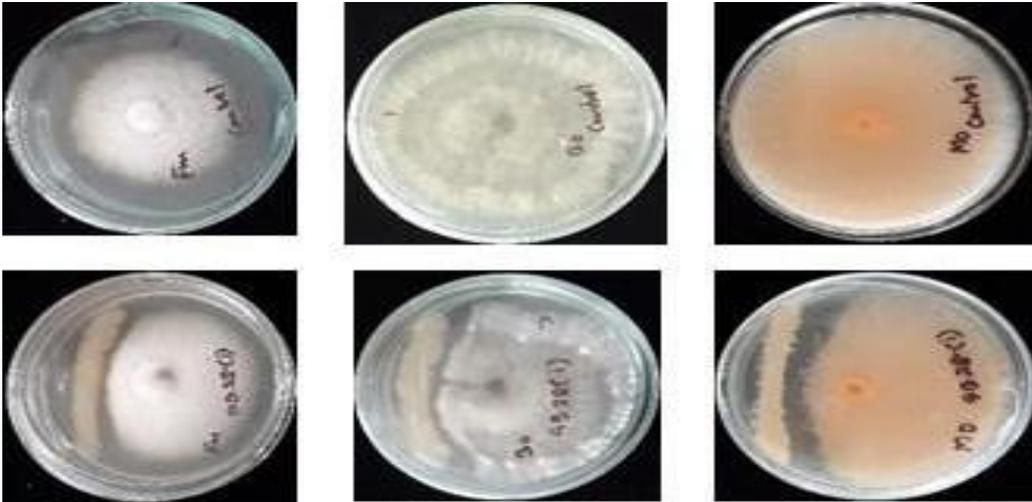
Disease coupling model for early warning system



Drone technology for disease monitoring

❖ To enabling farmers in combating diseases in rice, different **Internet of Things (IoT)** are now applying in plant pathological research with the collaboration of BUET and BSMRAU.

Application of Biocontrol Agents for Rice Disease Management



Pathogenic fungal growth inhibition by bio-control agent (bacteria)



Formulated tricho-compost for rice disease management and yield maximization

- ❖ Biopesticides produced from *Trichoderma* and biocontrol bacteria were evaluated and found effective against rice pathogens.



Thank you

The Family of Plant Pathology Division