

Plant Pathological Research in NARC

(Mandate, current status, Challenge, role & future Plan)



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MANDATE:

1. Generate information about disease identification and their status on agriculture crops.
2. Generate epidemiological information and preservation of plant pathogens
3. Develop appropriate research materials and methods and make them available to concerned stakeholders.
4. Develop effective and sustainable crop disease management technologies.
5. Generate appropriate mushroom cultivation technology and spawn production and distribution.
6. Enhance coordination and networking of plant pathological research with federal, provincial and local government agencies, universities, NGOs, private sectors and international organizations.
7. Provide advisory services and scaling up technologies to the stakeholders.
8. Enhance institutional and individual capacity.

PLANT DISEASE MANAGEMENT

Survey and surveillance

Problem Identification
- Biotic - Abiotic

Causal agent
- Disease cycle/epidemiology

- Soil - nutrients
- Water/moisture - Humidity
- Temperature - Heat/light
- Aeration - Others

Potential economic losses
- Qualitative - Quantitative

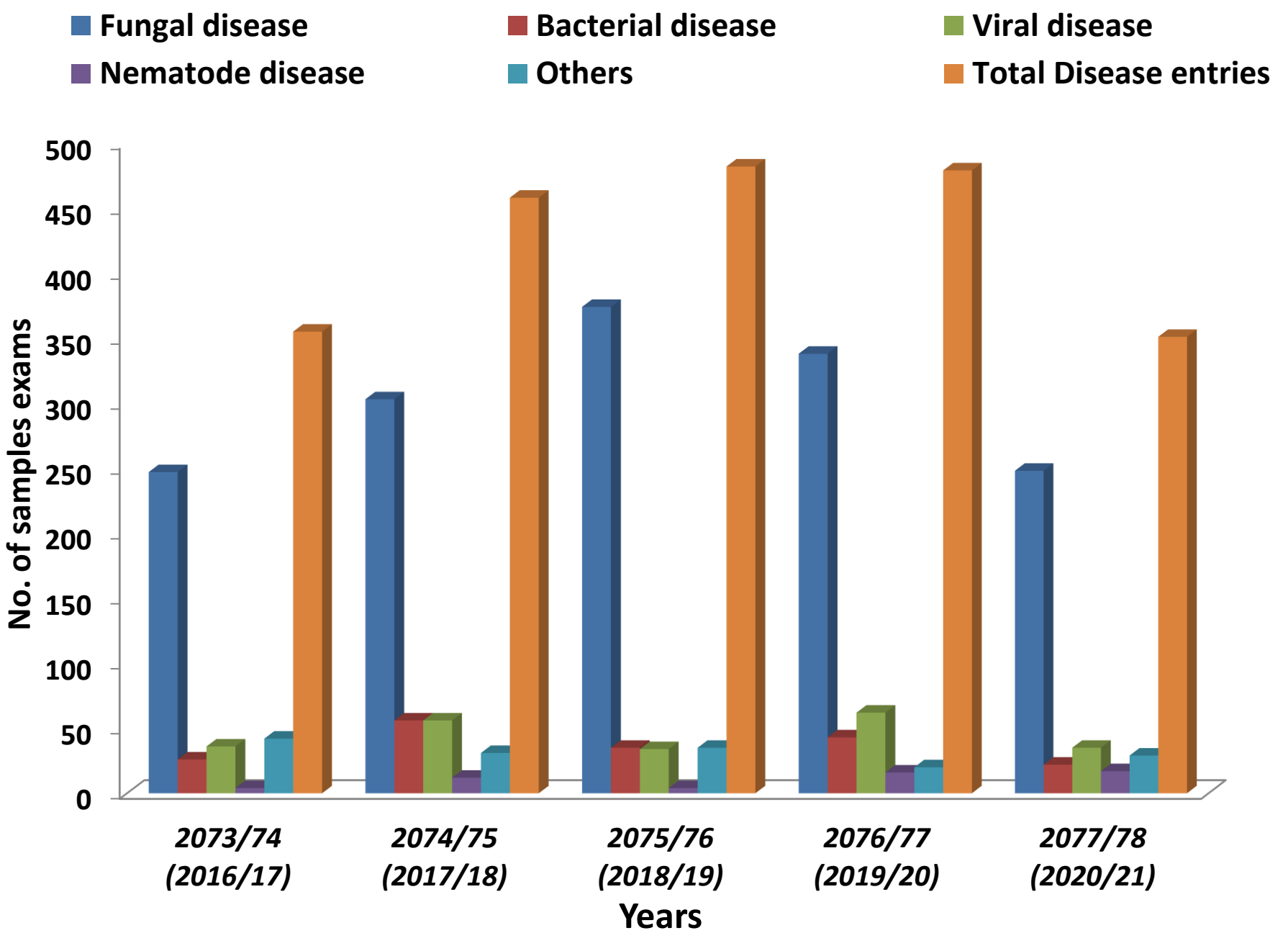
Management

Cultural methods
- Spacing - Sanitation
- Date of planting - Inputs

Genetic materials
- Screening - Breeding
- Tissue culture
➤ Local
➤ Exotic

Chemical methods
- Contact - Systemic
➤ Dose, number and interval

Eco-friendly substances
- Botanicals - Biologicals
➤ Dose, number and interval



Frequency of plant disease samples diagnosed in different years in Plant Pathology Division lab

Commonly Recorded Plant Diseases in 2017-2021 AD

Crop	Disease	Pathogen
Rice	Blast Bacterial Leaf Blight Bacterial leaf streak Brown leaf spot Sheath blight False smut Foot rot Udbatta disease	<i>Pyricularia oryzae</i> <i>Xanthomonas campestris pv. oryzae</i> <i>Xanthomonas oryzae pv. oryzicola</i> <i>Bipolaris oryzae</i> <i>Rhizoctonia solani</i> <i>Ustilaginoidea virens</i> <i>Fusarium sp.</i> <i>Ephelis oryzae</i>
Wheat	Yellow rust Brown rust Foliar blight Powdery mildew Loose smut Karnal bunt	<i>Puccinia striiformis</i> <i>Puccinia triticina</i> <i>Bipolaris sorokiana</i> <i>Blumeria graminis f. sp. Tritici</i> <i>Ustilago tritici</i> <i>Tilletia indica</i>
Maize	Northern leaf blight Southern leaf blight Gray leaf spot Banded leaf and sheath blight Common rust Curvularia leaf spot Cob rot	<i>Helminthosporium turcicum</i> <i>Helminthosporium maydis</i> <i>Cercospora zea maydis</i> <i>Rhizoctonia solani</i> <i>Puccinia sorghi</i> <i>Curvularia lunata</i> <i>Fusarium moniliformae</i>
Barley	Yellow rust Leaf rust Loose smut Spot blotch Net blotch	<i>Puccinia striiformis f. sp. hordei</i> <i>Puccinia hordei</i> <i>Ustilago nuda</i> <i>Bipolaris sorokiniana</i> <i>Pyrenophora teres</i>
Finger millet	Blast Cercospora leaf spot	<i>Pyricularia grisea</i> <i>Cercospora sp.</i>

Crop	Disease	Pathogen
Crucifers	Clubroot Rhizoctonia disease Black rot Bacterial leaf spot of broad leaf mustard	<i>Plasmodiophora brassicae</i> <i>Rhizoctonia solani</i> <i>Xanthomonas campestris</i> pv. <i>campestris</i> <i>Pseudomonas syringae</i> pv. <i>maculicola</i>
Solanaceous crops (Tomato/ Potato / Eggplant)	Late blight Common scab, powdery scab Bacterial wilt Viral disease complex Root Knot Nematode Bacterial stem rot of tomato Pith Necrosis of tomato	<i>Phytophthora infestans</i> <i>Streptomyces scabies</i> , <i>Spongospora subterranea</i> <i>Ralstonia solanacearum</i> TYLCV (Tomato Yellow Leaf Curl Virus, ToMV (Tomato Mosaic Virus), CMV (Cucumber Mosaic Virus), PepMV(Pepino Mosaic Virus) <i>Meloidogyne</i> spp <i>Erwinia carotovora</i> sub sp. <i>carotovora</i> <i>Pseudomonas corrugata</i>
Cucurbits	Viral disease complex Downy mildew Gummy stem blight	CMV (Cucumber Mosaic Virus), ZYMV (Zucchini Yellow Mosaic Virus), CGMMV (Cucumber Green Mottle Mosaic Virus), WMV (Watermelon Mosaic Virus) <i>Pseudoperonospora cubensis</i> <i>Didymella bryoniae</i>
Pepper	Phytophthora blight Viral disease complex	<i>Phytophthora capsici</i> CMV (Cucumber Mosaic Virus), PVMV (Pepper Veinal Mottle Virus), TLCV (Tomato Leaf Curl Virus)

Crop	Disease	Pathogen
Citrus	Canker Citrus greening	<i>Xanthomonas axonopodis</i> pv. <i>citri</i> <i>Liberibacter</i> sp.
Banana	Sigatoka leaf spot Panama wilt Heart rot Banana blast	<i>Mycosphaerella musicola</i> <i>Fusarium oxysporum</i> f sp. <i>cubense</i> <i>Fusarium moniliforme</i> <i>Pyricularia angulata</i>
Mango	Anthracnose Powdery mildew	<i>Colletotrichum gleosporioides</i> <i>Oidium magniferae</i>
Apple	Scab	<i>Venturia inaequalis</i>
Sugarcane	Red rot of sugarcane	<i>Colletotrichum falcatum</i>
Cardamom	Wilt complex/Rhizome rot Leaf blight complex/rust Viral	<i>Fusarium</i> sp, <i>Rhizoctonia</i> sp <i>Pestalotia</i> sp, <i>Phakospora</i> sp
Tea	Blister blight	<i>Exobasidium vexans</i>
Coffee	Rust anthracnose	<i>Hemileia vastatrix</i> <i>Gleosporium gleosporioides</i>

Crop	Disease	Pathogen
Merigold	Rust Septoria leaf spot Viral disease	<i>Puccinia tageticola</i> <i>Septoria</i> sp. Virus
Carnation	Root rot Rust	<i>Verticillium</i> sp. <i>Uromyces dianthi</i>
Gladiolus	Root rot Leaf blight Rhizome rot	<i>Fusarium</i> sp. <i>Cercospora</i> sp. <i>Fusarium</i> sp.
Azalea	Leaf blight Root rot Leaf spot	<i>Cylindrocladium</i> sp. <i>Fusarium</i> sp. <i>Cladosporium</i> sp., <i>Phoma</i> sp.
Hydrangia	Leaf spot	<i>Cercospora</i> sp.
Rose	Black spot Leaf blight Powdery mildew Anthracnose	<i>Diplocarpon rosae</i> <i>Alternaria</i> sp. <i>Sphaerotheca pannosa</i> <i>Colletotrichum</i> sp.
Gerbera	Root rot Wilt	<i>Fusarium</i> sp. <i>Fusarium</i> sp.
Chrysanthemum	White rust	<i>Puccinia horiana</i>
Rhododendron	Leaf spot Root rot	<i>Pestalotia</i> sp. <i>Fusarioum</i> sp.

Bacterial Leaf streak of rice
Xanthomonas oryzae pv. *oryzicola*



Management:

1. Spraying of copper base fungicides @ 2g per litre of water.
2. Avoid use of nitrogen fertilizer.
3. Ensure good drainage of field and nurseries.
4. Dry the fields during fallow period to kill bacteria.

Gray leaf spot disease of maize
Xanthomonas oryzae pv. *oryzicola*



Net blotch of Barley
Pyrenophora teres

Fungicides
Propiconazole,
Azoxystrobin
effective than
tebuconazole



Management:

1. Planting of resistant genotypes Manakamana-1, Manakamana-3, Manakamana-6, Manakamana -9
2. Application of fungicides like Bavistin (Carbendazim) @ 1.5 g or Dithane M-45 (Mancozeb) 2.5 g per litre of water in 7-10 days interval.

Leaf rust pathotypes recorded since last few years in the country

S.N	Genotypes	Score	GPS	Pathotypes		
				Old Name	New Name	North American equivalent name
1	Gautam	90S	1661m	77-9	121R60-1	MHTKL
2	WK 1204	20S	701m	143	57R27	KHTPM
3	WK 1204	10S	1767m	104A	21R31	MGTDF
4	Sworgadwari	40S	725m	104	17R23	PGTKL
5	Dhaulagiri	10MR	1150	77-5	121R63-1	THTTM
6	Vijaya	15S	210m	77-3	125R55	THTTD
7	Sidhartha	60MS-S	1292m	77-1	109R63	THTTB
8	NL 297	100S	77m	104	17R23	PGTKL
9.	WK 3347	20MS	1760m	162A	93R15	KGTSB



**Newly released
genotypes for Terai**

Zinc Gahun 1

Zinc Gahun 2

Borlaug 2020

Yellow rust pathotypes recorded since last few years in the country

S.N.	Location	Genotypes	Score	Pathotypes
1	Rapti Sonora, Dang	Vijaya	60S	6S0
2	ARS, Dailekh	Dhaulagiri	90S	238S119
4	Bijuwaphat, Pyuthan	Sworgadwari	60S	110S119
7	Dasarthpur, Surkhet	Banganga	40MS	46S119
8	Kimughau, Dailekh	WK 1204	40MS-S	46S119
9	Kavre, Dolkha	Zinshakti Gahun	20S	46S119
10	Kathmandu	WK 2123	40MS	46S119
11	Kusumgaht, Kailali	PBW 343	15MR	238S119
12	Bedkot, Sundarpur	Zinc Gahun	5MS	46S119
13	Gurash, Dailekh	NL 297	30MS	110S119
14	Kavresthali, Kathmandu	NL 297	40MS	46S119
15	Khumaltar, Lalitpur	Sworgadwari	20S	46S119



**Newly released
genotypes for hill**

Khumal Shakti
Bheri-Ganga
Himganga
Suruma
Module 1
Tila

**Newly detected Tomato leaf curl New Delhi virus
at Panchkhal, Kavre and Lamjung from Immuno-strip test**



Common virus in vegetables



Management

1. Uprooting of virus infected plants.
2. Management of virus vector insect in the field.
3. Application of cow milk 25ml per liter water in 3-5 days interval for 5-6 times.

Powdery scab of potato (*Spongospora subterranea*)



Management

- 1. Dipping of potato tuber in 5% Nekobu (Amisulbrom) solution for 30 mins before planting can be minimized disease significantly.**
- 2. Dipping of potato tuber in 5% of Huront (Fluazinam SC) solution for 30 mins before planting can be minimized disease significantly.**

Purple blotch of onion (*Alternaria porri*)



Management

- 1. Application of Sectin 60% WG (Fenomidone 10% + mencozeb 50%) @ 1.5g per liter of water in 10 days interval for three times effectively control disease .**
- 2. Similarly, application Surakshya (Chlorothalonil 75% WP) @ 2ml per water in 10 days interval for three times also control disease .**

Phomopsis blight and fruit rot (*Phomopsis vexans*)



Management

- ❖ Spraying of carbendizim or Copper base fungicides @ 2 g per litre of water in 10 days intervals with 2-3 times.

Gummy Stem blight of cucurbits (*Didymella bryoniae*)



Management

- ❖ Spraying of Mancozeb @ 2.5 g per litre of water in 10 days intervals with 2-3 times.

Pith Necrosis in tomato (*Pseudomonas corrungata*)



Management

1. Avoid excess use of nitrogen fertilizer than recommended dose.
2. Avoid close planting, make enough space for air-circulation.
3. Remove mulching if disease severity is high.
4. Open side plastic of tunnel in day time to reduce relative humidity and temperature
5. Increase night temperature with closing of plastic from all sides of the tunnel.
6. Spraying copper base fungicide 2g per litre of water or Stetromycin 1 ml per litre of water 2-3 times in 10 days intervals.



MUSHROOM RESEARCH



- 7 different indigenous *Pleurotus* strains and 5 different strains of *Agaricus* sp. have preserved and distributed to the mushroom growers.
- More than 2700 packets of mushroom spawn are distributed to different districts every year.
- Developed the cultivation technology for *Pleurotus* sp., *Agaricus* sp., *Calocybe indica*, *Lantunela edodes*, *Ganoderma* sp.
- Regular training for cultivating different edible mushrooms to the mushroom growers



Milky mushroom



Ganoderma cultivated
in paddy straw



Training on Shiitake
mushroom cultivation



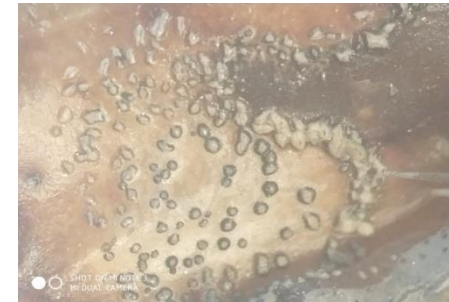
Diseases on Dragon fruit orchard at Namobuddha, Kavre



Field inspection of dragon fruit orchard



Anthracnose



Acervuli of *Colletotrichum gloeosporioides*



Leaf spot of dragon fruit



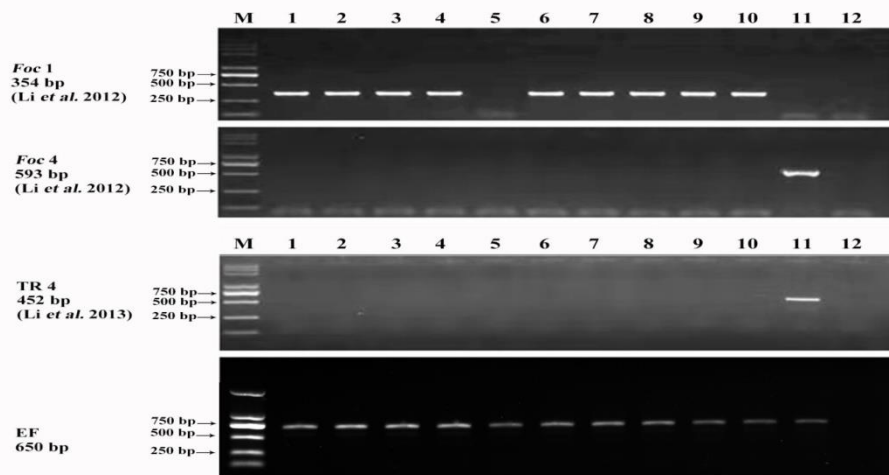
Botryosphaeria spores



Conidia of *Colletotrichum gloeosporioides*

Occurrence of *Fusarium oxysporum* f. sp. *cubense* race 1 in banana orchards in Nepal

- ❖ Sample collections from Chitwan and Nawalparasi districts at central region of the country at an altitude of 170 m to 210 m.
- ❖ Samples collected from seven farmers' field in Chitwan district and four farmers' field in Nawalparasi district.

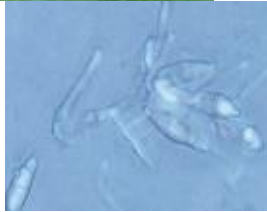


- ❖ The primer sets W1805F/W1805R and W2987F/W2987R were used to identify *Foc* R1 (354 bp) and *Foc* R4 (593 bp), respectively

PCR amplification and Phylogenetic analysis



Banana blast disease *Pyricularia angulata*



Management

1. Spraying of Tilt (Propiconazole 25 EC%) @ 1ml per litre of water or Nativo (Tebuconazole 50% +Trifloxystrobin 25%) @ 05 ml of water 2-3 times 15 days intervals.

Root knot of nematode in KIWI fruit *Meloidogyne arenaria, M. incognita*



Management

1. Soil application mustard cake @ 250 gm per m² during land preparation or ring application around the plant.
2. Application of 40 g crushed yellow mustard per plant during planting or ring application around the plant.
3. Application of *Trichoderma harzianum* in soil.

Bio-control agents used against Plant diseases

SN	Biocontrol agents	Plant diseases
1.	<i>Trichoderma harzianum</i>	<i>Sclerotinia sclerotiorum</i> in cauliflower, <i>Rhizoctonia solani</i> in bean wilt, ginger rot, <i>Pythium</i> sp. <i>Alternaria</i> sp., <i>Fusarium</i> sp. In damping off disease of vegetables, Root knot nematode in vegetables
2.	<i>Trichoderma viride</i>	<i>Plasmodiophora brassicae</i> in brassicas, <i>Rhizoctonia solani</i> f. sp. <i>sasakii</i> in BLSB of maize
3.	<i>Trichoderma harzianum</i> (T22)	<i>Bipolaris sorokiniana</i> in wheat, <i>Rhizoctonia solani</i> f. sp. <i>sasakii</i> in BLSB of maize, <i>Meloidogyne</i> sp. in tomato
4.	<i>Trichoderma</i> spp. (A23)	<i>Bipolaris sorokiniana</i> in wheat
5.	<i>Paecilomyces lilacinus</i>	<i>Meloidogyne</i> sp. in tomato, <i>Plasmodiophora brassicae</i> in brassicas
6.	<i>Pestalotopsis</i> sp.	<i>Sclerotinia sclerotiorum</i> in cauliflower
7.	<i>Pseudomonas fluorescens</i> <i>Pseudomonas</i> sp.	<i>Meloidogyne</i> in tomato, <i>Plasmodiophora brassicae</i> in brassica
8	<i>Trichoderma asperellum</i>	Clubroot in cauliflower

Botanical extracts using against Plant diseases

SN	Botanical extract	Plant diseases
1.	Extract of garlic 1%	Club root disease and viral disease complex
2.	Application of cow milk @ 25m/l water	<i>Viral disease complex in vegetables</i>
3.	Extract of timur (<i>Zanthoxylum armatum</i>) 1%	<i>Leaf spot disease</i>
4.	Extraction of Bougainvillea 10%	<i>Viral disease in vegetables</i>
5.	Black pepper Extract 1%	<i>Leaf spot diseases</i>
6.	Extract of clove 1%	Bacterial wilt, <i>Sclerotinia sclerotiorum</i>
7.	<i>Asparagus root 1%</i>	<i>Alternaria leaf spot diseases, Rhizoctonia solani</i>
8.	Tete-pati (<i>Artemisia vulgaris</i>) and Ashuro (<i>Justicia adhatoda</i>) 10%	Soil borne diseases
9.	<i>Eucalyptus leaf extract 10%</i>	Leaf spot and foliar blight in vegetables
10	<i>Tejpat or bay leaf (<i>Cinnamomum tamala</i>) extract 1%</i>	<i>Rhizoctonia solani, Sclerotium rolfsii</i>
11.	<i>Mustard cake @ 50g/ plant</i>	Root knot nematodes

Genotypes Screening against various plant diseases

S. N.	Crop	Diseases	Genotypes (Tolerant to Resistant)
1.	Rice	Blast (<i>Pyricularia oryzae</i>)	Khumal – 10, Chandannath 1,2,3, Lekali 1, 3 (Hill) Parawanipur 1, Laxmi, Khajura 2, Chaite 2, Hardinath 2, Shwonna, Sukkha dhan 1,2 (Plann/Terai)
		Bacterial blight (<i>Xanthomonas oryzae</i>)	Sukha dhan 1-6, Radha 4, 7, 11, Hardinath 1, Chaite 2, 4, Khajura 2, Laxmi, Sworna sab1, Shamba Mansuli sab 1
2.	Maize	Gray leaf spot of maize (<i>Cercospora zae</i>)	Manakamana-1, Manakamana -3, Manakamana -6, Ganesh 1, Deuti, Exotic lines: SADVI 05, SADVI 07, ZM 627, ZM 525
		Northern Leaf blight (<i>Exserohilum trubicum</i>)	Ganesh 1, Ganesh 2, Mamnakamana 3, Manakamana 7, Manakamana 9
		Stalk rot of maize (<i>Pythium aphanidermatum</i>)	Manakamana 1,3, Deuti, Rampur Composite
3.	Wheat	Yellow rust (<i>Puccinia striiformis</i>)	Pasang Lhamu, Chyakhura, Khumal Shakti. Mudule 1, Himganga, Bheri ganga, Suruma, Tila
		Leaf rust (<i>Puccinia triticina</i>)	Borlaug 2020, Zinc 1, Zinc 2, Dhaulagiri
		Stem rust (<i>Puccinia gramini tritici</i>)	Bijaya, Triloctamma, Francoline, Chyakhura, Borlaug 2020
4.	F. millet	Sheath blight (<i>Rhizoctonia solani</i>)	Kavre kodo 1, 2, Shailunge kodo 1
5.	Lentil	Rust (<i>Uromyces fabae</i>)	ILL 7723, ILL 7164, Shikha, shimal, Sagun, Khajura 2
		Stemphylium blight (<i>Stemphylium botryosum</i>)	ILL 7723,IIL 7986,ILL 8188, ILL 9993, Masuro 4, Meheshwor, Shikhar, Shimal, Sagun, Khajura 1, 2, Bharati
6.	Coffee	Rust (<i>Hemileia vastatrix</i>)	Catimor, Ketisic, selection-10

Genotypes Screening against various plant diseases

SN	Crop	Diseases	Genotypes (Tolerant to Resistant)
1.	Chilly/Pepper	Blight (<i>Phytophthora capsici</i>)	NS 1701, Super Tara, Angarika
2.	Cauliflower	Club root (<i>Plasmodiophora brassicae</i>)	Clapton A, Clapron B, Clarify A, Clarify B
3.	Cabbage	Club root (<i>Plasmodiophora brassicae</i>)	Kilaberb, Tekila, Kalitn, Kilaherb, Kilaxy, Kilazol
		Black rot (<i>Xanthomonas campestris</i> pv. <i>campestris</i>)	Defender, Tropicana, Constanza, Green crown, Green coronet
4.	Mustard	Alternaria blight (<i>Alternaria brassicae</i>)	T-9, Bikash, Lumle 1, Pusha bold, Krishana, Pragati
5.	Tomato	Bacterial wilt (<i>Ralstonia solanacearum</i>)	N- 162, CLN 2026 C, CLN 2026 D, Kabita, Makis, Amita, Mamita, Platinum 701, CLN 2545 B
		Rootknot nematodes (<i>Meloidogyne</i> spp.)	VFN 08, Grafting with root stock of Wild brinjal (<i>Solanum sysimbriifolium</i>)
6.	Potato	late blight (<i>Phytophthora infestans</i>)	CIP 389746.5, 392797, 395443.103, 395017.229 PRP 266264.5, 276264.1, 136769.1, 276264.1
7.	Rayo	Club root	Marpha Rayo

CHALLENGE/SCOPE OF PLANT PATHOLOGICAL RESEARCH

S. N.	Causes	Effects	Outcomes
1.	Open border – (Informer and Former Trade)	Chances of Introduce of new pest/ QPs	Outbreak of new diseases/pathogens
2.	Introducing of high yielding cultivars/genotypes - Hybrid	Susceptible for minor pests become major	Out break of new diseases/pathogens
3.	Introducing of crops (new crops or genotypes)	Susceptible/host for minor pests	Outbreak of new pathogens/ diseases
4.	Climate (Sub-Tropical to Temperate)	Spread of pests in different locations	Establishment of Pests
5.	Cultivation practices - (plastic tunnel, drip irrigation)	Adverse effect to beneficial organisms, Congenial environment to pathogen/s	Establishment of Pathogen/s
6.	Injudicious use of (Pesticides and fertilizer)	Toxicity on plant and soil, adverse effect on environment, Persist resistant against pesticide	Reduce the production and Productivity
7.	High biodiversity (Wide host range)	Conducive environment for pest on different hosts	Establishment and spread of Pests

Role of Pathological Research on trade

Export and Import obligation on WTO agreement

Import

Detection of Pathogens



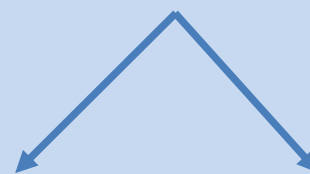
Detection of associated pathogens



Entry of Pathogen free products/consignments

Export

Identification of Pathogens



Disease management in cropping system

Identification of associated pathogen/s



Pathogen free products/consignments

- ❖ Survey and surveillance of pest and update national pest database
- ❖ Pest Risk Analysis (PRA)
- ❖ Support to NPPO for additional declaration, SPS certificate
- ❖ Preservation and maintenance of pathogens (*Repository centre*)

FUTURE NEED

- Establishment of reference laboratory for disease diagnosis and centre for advance studies for Plant Pathology
- Capacity building and Training
- Regular program on Survey and surveillance and regular update national pest data base
- Strengthen research for control of major threatening diseases of crops
- Climate resilient technology for disease control
- Strong linkage and co-ordination among Research, Extension and Education and NGOs and INGOs partners
- Use expertise of ex NARC/DOA/Universities/Others

THANK YOU