Effect of changing weather variables on the outbreak of legume diseases

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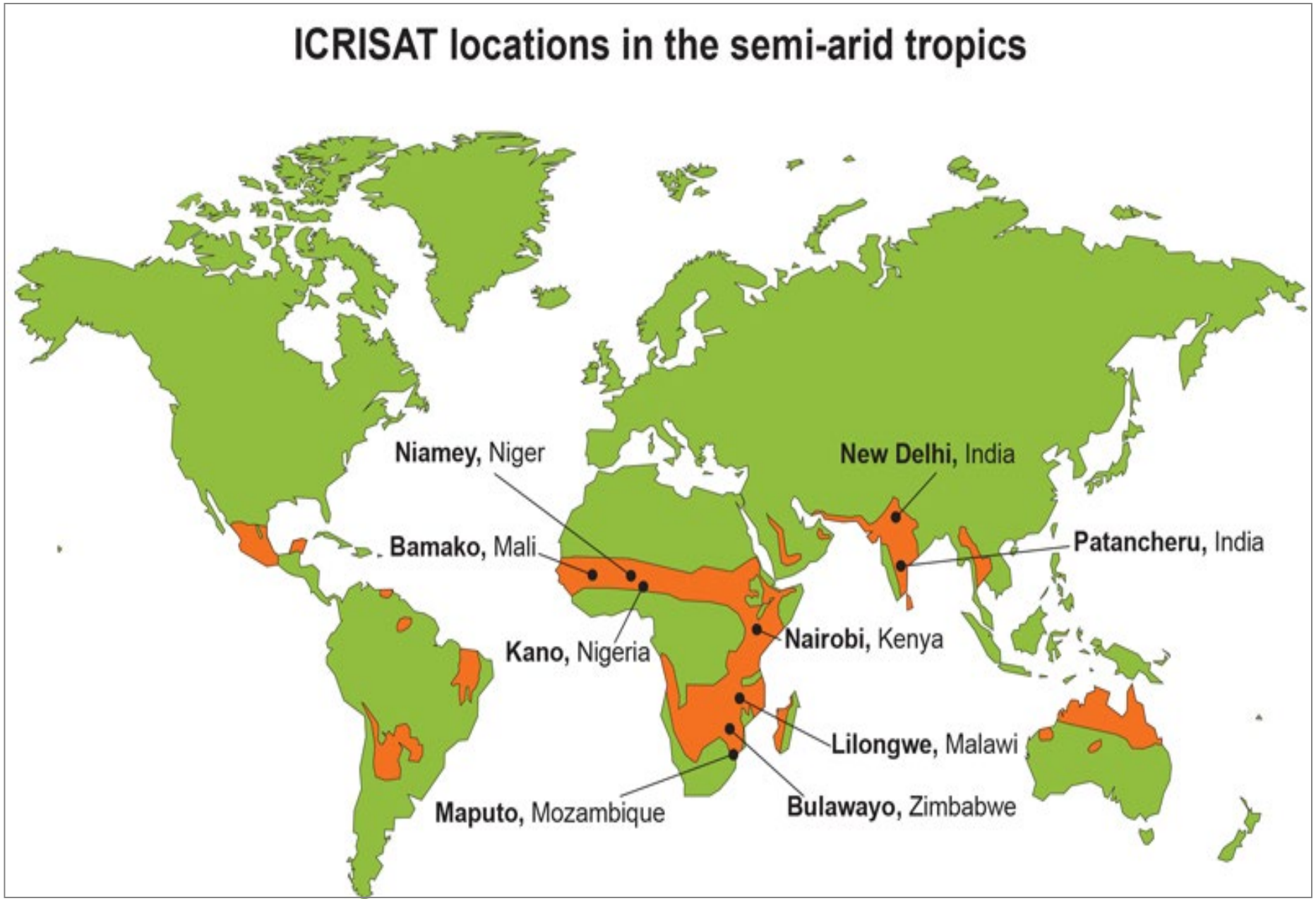
ICRISAT locations in the semi-arid tropics




Chickpea


Pigeonpea


Groundnut


Sorghum

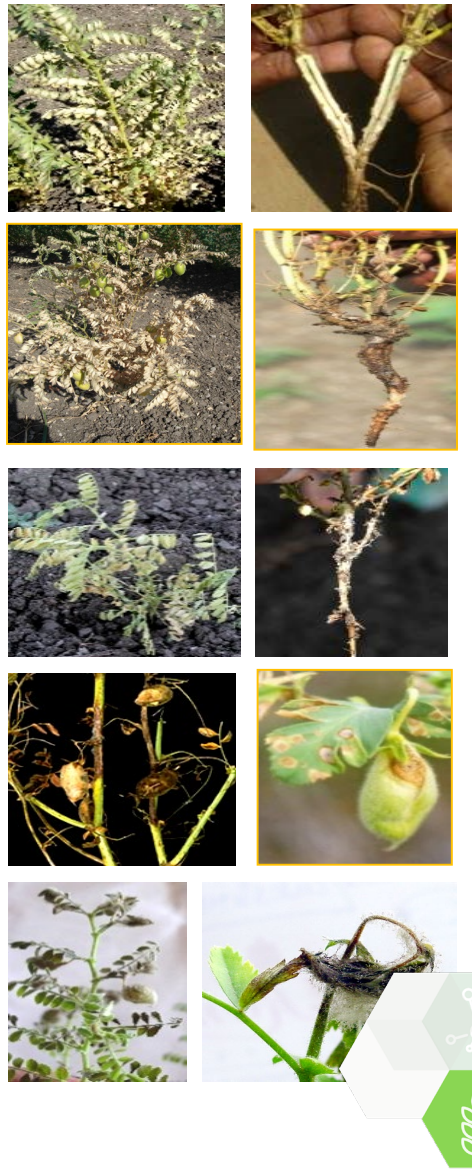

Finger millet


Pearl millet

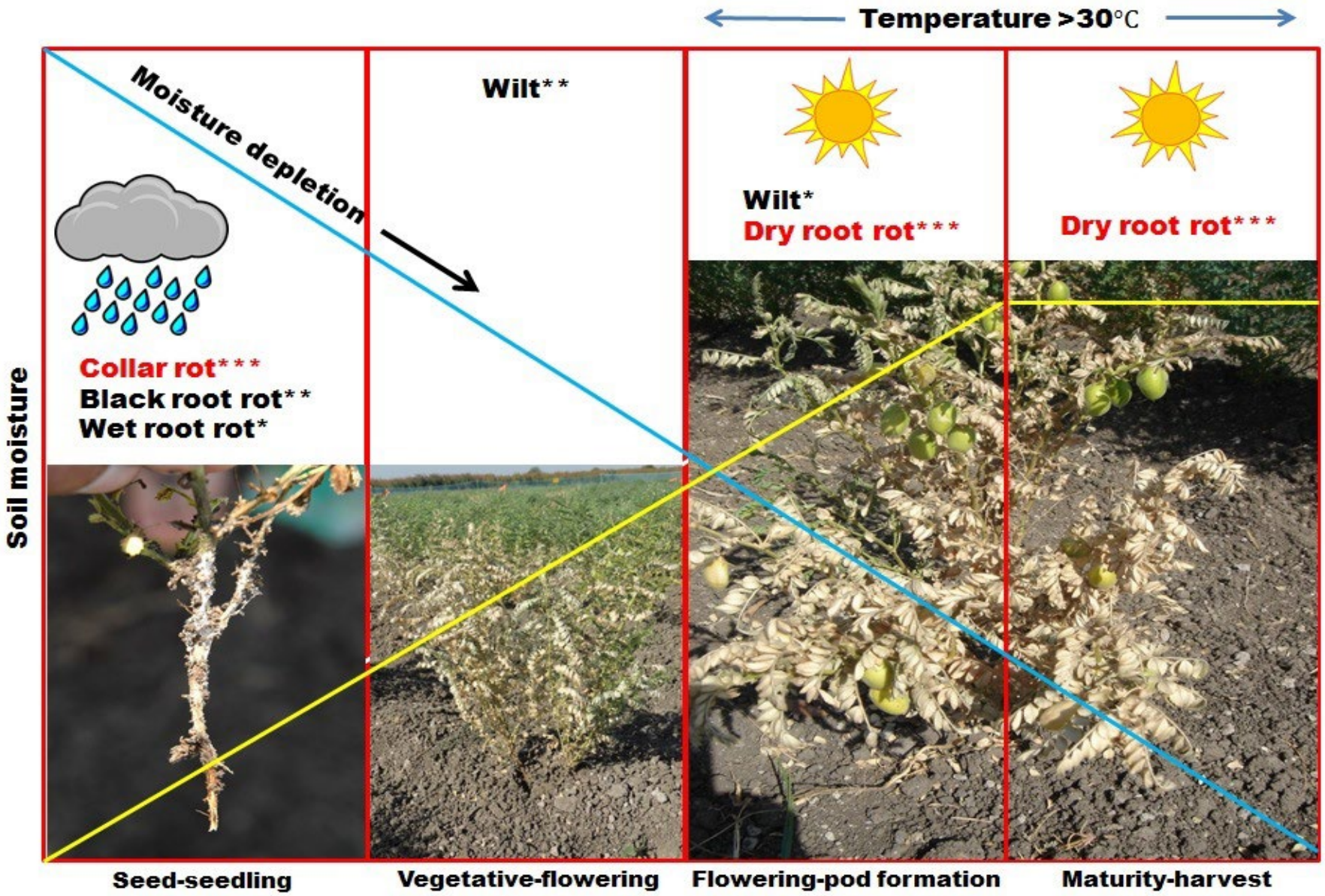
Changing scenario of diseases **in legumes - Chickpea and Pigeonpea**

Chickpea diseases: Global importance & Prioritization

Disease	Causal organism	Yield losses (%)	Priority	Importance
Fusarium wilt	*F. oxysporum* f. sp. *ciceris*	20-90	1	Complex: watch
Dry root rot	*R. bataticola*	10-60	2	Potential threat under climate change
Collar rot	*S. rolfsii*	10-40	3	Threat: Rice-chickpea
Ascochyta blight	*A. rabiei*	50-90	2	IGP and Ethiopia Sporadic
Botrytis gray mold	*B. cinerea*	50-90	5	Central & Eastern IGP-Sporadic



Heat & Soil Moisture Stress Differentially Impact Chickpea Plant Infection with Fungal Pathogens



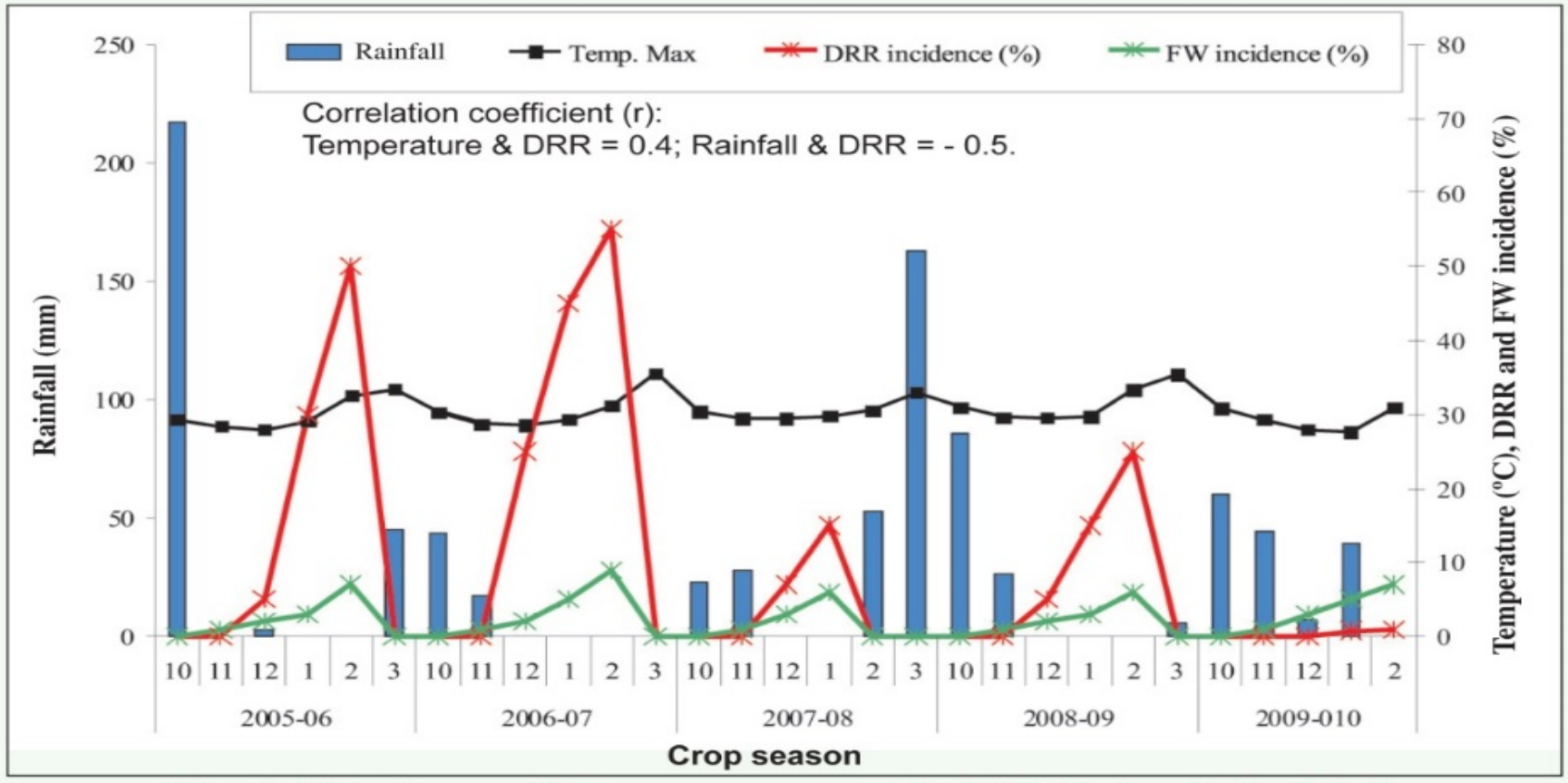
General scenario: wilt is predominant

Scenario 1: high soil moisture, collar rot is predominant

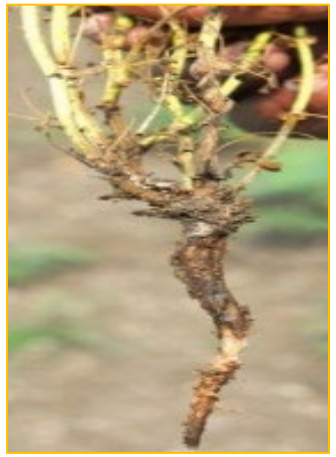
Scenario 2: high temperature and soil moisture stress; dry root rot is predominant

Shift in the occurrence & distribution

Higher risk of dry root rot in the years when the temperature exceed 30^0C coupled with soil moisture stress at the time of flowering and podding.

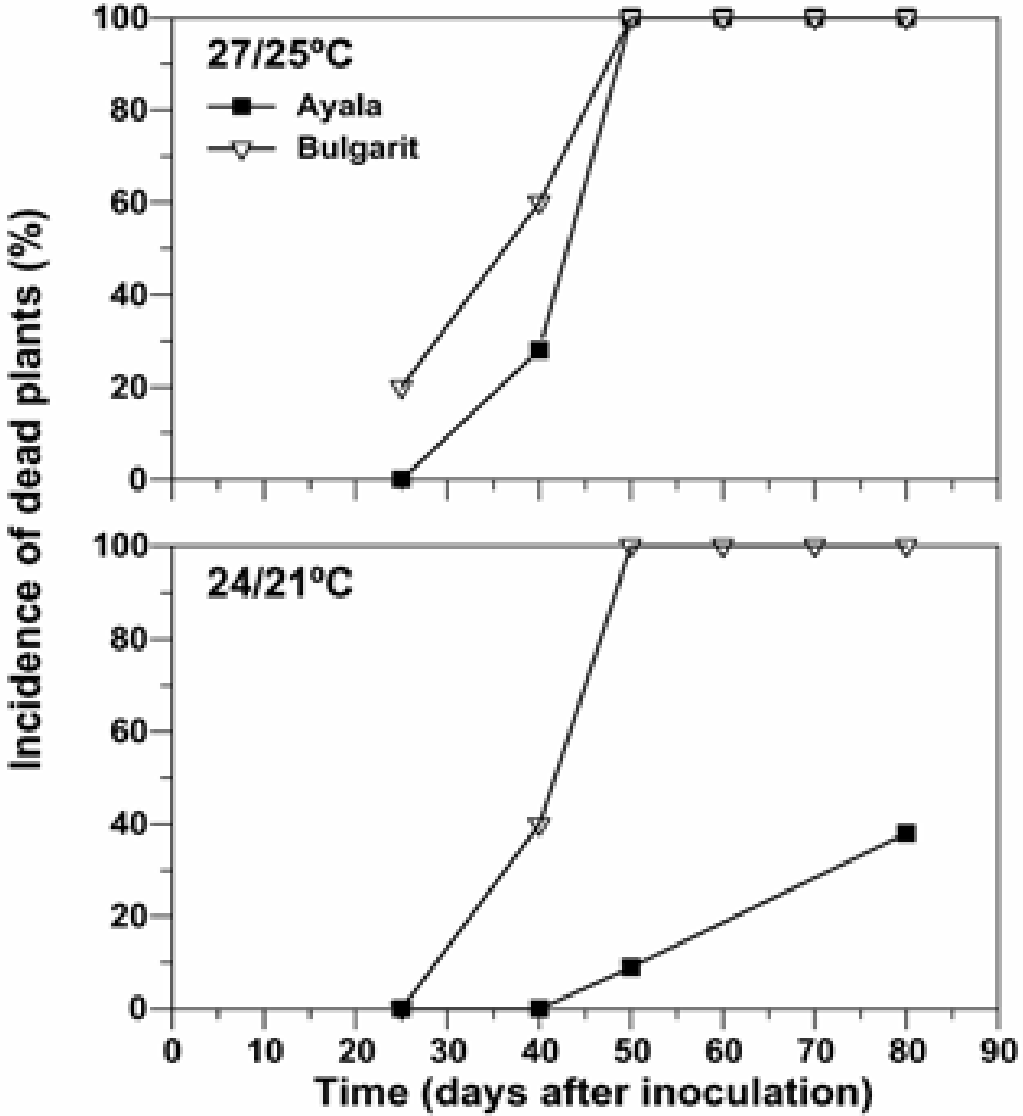


Sharma and Ghosh, 2017



Increased host susceptibility

Temp increase of 3°C from 24 to 27°C shifted the disease reaction of **Fusarium wilt resistant cultivar to susceptible in chickpea**



Pigeonpea: Emerging Diseases

Wilt (*Fusarium udum)*

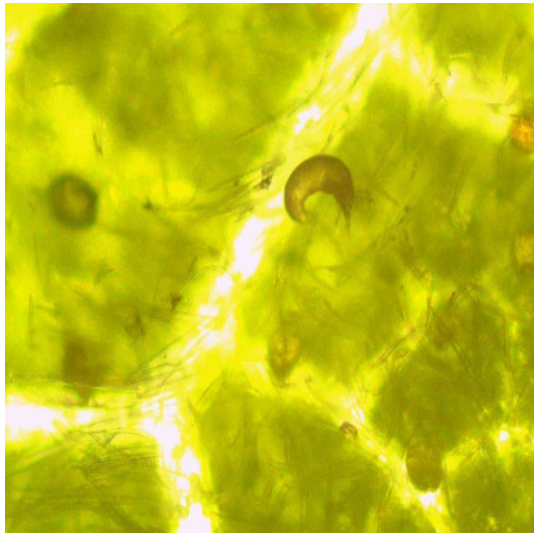
Sterility mosaic (*Pigeonpea sterility mosaic virus*)

Phytophthora blight (*P. cajani*)

Dry root rot /stem canker (*Rhizoctonia bataticola/Macrophomina*)

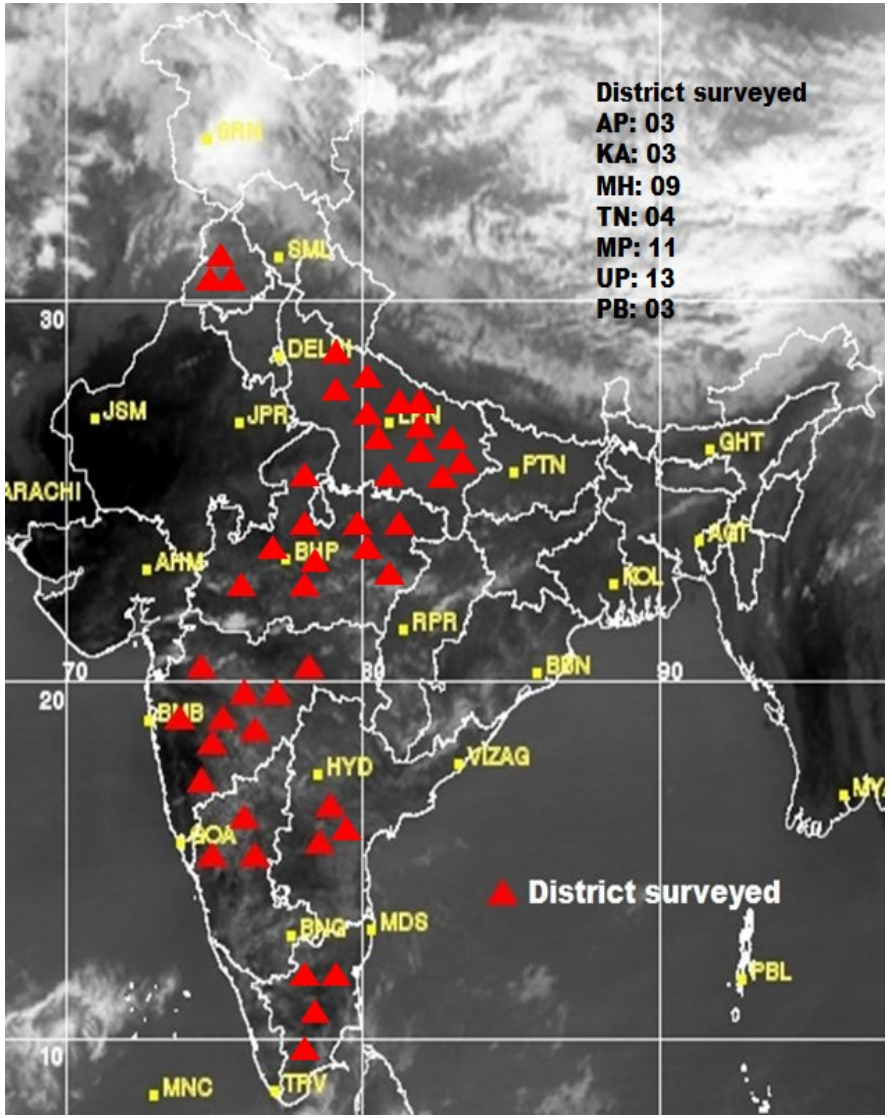
Collar rot (*Sclerotium rolfsii)*

Alternaria blight (*Alternaria tenuissima)*

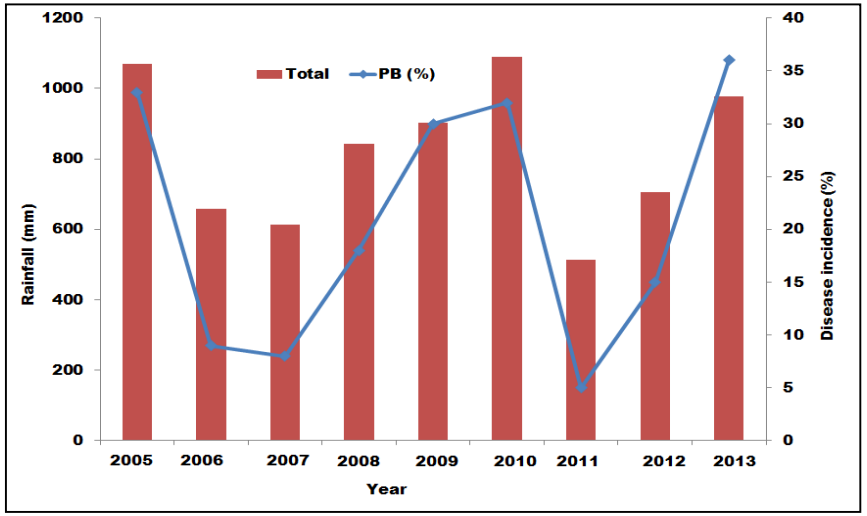


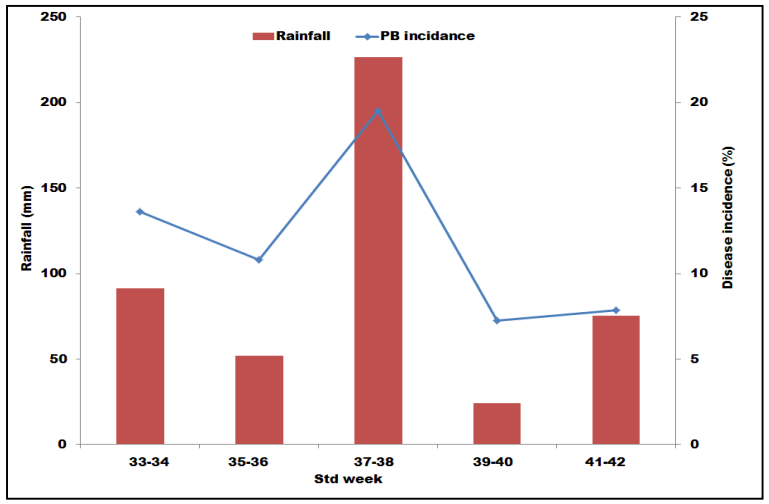
PB occurrence & distribution

State	Field surveyed (No)	PB incidence (% range)
AP	36	0 - 7.3
TS	111	0 - 75.5
KA	73	0 - 52.5
MH	228	0 - 42.7
TN	49	0 - 5
UP	97	0 - 20
MP	37	2 - 75
CG	19	2 - 12
PA	17	10 - 30
Total	667	0 - 75.5%

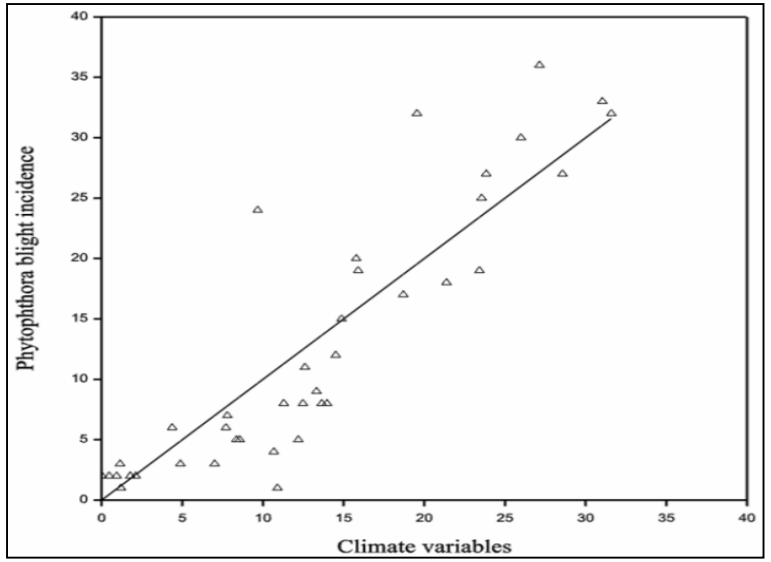


Phytophthora blight and weather variables





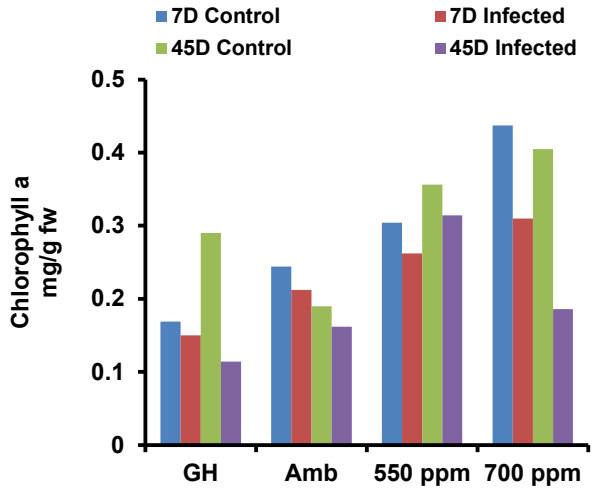
Weather parameters	Correlation
Rainfall	0.95
Temperature max	0.48
Temperature min	-0.42
RH max	0.92
RH min	-0.54

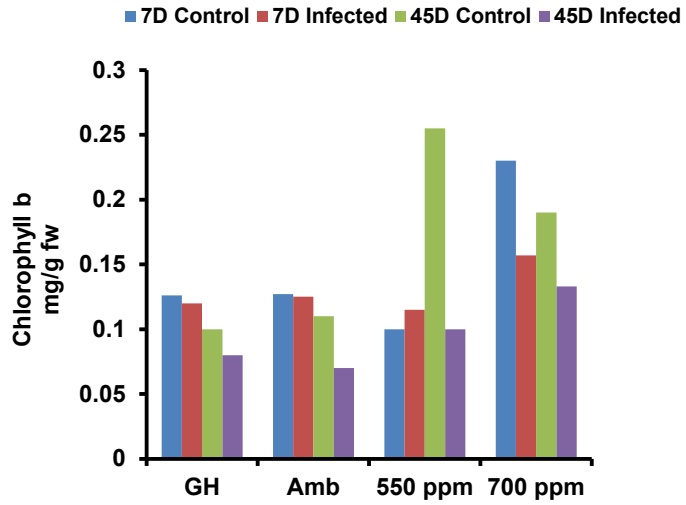


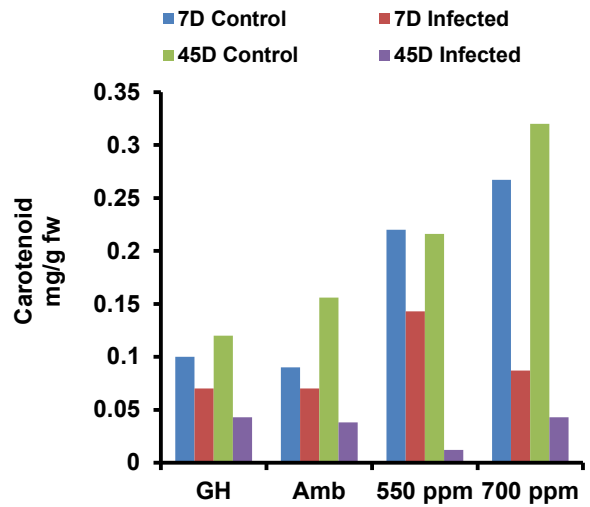
Effect of Elevated CO_2

Responses of SMD challenged pigeonpea

- Under elevated CO_2, SMD severity increased.
- Chlorophyll content, carotenoids and plant biomass increased in elevated CO_2 as compared to ambient.







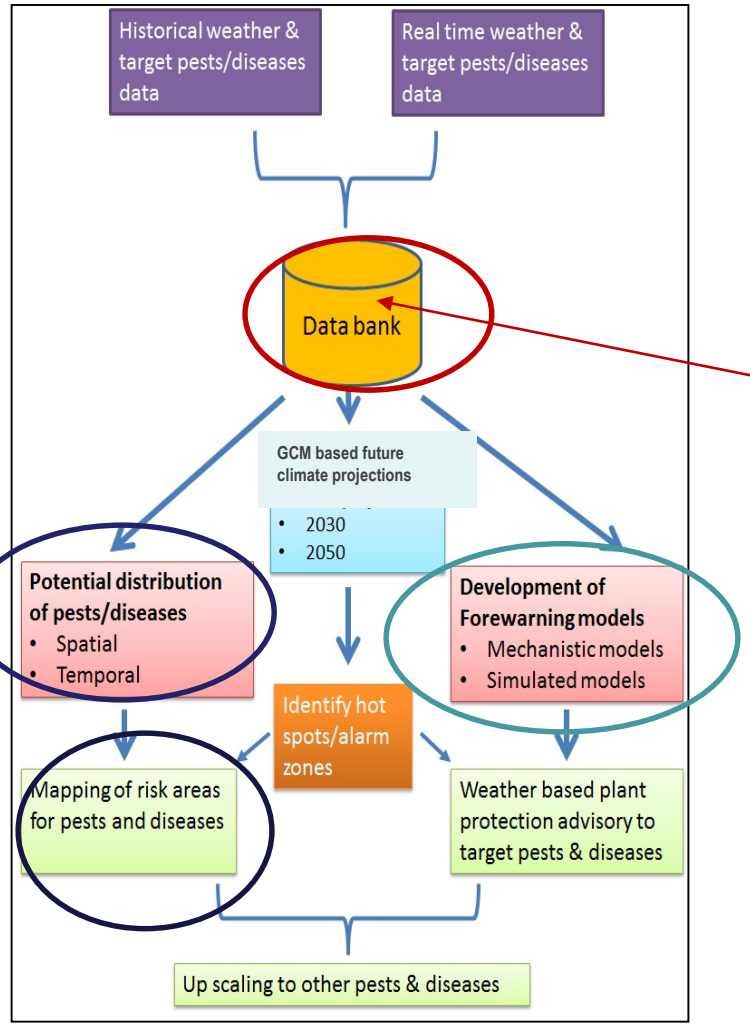
Centre of Excellence on Climate Change Research for Plant Protection (CoE-CCRPP)

Target insect pests and diseases

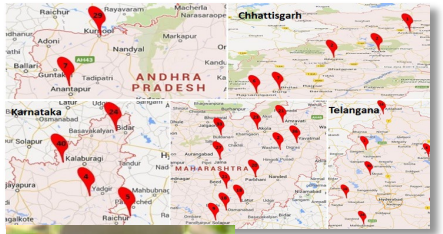
Mapping the spatial and temporal distribution

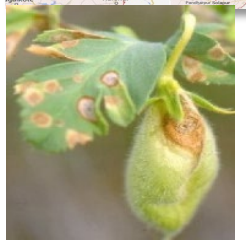
Target insect-pests and diseases	Crop	Critical crop growth stage	Critical weather	Responsible Institute*
Dry root rot (*R bataticola*)	Chickpea	Flowering to podding	High temp >30°C & soil moisture stress	ICRISAT
Phytophthora blight (*P. cajani*)	Pigeonpea	Seedling to flowering	High rainfall, hot & humid	
Pod borer (Maruca vitrata)		Flowering to podding	Rainfall coupled with high humidity with temperature >25°C	
Blast (*Magnaporthe oryzae*)	Pearl millet and Rice	All growth stages	Cool temp, high moisture, cloudy weather and dew.	ICRISAT IIRR
Plant hoppers (*Nilaparvata lugens*	Rice	All growth stages	Cold and dry or hot and wet	IIRR
Mungbean Yellow Mosaic Virus (MYMV)	Mungbean	Vegetative stage	Critical weather window is 29-33 SMW & max temp	PAU
Pink bollworm (*Pectinophora gossypiella*)	Cotton	Flowering to boll development	Max temp 33-34°C in 40th SMW, min temp <17°C in 44th SMW, humidity <70%	UAS
Diamond back moth, *Plutella xylostella*)	Crucifers	Flowering to podding	High temperature coupled with moisture stress	TNAU

Identification of risk areas for mapping the spatial &temporal distribution of diseases & insect-pests under a changing climate scenario

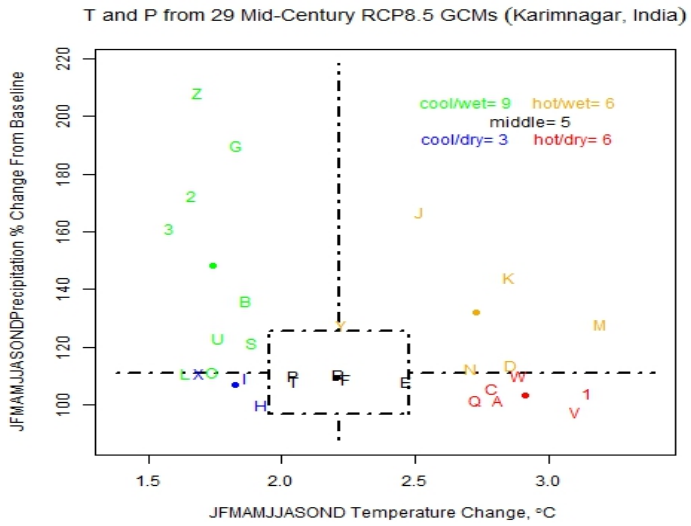


Real time surveillance



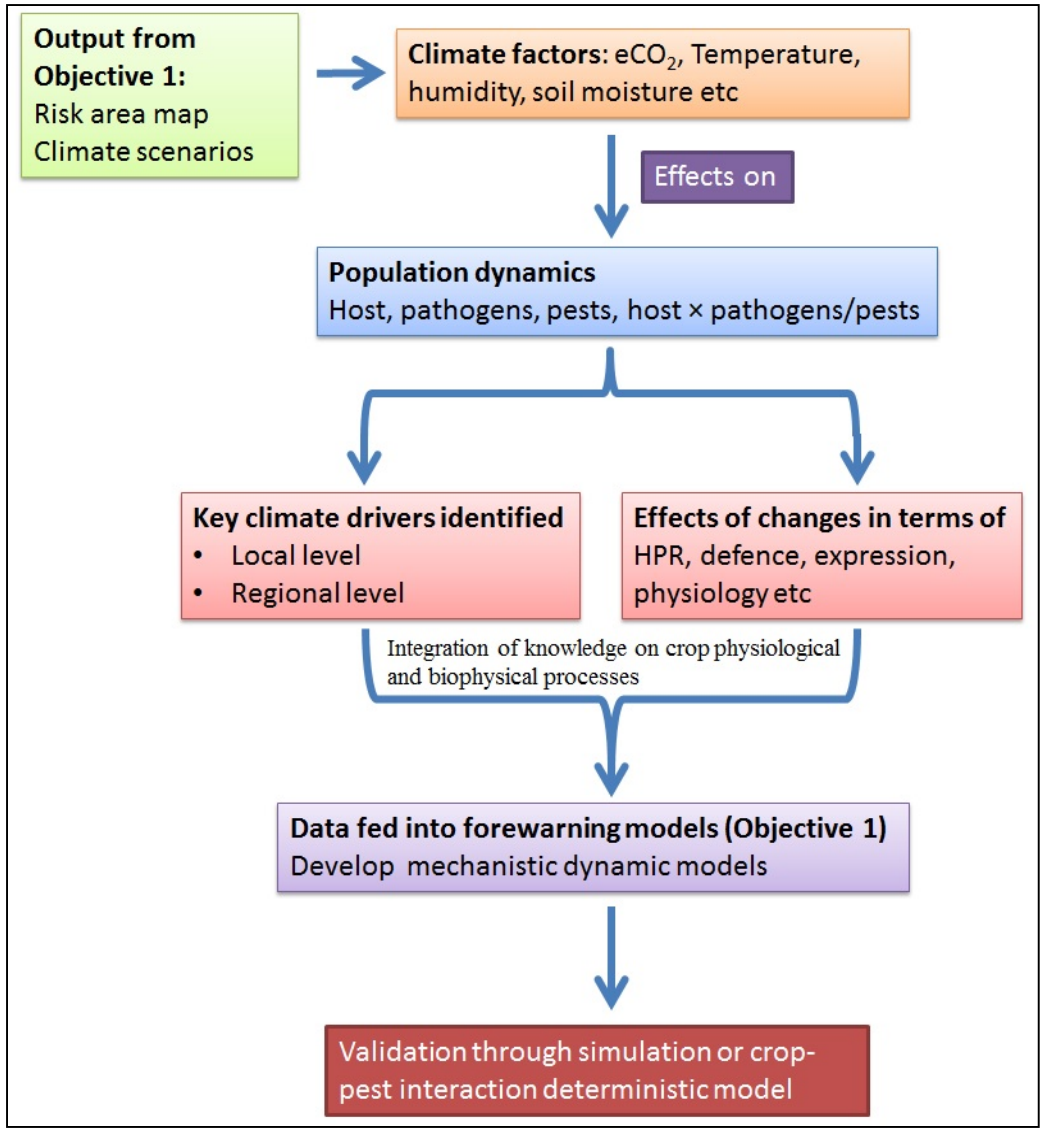


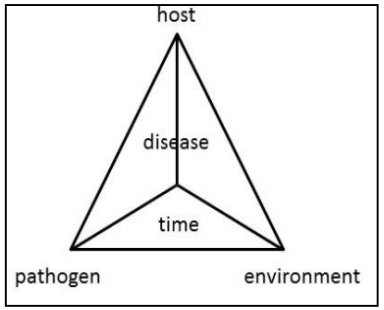
RCM/GCMs selection

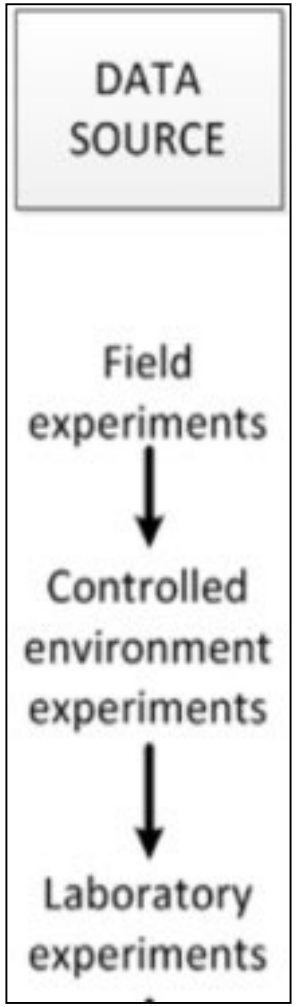


- Hot-Wet scenario
- Hot- dry - Pessimistic scenario
- Cool-Wet - Optimistic scenario
- Cool-Dry scenario

Host–insect-pests/pathogens interactions in relation to simulated climate variables







Parameters for process-based insect-pest/disease simulation models

Weather-based plant protection advisory tools for the timely management of diseases and insect-pests

Output from Objective 1:
- Potential risk areas
- Forewarning models

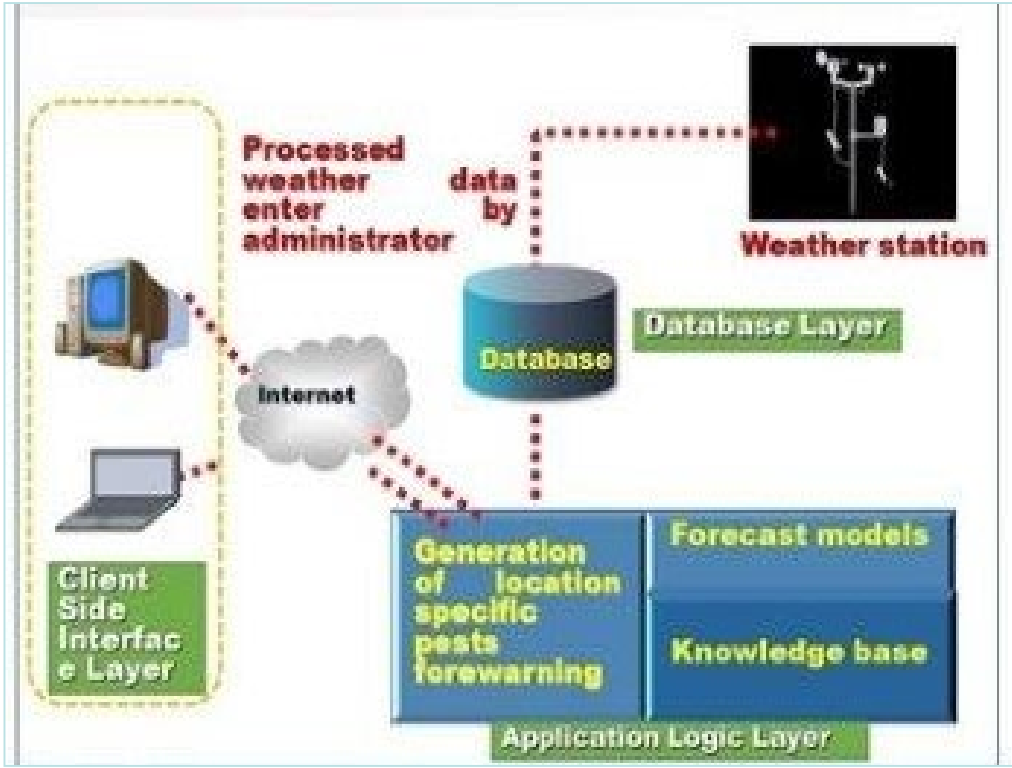
Output from Objective 2:
- Mechanistic dynamic models

Development of web based forewarning system

Linking decision support system with management practices

Validation
Dissemination

SAU's
KVK's
Farmers



Look forward from IPPRG

Data available:

- Available historical data of pests and diseases
- Multi-location data of few locations
- Information on crop, biology of pathogen and epidemiology of disease

Need:

- Mapping the potential geographical distribution of targeted pest and diseases
- Developing risk maps/identify risk zones
- Building capacity in the area of pest risk modelling

Thanks & Acknowledgements

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DST

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ICIPE, Kenya

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