

## Overview of Research and Development of Black Pepper in India

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### Cultivation of Black Pepper in India

As a mixed crop in homesteads in coastal and midland areas, trailed on various trees.

As a mixed crop in arecanut gardens in valleys in midland areas.

As a mixed crop in coffee and tea plantations in highland areas.

As a pure crop in midland and highland areas.

> 95% of black pepper is grown as a mixed crop, predominantly (> 80%) by small (<0.5 acre) and medium (0.5–2.0 acres) farmers.



### Constraints - Productivity of Black Pepper in India

Predominance of senile plantations  
Cultivation of inferior genotypes  
Non-availability of improved planting materials  
Non-adoption of scientific cultivation practices  
Changing climatic factors  
Infestation by pests and diseases  
Low price and poor financial status of farmers



### Organizations – Research and Development of Black Pepper

#### Research

Indian Institute of Spices Research  
(Indian Council of Agricultural Research)  
Calicut (Kozhikode) (Kerala)



Pepper Research Station  
(Kerala Agricultural University)  
Panniyur (Kerala)



Horticultural Research Stations  
Chintapalle (Andhra Pradesh), Dapoli (Maharashtra),  
Sirsi, Mudigere (Karnataka), Yercaud (Tamil Nadu)

### **Organizations – Research and Development of Black Pepper**

#### **Development**

**Spices Board**  
**Kochi (Kerala)**

**Directorate of Arecanut and Spices Development**  
**Calicut (Kozhikode) (Kerala)**

**National Horticulture Mission**  
**New Delhi**

**Department of Agriculture / Horticulture**  
**Kerala, Karnataka, Tamil Nadu**

### **Major Research Initiatives**

**Genetic Resources**  
**Crop Improvement**  
**Crop Management**  
**Crop Protection**  
**Post- harvest Management**

## Genetic Resources

Western Ghats : Centre of origin of black pepper

Collection : Farmers fields and biodiversity hotspots

### At Calicut

2062 Cultivated types

1266 Wild types

9 Exotic species



### At Panniyur

217 Cultivated types

72 Wild types

Ex situ conservation of germplasm

Field gene banks

In vitro gene banks (Endangered species)

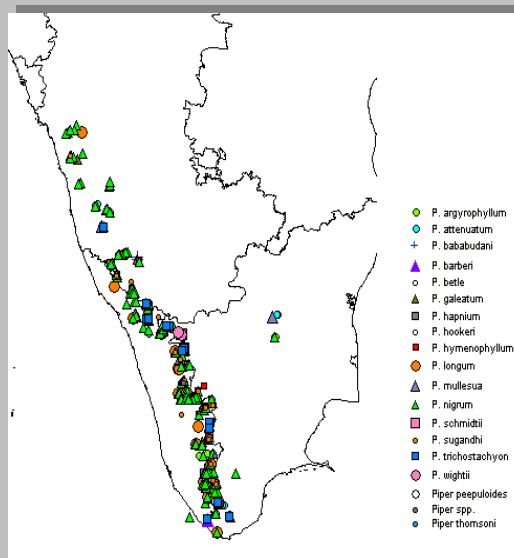


## Application of GIS

Distribution of *Piper* species in Western Ghats.

Understand pattern of genetic diversity.

Prediction of availability of *Piper* spp. during surveys.



Biodiversity of *Piper* spp.

## Characterization of Germplasm

Morphological basis - Using standard descriptor

Molecular profiling - Interrelationships

**RAPD, AFLP, ISSR**

Genetic fidelity testing

**Registration of germplasm**

National Bureau of Plant Genetic  
Resources, New Delhi

With unique traits - To meet requirements  
of IPR, breeder rights, farmers rights



## Evaluation of Germplasm

Yield

Quality

Drought

Pests and diseases

### Improved Varieties – IISR

Sreekara  
Subhakara  
Panchami  
Pournami  
PLD-2  
IISR-Thevam  
IISR-Malabar Excel  
IISr Girimunda  
IISR-Shakti



Developed for yield, quality and other traits

### Improved Varieties – KAU

Panniyur - 1  
Panniyur - 2  
Panniyur - 3  
Panniyur - 4  
Panniyur - 5  
Panniyur - 6  
Panniyur - 7



Developed for yield, quality and other traits

### Protection of Plant Varieties and Farmers Rights Act 2001

#### Distinctness Uniformity & Stability (DUS)

Guidelines developed based on 22 characters

IISR - Nodal centre for DUS testing



Effective system for protection of plant varieties, the rights of farmers and breeders and encourage the development of new varieties

#### Registration of varieties

Extant varieties released during the last 15 years can be registered



### Evaluation for Quality

#### Oleoresin, essential oil, piperine contents

Cultivars with high quality identified

Kottanadan, Kuthiravally, Kumbhakodi : Rich in oleoresin

Balankotta, Kumbhakodi, Kaniakadan : Rich in essential oil

#### Chemo-profiling of germplasm accessions

Composition of essential oil

Flavour compounds

Caryophyllene 10-22%

#### High caryophyllene lines identified

(Accs. 840, 971, 1019, 1022)



## Evaluation for Drought Tolerance

### Physiological parameters

RWC (high)  
 Cell membrane leakage (low)  
 Chlorophyll fluorescence (stable)  
 Catalase & Superoxide dismutase activity (high)

### Six lines short listed

KS 69, 51, 114, Accs. 813, 931, 1495

## Evaluation against Pests and Diseases

### *Phytophthora capsici*

1 variety (IISR-Shakthi) developed  
 1 line (P 24-04-01) being evaluated in the field  
 3 *Piper* spp. identified



### Nematodes

1 variety (Pournami) developed  
 2 lines (HP 39, 60) being evaluated in the field  
 3 *Piper* spp. identified

### Viruses

None identified

### Pollu beetle

4 cultivated types (Accs. 816, 841, 1084, 820) and  
 6 *Piper* spp. identified



*P. nigrum* grafted on  
*P. colubrinum*

## Breeding Strategies

### Clonal selection

(Sreekara, Subhakara, Panchami, Pournami, IISR-Thevam, Panniyur-4, Panniyur-6)

### Open pollinated progeny selection

(Panniyur-2, Panniyur-5, Panniyur-7, IISR-Shakti)

### Hybridization

(Panniyur-1, Panniyur-3, IISR-Girimunda, IISR-Malabar Excel)

### Breeding for

High yield, quality, high altitude areas

Drought, insect pest, nematode, disease resistance

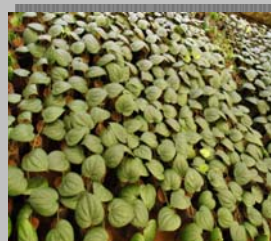
Convergent breeding programmes in progress

## Rapid Multiplication of Nucleus Planting Material

Split bamboo method

Serpentine method

Micropropagation



## Cropping Systems

Spacing - Standardized for various cropping systems

Mixed cropping systems developed - Increasing productivity

Coconut + Pepper, Arecanut + Pepper, Coffee + Pepper,  
Tea + Pepper, Cardamom + Pepper

Varieties suitable in cropping systems identified

Intercrops suitable in black pepper gardens identified

(Annual spice crops, Tuber crops, Fodder crops,  
Vegetable crops, Medicinal crops)



## Nutrition Management

Fertilizer schedules and foliar diagnostic norms standardized.

Integrated nutrient management technologies standardized.

Substitution of 50% inorganic NPK with farmyard manure  
and bio-fertilizers.

Critical levels of micronutrients for soil and foliage determined.

Organic farming technologies standardized.

Farmyard manure, neem cake, vermi-compost and bio-fertilizers  
as nutrient sources.

## Support Tree – Rhizosphere Interactions

### Popular support trees

*Ailanthus triphysa*, *Erythrina* spp., *Gliricidia sepium*, *Garuga pinnata*, *Grevillea robusta*.

Greater levels of soil organic C, microbial biomass-C, dissolved organic C & N, available N & P in rhizosphere of *G. sepium* & *G. pinnata*.

Tree rhizospheres positively affected soil enzymes (dehydrogenase, urease, acid phosphatase) involved in nutrient cycling.

*G. sepium* - Ideal tree species for restoration of degraded plantations and overall improvement in soil quality



## Climate Change

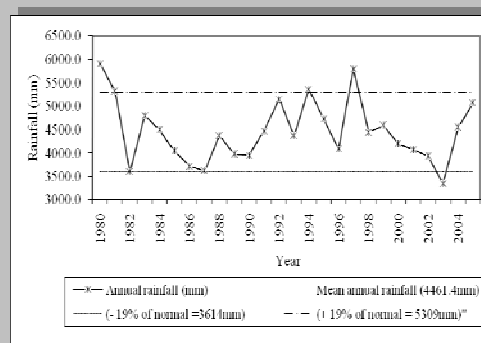
### Kerala (Peruvannamuzhi)

### Rainfall Pattern (1980-2005)

Normal range : 3614 - 5309 mm

Below normal range for 1 year

Above normal range for 4 years

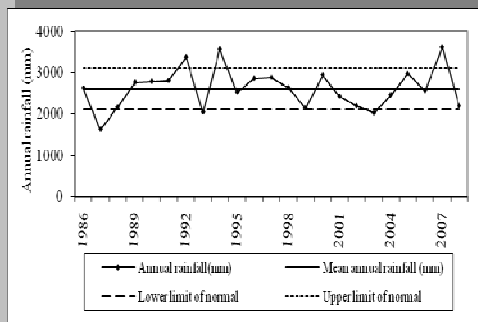


## Climate Change

### Karnataka (Kodagu)

#### Rainfall pattern (1986-2008)

Normal range : 2120 - 3115 mm  
 Below normal range for 3 years  
 Above normal range for 3 years

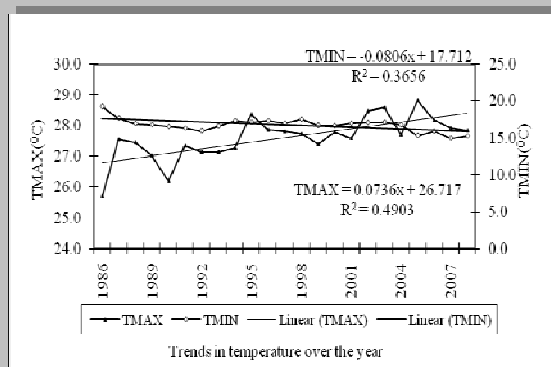


## Climate Change

### Karnataka (Kodagu)

#### Temperature (1986-2008)

Tmax: 23.8 - 31.7° C  
 Tmin : 13.4 - 19.1° C  
 Tmax increased by 0.8° C  
 Tmin decreased by 0.7° C



### Correlation Between Weather and Yield

#### At Panniyur

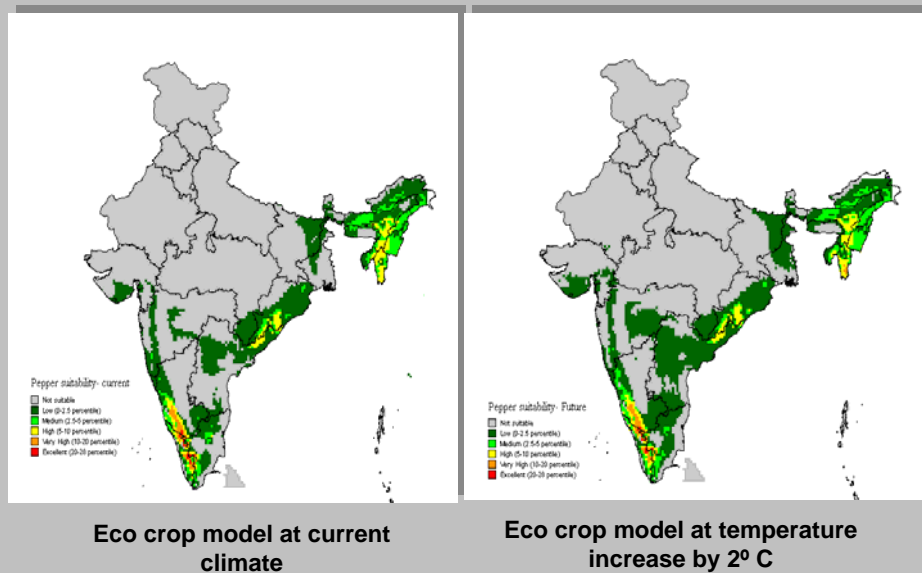
Rainfall of 70 mm received during May-June is sufficient for triggering flushing and flowering.  
Continuous showers during the next 16 weeks good for higher yield.

**Relationships between weather and yield:** Rainfall > Tmin > Tmax

#### At Kodagu

March-May rains had positive impact on productivity.  
Summer irrigation (March-April) - 50 litres/vine at fortnightly intervals enhanced the yield by over >100%.

### Impact of Climate Change on Black Pepper GIS Study



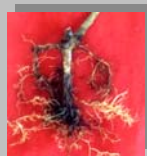
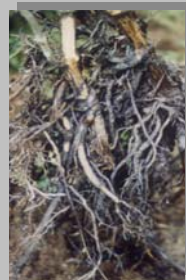
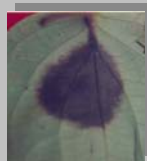
## Major Diseases

*Phytophthora* foot rot  
(*P. capsici*)

Slow wilt  
(*Radopholus similis*,  
*Meloidogyne* spp.)

### I P M Technology

Solarisation, Phytosanitation, Resistant lines,  
Cultural, Biological, Chemical methods



## Emerging Diseases

Stunt (virus) disease  
*Piper yellow mottle virus*  
*Cucumber mosaic virus*



Anthracnose  
*Colletotrichum gloeosporioides*



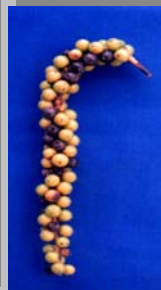
### Major Insect Pests

**Pollu beetle**  
(*Lanka ramakrishnai*)



**Scale insects**  
(*Lepidosaphes piperis*  
*Aspidiotus destructor*)

**Root mealybugs**  
(*Planococcus* spp.)



**I P M Technology**  
Cultural methods, Plant products,  
Biological, Chemical methods

### Emerging Insect Pests

**Erythrina gall wasp**  
On *Erythrina* sp. standards



**Termites**  
On silver oak (*Grevillea* sp.)  
standards



## Post-harvest Management

### Mechanization

Evaluation of threshers, dryers, graders

### Packaging systems

Monitoring of quality in packaging systems

### Pesticide residue management

Monitoring of produce



## Development

### Technology transfer

Capacity building of stake-holders

Micro-enterprise development

Agricultural Technology Information Centre  
Krishi Vigyan Kendra (Farm Science Centre)

### Pepper Technology Mission

Rejuvenation Programme for Pepper in Idukki District

Pepper Rehabilitation Package in Wayanad District



### **Future Thrusts**

Conservation of germplasm resources and their finger-printing.

Breeding varieties for high yield, quality and abiotic and biotic stress.

Diagnostics for production of disease-free planting material.

Soil-water-nutrient dynamics in sustainable production systems.

Sustainable IPM strategies for pests and diseases.

Post-harvest processing, value-addition, and storage.

Capacity building of farmers and other stake-holders.

**Thank You**