HOW TO PREVENT THE MOST SERIOUS DISEASES OF BLACK PEPPER (*Piper nigrum* L.)

A CASE STUDY OF VIETNAM

Nguyen tang Ton, Bui chi Buu
IAS, Vietnam

Phytophthora foot rot, considered the most devastating disease of black pepper causes an annual crop loss of 5-95%.

The highest level during May to November.
FOOT ROT

TYPICAL SYMPTOMS

- root rotted
- underground stem showing a brownish-black lesion

Sudden leaf wilting and dropping
Leaves turn black but still hang on the dying vines for weeks or months.
The disease progresses rapidly, especially during the rainy season, and the plant death occurs within 2-3 weeks.

BLACK PEPPER DEATH DUE TO PHYTOPHTHORA FOOT ROT
Main causes of foot rot of black pepper in major pepper growing areas of Vietnam

<table>
<thead>
<tr>
<th>Causes</th>
<th>Evaluation† (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff water from infected gardens</td>
<td>96.1</td>
</tr>
<tr>
<td>Soils of high humidity</td>
<td>68.6</td>
</tr>
<tr>
<td><em>Phytophthora capsici</em></td>
<td></td>
</tr>
<tr>
<td>Nematodes</td>
<td>31.3</td>
</tr>
<tr>
<td>Unbalance fertilization</td>
<td>27.4</td>
</tr>
<tr>
<td>Clean weeding</td>
<td>13.7</td>
</tr>
<tr>
<td>Susceptible cultivars</td>
<td>11.7</td>
</tr>
<tr>
<td>Mealy bug</td>
<td>5.8</td>
</tr>
<tr>
<td>Excessive irrigation</td>
<td>9.8</td>
</tr>
<tr>
<td>Inherent fungi</td>
<td>5.8</td>
</tr>
<tr>
<td>Bumping crop</td>
<td>3.9</td>
</tr>
<tr>
<td>Heavy rain</td>
<td>1.9</td>
</tr>
<tr>
<td>Deep planting, no ridging</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Note: † compared with normal case
Source: Nguyen Tang Ton, 2005

Slow Decline
- slow growth
- leaves turn to yellowish green, then pale yellow
- LEAVES gradually drop from the lower to the upper parts of the plant
• parasitic nematodes (Meloidogyne incognita, Radopholus similis)
• mealy bug (Pseudococcus citri),
• or infected with soil-borne fungi (Fusarium sp., Rhizoctonia sp., Pythium sp.) solely
• or in combination, especially when pepper plants are in nutritional disorder.
MEALY BUG

BLACK PEPPER INFECTED BY VIRUS DISEASE
DISEASE MANAGEMENT

- Since the foot rot and slow decline diseases are soil-borne and the causal agents have a wide range of host plants, especially commercial pepper varieties/cultivars resistant to these two diseases are not available.
- Therefore, successful management of these two biotic stresses needs a holistic approach.
- In setting integrated disease management (IDM), integrated pest management (IPM) and integrated crop management (ICM) strategies for black pepper, there is a need to examine and define effective practices of each component.

ICM

- Integrated management of Land-Water-Crop-Organism (pest and diseases)
  - Integrated
  - Interactive & Sinergistic
  - Participatory
  - Dynamic
Dynamic technology have to be evaluated and improved

Integrated Management of Land, Water, Crop, & Organism

Integrated Crop Management (ICM)

Participatory Based on need assessment farmers', aspiration & support from official

Interactive Technology component & Resources

1. Resource Efficiency
2. Pepper Productivity increase
3. Value added of pepper

VARIETAL IMPROVEMENT

1. No pepper variety resistant to foot rot and slow decline.
2. In Vietnam, Lada Belantoeng variety imported from Madagascar in 1947, showed rather high tolerant to foot rot (Phan Huu Trinh et al., 1988).
3. Karimunda and Panniyur 1 imported from India during the early 1990 show promising in the first 3-4 years after planting, less suppressed by foot rot and slow decline.
4. Vinh Linh and Tieu Trung varieties, their origin is unknown, perform well in many pepper growing regions with low incidence and yield loss from diseases. However, sometimes and somewhere there have been outbreaks of diseases, especially foot rot (Nguyen Tang Ton, 2005).
5. In Vietnam, farmers commonly use their own cuttings or cuttings from neighbors as planting material, this is a problem in the dissemination of latent infected planting material from fields to fields.
6. Grafting work using Phytophthora capsici resistant pepper as rootstocks and P. nigrum as scions was tested (Nguyen Tang Ton, 2010).
Poor drainage enhances the dissemination and outbreak of soil-borne fungi, especially *Phytophthora*.

**WELL DRAINED PRACTICE IS A KEY FACTOR.**

### CULTIVATION PRACTICES

**DRAINAGE & IRRIGATION**

*Less than 50% pepper orchards have good drainage systems in Vietnam*

Under canopy irrigation
“UNDER CANOPY” IRRIGATION SYSTEM

DRIP IRRIGATION
SOIL TREATMENTS

• The utilization of sun-dried soils mixed with *Trichoderma* treated manure in nursery shows effective against *Phytophthora* foot rot during the first two years after planting,
  – This helps to lower 22% of infected plants as compared with conventional method of seedling propagation (Nguyen Tang Ton, 2005).
  – However, the adoption by farmers is still limited due to permanent shading of nursery and unavailability of effective *Trichoderma* product in remote areas.
• Sun-drying of soils in the pits two month and the treatment of these soils with Bordeaux mixture one week before planting become more common to pepper farmers.
  – 78% of these farmers adopted this practice and the incidence of diseases decreased 22.8%.

Cover crops and mulching

To keep stable soil moisture in the dry season
To reduce water runoff in the rainy season
To enrich organic matter in soils and reduce upturning and breaking of soil surface
Cover crops and mulching

- wild groundnut (Arachis pintoi)
- Chinese wedelia (Wedelia chinensis)
- stylo (Stylosanthes guianensis)
- rice straw and dried weeds

Restricted Weeding

Clear weeding disturbs the ecology in pepper gardens, enhances water flow in the rainy season, and provides the opportunities for pests and diseases outbreaks, especially foot rot and slow decline.

Clear weeding also enhances soil erosion and nutrient washout in pepper orchards on sloping lands.
Support systems, pruning of live support and pepper plant

- Live support is used in almost newly established pepper orchards in Binh Phuoc province and in the Central Highlands.

- Diseases incidence and percentage of died plant from foot rot were lower in the pepper fields with live support as compared to dead wood standard, concrete and brick tower.

- Six live supports recommended, namely Cassia siamea, Wrightia annamensis, Leucaena leucocephala, Adenanthera pavonina, Glyricidia sepium and Gmelina arborea (Nguyen Tang Ton, 2005).

- From 3rd year after planting, pruning of live support three times a year, one month after the onset of the rainy season, mid-rainy season and one month before the dry season can limit support shading and provides a good environment for the growth and development of pepper.

- Three prunings reduce 2.3% died plant from foot rot as compared with two prunings (Nguyen Tang Ton, 2010).

PRUNING OF LIVE SUPPORT

Keo dâu support  Muống cuộm support  Trôm mủ support
Concrete support  Brick support  Dead wood standard support.

**Balance fertilization**

Appropriate proportions of N:P₂O₅:K₂O are 3:2:3 on Haplic Acrisols and 2:1:2 on Ferralsols.

**ORGANIC FARMING**

Thí nghiệm phân bón cho cây hồ tiêu gia đoạn kiến thiết cơ bản
Recommended fertilizer application

10-12 months after planting, pruning applied at 40-50cm apart from soil surface
## Prevention and control measures for foot rot and slow decline

<table>
<thead>
<tr>
<th>Prevention and control measures</th>
<th>Effectiveness† (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good drainage systems</td>
<td>94.1</td>
</tr>
<tr>
<td>Plant health maintenance</td>
<td>58.8</td>
</tr>
<tr>
<td>Organic fertilizer application</td>
<td>49.8</td>
</tr>
<tr>
<td>Balanced inorganic fertilizer application</td>
<td>48.3</td>
</tr>
<tr>
<td>Agro-chemicals and bio-fungicide application</td>
<td>47.6</td>
</tr>
<tr>
<td>Cover crops, mulching</td>
<td>39.8</td>
</tr>
<tr>
<td>Liming</td>
<td>33.3</td>
</tr>
<tr>
<td>Foliar fertilizer application</td>
<td>1.9</td>
</tr>
<tr>
<td>Limited upturning soil</td>
<td>1.9</td>
</tr>
<tr>
<td>Ridging, shallow planting</td>
<td>1.9</td>
</tr>
</tbody>
</table>

† compared with farmers’ practice  
Source: Nguyen Tang Ton, 2011
COFFEE AND PEPPER INTERCROPPING
CONCLUSIONS

• Five major species of fungi, in which *Phytophthora capsici* is the most destructive fungus; two species of nematodes and mealy bug / black pepper.
• Good drainage in the rainy season, water-saving irrigation including drip irrigation and under-shade sprinkler minimise the spread and contamination of diseases
• *Arachid pintoi* and *Stylosanthes* sp considered as the best mulching application
• Micro-organism products, namely *Trichoderma harzianum*, *Pseudomonas fluorescens* and *Bacillus* sp. help to limit the development of foot rot and slow decline

CÁM O’N

Thank You