Plant pathogens: Characteristics, The problems they cause, and Solutions

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Disease

1. Any disturbance in normal activity of the plant

2. It has an economic (or other) value

3. This includes both biotic and abiotic agents

Biotic Diseases

Caused by pathogens:

Bacteria

Fungi

Viruses

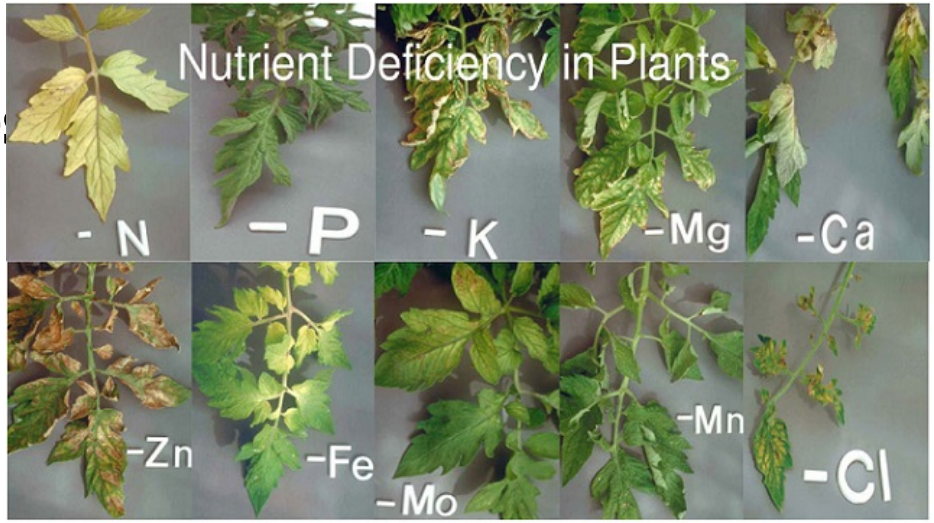
Nematodes

Late Blight of Potato– *Phytophthora infestans*

Late Blight of Potato– *Phytophthora infestans*

Abiotic diseases

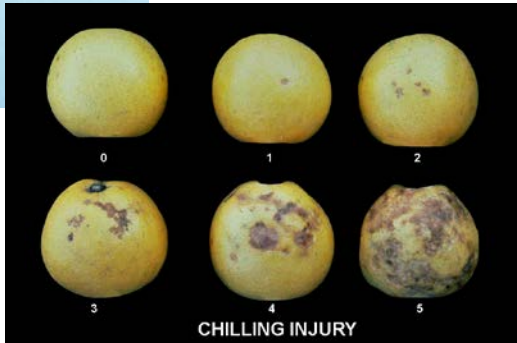
1. Mineral deficiencie



2. Pesticide

3. Climatic injuries

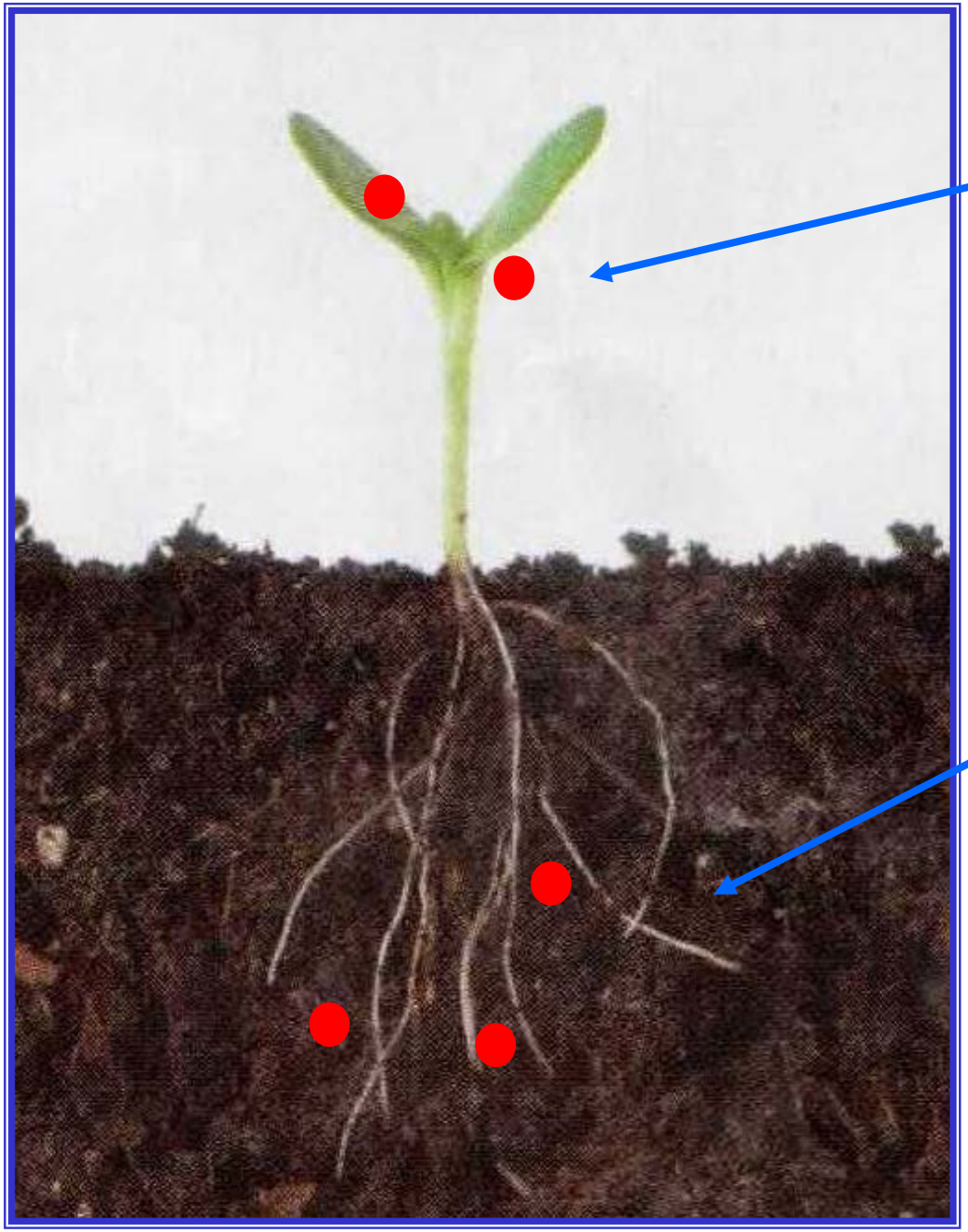
4. Mechanical effects



Pathogen

Host

Inoculum



Foliar diseases

Soilborne diseases

Major plant diseases

1. **Foliar diseases:**

   Airborne inoculum

   Control via foliar treatments

2. **Soil-borne diseases (root diseases)**

3. **Post-harvest diseases**

4. **Seed-borne diseases**

Foliar diseases

1. Spread during the season

2. Control

   1 – Chemicals (Fungicides, bactericides)

   2 – Biocontrol agents

   3 – Resistant cultivars

   4 - Cultural

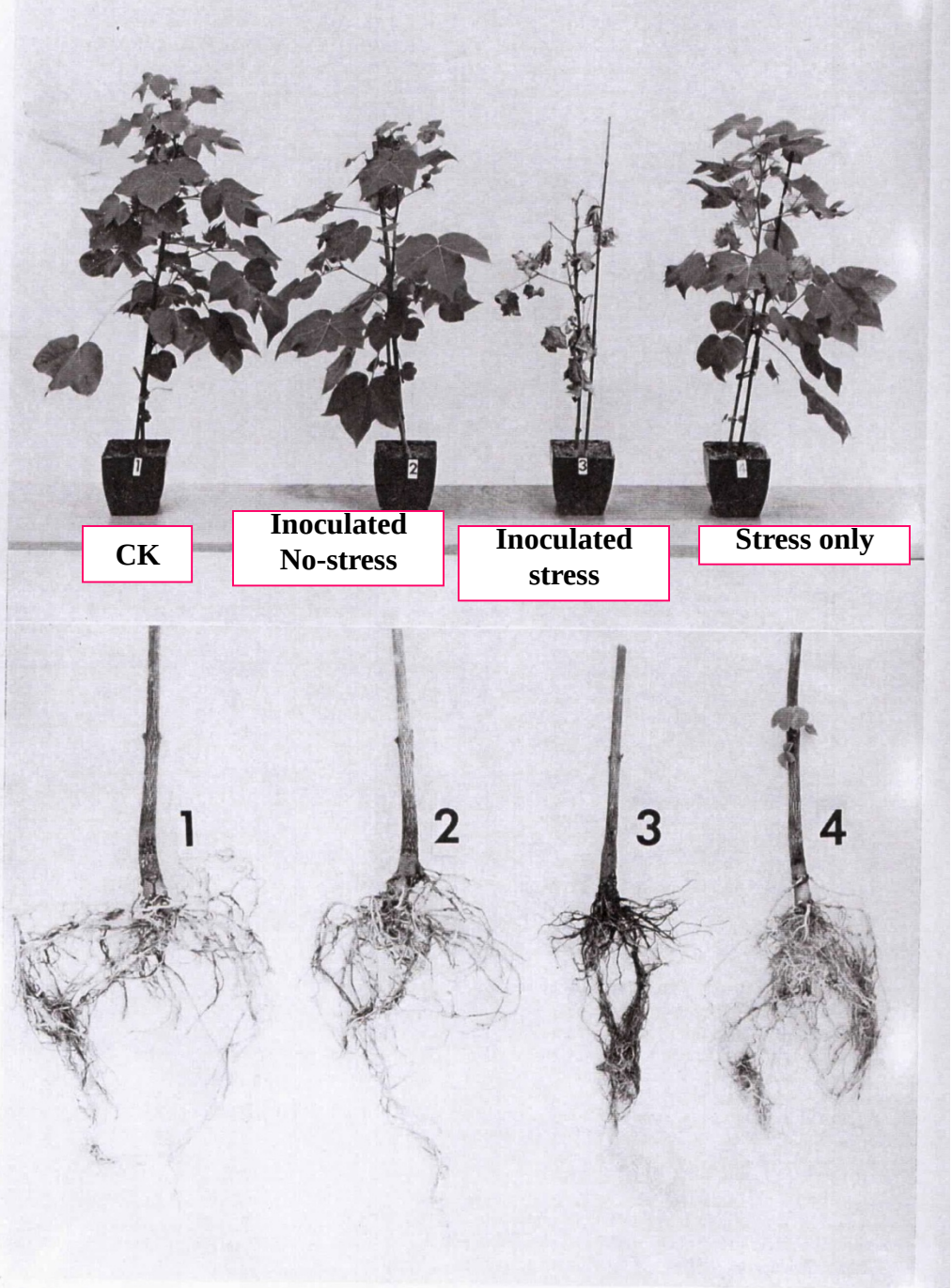


Fig. 1. The effect of water stress on the severity of root disease caused by *Macrophomina phaseoli* on cotton. Plants 1 and 2 were watered regularly. Plant 2 was inoculated with a suspension of mycelium. Plants 3 and 4 were subjected to water stress. Plant 3 was inoculated but plant 4 was not.

Effect of water stress:

Macrophomina in cotton

Therefore, irrigation can reduce the disease

Soil-borne diseases

1. Seedling diseases:

caused by Phythium, Rhizoctonia etc.

2. Wilt diseases:

caused by Fusarium, Verticillium etc.

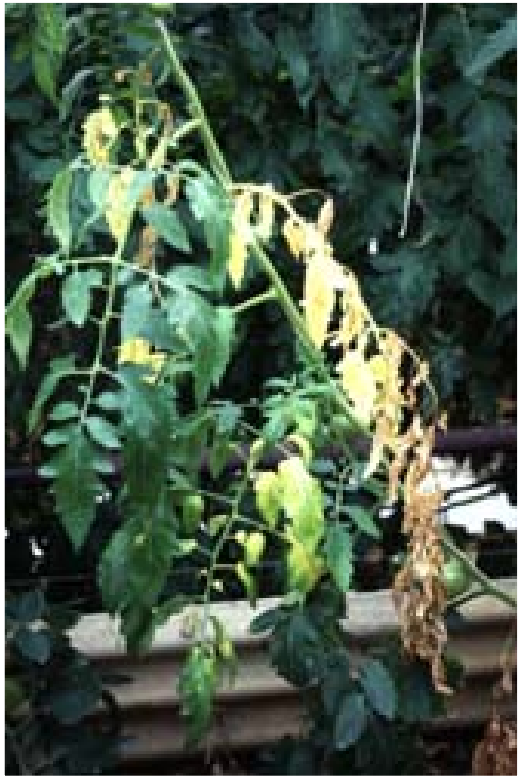
3. Root rots:

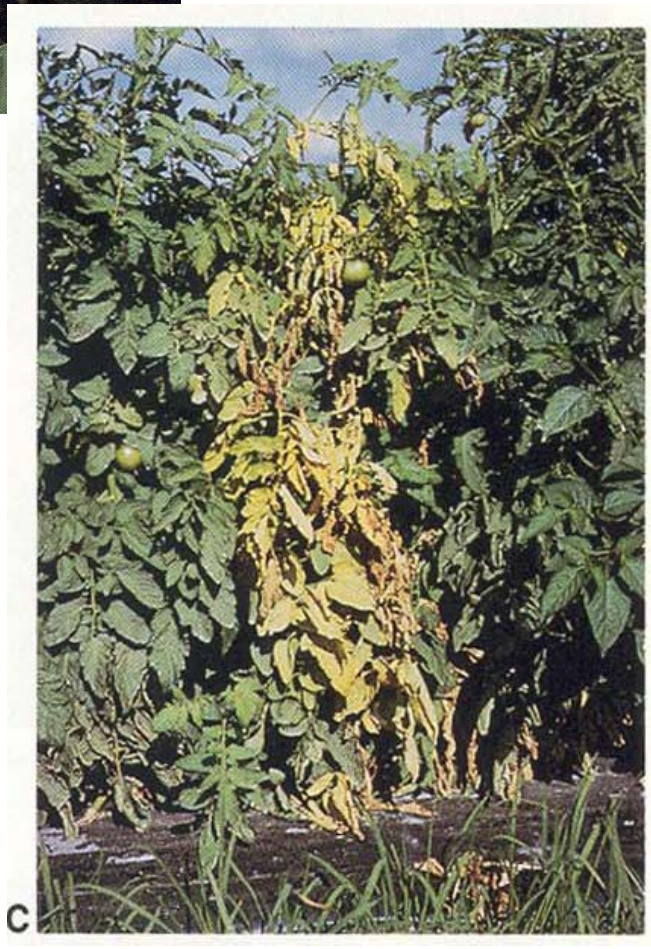
Caused by nematodes, Phytophthora etc.

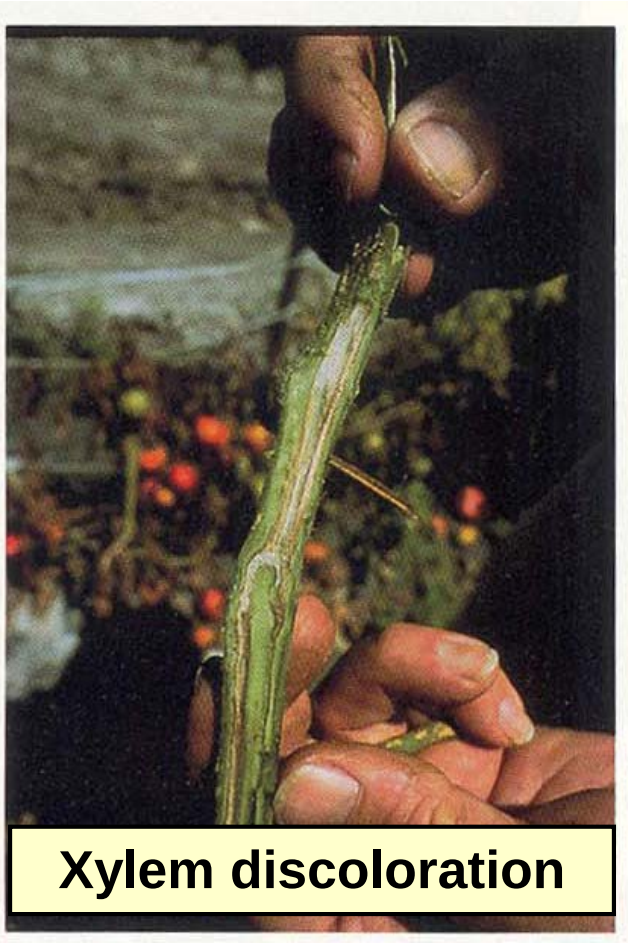
Fusarium Wilt – מגלת הנבילה בעגבניות

Fusarium oxysporum f. sp. *lycopersici* (FOL)

Fusarium wilt in tomato







Soil-borne (root) diseases

1. Caused by various pathogens from different groups: fungi, bacteria, viruses, parasitic plants

2. Nevertheless, these diseases share many common features

3. These pathogens are connected with soil

Spread (movement) of pathogens in space

1. These pathogens have only limited self movement in soil (few cm per year)

2. Nevertheless, these diseases spread within each field, from one field to another and from one region (or one country) to another

3. This, since there are many mechanisms for dispersal of these pathogens

Mechanisms of dispersal (spread) of soil-borne pathogens

1. **Propagation material:**

   seeds, bulbs, transplants, cuttings etc.

2. **Soil, via: machinery, water, wind**

3. **Water: furrow irrigation, recycled water in greenhouses**

4. **Airborne conidia**

Mechanisms of dispersal (spread) of soil-borne pathogens ...(cont)

5. Manure

6. Insects

7. Infected root and stem pieces

Survival

Resting structures

1. Long time survival.
2. Resistance to severe environmental conditions
3. Large mass production

Management of soilborne pathogens

(control)

The concept

Disturbing the disease cycle,

thus leading to economic reduction of disease,

with minimal disturbance of the environment

Comments

1. **Interference with any disease component:** ***killing of the pathogen is only one of the tools***

2. **Any disease reduction should be considered,** ***if it is economic***

3. **Environmental, social, legislative, and even political parameters, might be considered**

4. **Disease management *vs*-disease control**

Soil disinfestation

(not sterilization, not disinfection)

The concept:

- ***Treating the soil by drastic physical or chemical means to eradicate the pathogens (and weeds or other pests)***
- ***It has to be applied before planting, since it can kill the plants***
- ***It is effective only against inoculum existing in the soil; therefore,***
- ***It cannot control a pathogen contaminating the soil, after disinfestation***
- ***Thus, reinfestation of the soil, must be avoided***

Major approaches of soil disinfestation

1. **Physical:**

   Heating the soil, mainly by steam

2. **Chemical, mainly by fumigation:**

   Treating the soil with highly toxic chemicals which are either volatiles (e.g. methyl bromide) or in a solution (vapam, formalin)

   Usually the soil has to be covered with plastic sheets to delay the escape of the volatiles.

   It is the major approach used. Methyl bromide was the major fumigant used.

3. **Soil solarization**

   Heating the soil by solar energy (mulching with plastic)


Soil solarization
= Solar heating of the soil

The Idea:

Using solar energy (by plastic mulching of the soil) for heating the soil and killing the pathogens

The idea originated from extension people

Field experiments

Onion – Pink root

Carrot - *Orobanche*

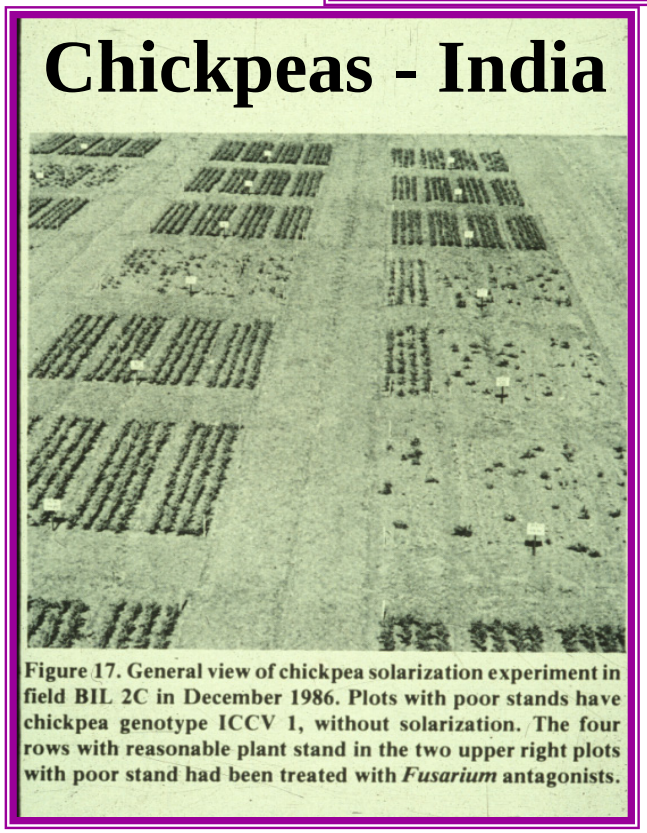
Soil solarization around the world:

THE WORLD

SOIL SOLARIZATION

Celery - Japan

Peru

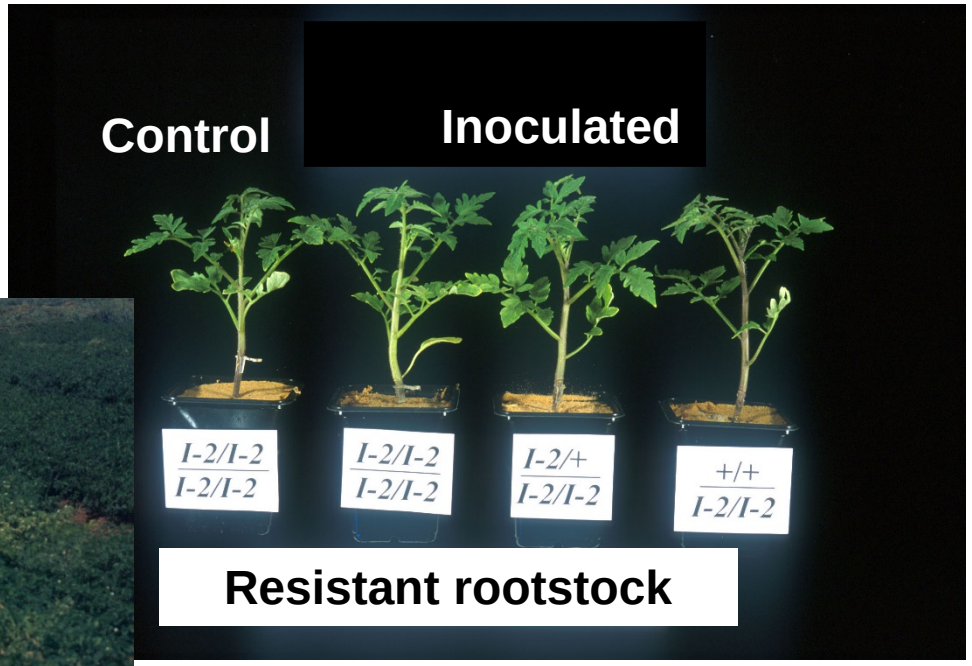


Chickpeas - India

Figure 17. General view of chickpea solarization experiment in field BIL 2C in December 1986. Plots with poor stands have chickpea genotype ICCV 1, without solarization. The four rows with reasonable plant stand in the two upper right plots with poor stand had been treated with *Fusarium* antagonists.

Disease management tools: Examples

1. Resistant cultivars and grafting



Resistant cultivars (varieties)

Advantages:

1. Very effective
2. Environmentally acceptable
3. No special technology needed
4. Long term (?)

Resistant cultivars (varieties) ...(cont)

Problems:

1. It takes many years to develop

2. Appearance of new physiological races

4. Compost

Well-prepared and mature composts, *of a certain source,* reduce disease

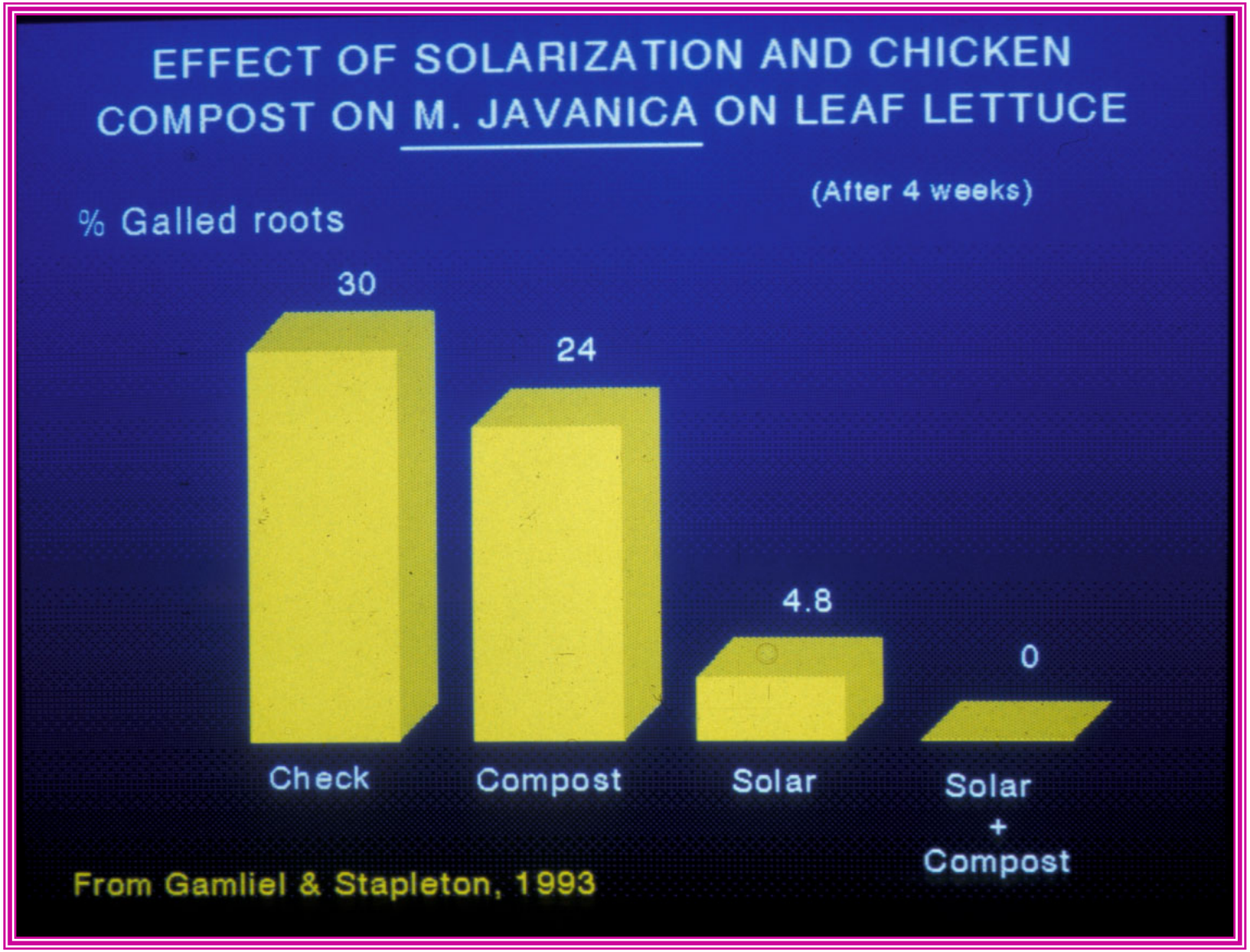
Compost does not reduce diseases in all cases

Effect of compost on Pythium in cucumber

2. Flooding - (Anaerobic soil disinfestation)

Panama disease (Fusarium) in Banana

Combining methods of control



Thank you for your attention