

Control of *Phytophthora palmivora* in organic cocoa in Southern Vietnam

The fungal genus of *Phytophthora* is the most important disease of cocoa worldwide, causing yield losses of up to 90 %. The cocoa tree (*Theobroma cacao*) is attacked by several different species of *Phytophthora*, in Asia the most important one is *P. palmivora*. This species can cause symptoms on the cocoa trees like canker, Black pod, leaf blight and sub-clinical root decay (Drenth, 2009).

Smallholders, who produce the largest share of cocoa worldwide, often face constraints regarding access to inputs. Botanical sprays or resistant cultivars could help smallholders, because they often do not imply cash expenditures. Therefore, the Mekong Delta Eco-Cocoa program (supported by the Swiss NGO Helvetas) worked with garlic as botanical spray and tested 83 cocoa clones available at research station level for resistance to *Phytophthora palmivora*.



Leaf necrosis Black pod Stem cancer

Garlic extract as a control measure of *P. palmivora* in organic cocoa

Garlic extract contains the agent allicin, which is produced in the cells of the plant, if the tissue is damaged. Allicin was tested successfully on its antifungal properties in several trials in the past. Therefore it was considered as a possible biological control of *P. palmivora* in organic cocoa.

Material and Methods:

Trials were first carried out in the laboratory to see the effect of garlic extract on the growth of *P. palmivora* and to find the minimal required concentration of garlic extract diluted with water to have an effect on *P. palmivora*. Carrot agar was mixed with diluted garlic extract in petri dishes and mycelium of *P. palmivora* was cultured on it. Then the diameter of the radial growing fungus was measured.

After having found the minimal dose required, a trial under field conditions on cocoa seedlings was carried out. The cocoa seedlings were sprayed with garlic extract and after 24 hours the seedlings were sprayed with zoospores of *P. palmivora* and then the leaves were rated on their infected leaf area.



Results and Discussion:

Pure garlic extract mixed with the agar had a very strong effect, no fungal growth could be observed. A minimal concentration of 0.2% garlic extract in water was needed to have an effect on *P. palmivora*. The trial on seedlings showed no significant results (although the seedlings treated with 0.5% of the extract showed the lowest infection). As the design of the trial shows several weaknesses, it is recommended to treat it as a pilot trial.



Conclusion and Perspective

The potential of garlic extract was clearly shown in the laboratory trials. The simple preparation and its harmlessness to human health make it an interesting agent. The different clones also show potential: there are differences in the susceptibility to *P. palmivora* among the 83 clones. Nevertheless there is a big scope of variation and improvement that could be used for future trials:

- Mixture of garlic extract with other agents
- Use of the extract as a soil drench or spot spray
- Trial on resistance in the field with natural infection
- Leaf screening tests could be done instead of tests on cocoa pods
- In order to obtain a holistic assessment of the treatments and their possible effect on the environment field trials involving farmers are highly recommended

Trial on the resistance of 83 cocoa clones to *P. palmivora*

In organic agriculture few fungicides are allowed to be used. Therefore breeding for resistant clones might be a solution to fight *P. palmivora* in organic cocoa.

Material and Methods

15 cocoa pods per clone were harvested and inoculated with *P. palmivora*, using paper discs soaked with zoospores. The pods were then kept moist and stored in plastic bags according to the method of Phillips-Mora. After 10 days the diameter of the biggest lesion on each pod was measured and an average was obtained for each clone.



Results and Discussion:

The results of the ranking according to Phillips-Mora is summarized in the following table.

Rank	Number of clones
Moderately resistant	5
Susceptible	11
Moderately susceptible	26
Highly susceptible	41

The diameters of each clone were analyzed with the Tukey-Kramer multiple comparison test. The test showed, that the diameters of most clones are not significantly different from each other. This indicates that the ranks of Phillips-Mora do not have a statistical difference. To avoid this problem, more pods per clone would be needed to make the significance groups smaller.