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PoH-MED

2013-2016

Project funded via the ARIMNet 2011 Transnational Joint Call

Highlights

Potato Health - Managed for Efficiency and Durability

- Potato is a major crop in Mediterranean countries, and a major trade product (seed; early ware) with high phytosanitary stakes. The PoH-MED project thus targets the sustainable potato protection in Mediterranean environments.
- To this end, it is built around three target activities: 1) To characterise pathogens and their adaptive patterns, 2) To identify and integrate innovative control measures, and 3) To transfer knowledge.
- The research activities carried out in PoH-MED allowed: 1) To show similar genetic structures in populations of major pathogens (*P. infestans*, *P. atrosepticum* and *R. solani*) in Europe and Northern Africa; 2) To identify promising candidates of natural origin (olive extracts, pathogen filtrates) for effective biocontrol, and 3) to set up demonstration trials for cultivar choice.

Potato
Disease management
System sustainability
Biodiversity
Transfer and dissemination

Objectives

- Potato is a strategic crop on both sides of the Mediterranean sea: it is both a wholesome food and industry source, a major cash crop, and an important object for trade (seed from Europe, early potatoes for fresh markets from Northern Africa).
- From an agronomic point of view, potato is vulnerable to a wide range of pathogens, and as such is subject to many pesticide applications, both on seed and during vegetation. Its inclusion in highly intensive systems (i.e. short rotations) involving (at least in southern countries) other Solanaceae (pepper, tomato, etc.) only reinforces this vulnerability.
- The aim of PoH-MED is to provide keys for a more sustainable protection of potato crops around the Mediterranean basin, by: 1) Understanding the distribution, genetic variability and adaptation abilities of major pathogens, 2) Discovering protection means more sustainable than synthetic pesticides, and 3) Disseminating knowledge and building capacity.

Scientific results & innovation potential

PoH-MED was intended to yield:

- ✓ Academic knowledge and information about pathogen distribution, genetic structures, and relationships around the Mediterranean basin.
- ✓ Insights into new control methods, and their biological basis, applicable for more sustainable potato protection strategies in the future.
- ✓ Opportunities for dissemination and adoption of available control means (e.g. resistant cultivars) by growers.
- ✓ Training and capacity building through shared student tuition.

Figure 1. A potato field (*Photo: R. Corbière - INRA – UMR IGEPP – Rennes)*

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Partners

- École Nationale Supérieure d'Agronomie (ENSA) El Harrach, **ALGERIA**
- Laboratoire de Microbiologie Appliquée, Université Bejaia, **ALGERIA**
- Faculté Sciences et Techniques Laboratoire de Microbiologie, Université Hassan 2, **MOROCCO**
- Fédération Nationale des Producteurs de Plants de Pomme de Terre, **FRANCE**
- Centre National de Contrôle et de Certification, **ALGERIA**
- Laboratoire Électrophysiologie des Membranes, Université Paris VI - Jussieu, **FRANCE**
- Groupement National Interprofessionnel des Semences, **FRANCE**
- Institut Technique des Cultures Maraîchères et Industrielles, Amirouche Fatiha, **ALGERIA**
- Département de Biologie Moléculaire, Institut National de la Protection des Végétaux (INPV), **ALGERIA**
- Central Administration for Seed Certification, **EGYPT**

Research: from fields to labs and back

- The project relies on research activities starting from the fields (pathogen sampling), going into labs (molecular typing of isolates, mechanistic assessment of defence mechanisms, etc.) or under controlled conditions (temperature adaptation, pathogenicity tests) and then back to trial or demonstration fields (cultivar assessment).

Training and capacity building

- Training and capacity building were an integral part of the project strategy. It primarily involved scientific stays by PhD students in partner's labs to learn about new protocols and techniques.

Dissemination activities

- Demonstration platforms are efficient means to increase awareness and adoption of innovations by end-users. They were used within PoHMED mainly as cultivar demonstration fields, and supplemented the more classical means of information sharing through publications in scientific and technical journals and communications at scientific workshops and conferences (Figure 2).


DOSSIER

Mildiou en France : P. infestans sous surveillance

Le réseau d'épidémiosurveillance du mildiou de la pomme de terre permet de suivre les populations de Phytophthora infestans, ses résistances aux fongicides et ses contournements de résistances variétales. C'est utile.

...rian Phytophthora infestans populations ...otypic structuration on potato and tomato ?

Ann Microbiol (2012) 62:1411–1417
DOI 10.1007/s13213-011-0391-6

ORIGINAL ARTICLE

Molecular typing of *Pectobacterium carotovorum* isolated from potato tuber soft rot in Morocco

Meriam Terta · Souad Azelmat · Rajaa Ait M'hand · El Hassan Achbani · Mustapha Barakate · François Bouteau · Moulay Mustapha Ennaji

Received: 25 August 2011 / Accepted: 14 November 2011 / Published online: 3 December 2011
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Figure 2. Publishing scientific and technical achievements from PoH-MED

Why collaborating?

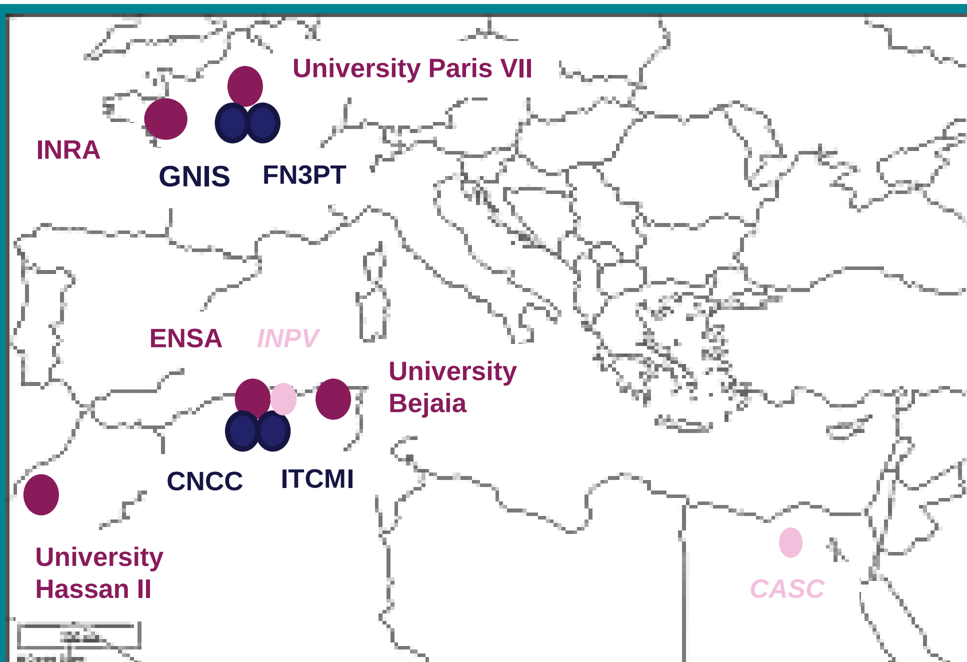
- Any project aiming at the development or improvement of agronomic systems needs the involvement of multiple actors: academic research, higher education, and extension. Furthermore, the sheer diversity of environments and local situations within the Mediterranean area make multilateral collaborations highly fruitful.
- Therefore, the initial PoH-MED consortium included 11 partners from 4 countries (Figure 3). Although administrative difficulties forced two partners to retire from the project, the partners still represented a wide range of competences, disciplines and positioning along the innovation chain.

Figure 3. PoH-MED Partners

Academic - research and higher education

Extension

Initial consortium member, but retired from operation for administrative reasons



ACHIEVEMENTS

Typing pathogen populations

Characterisation

Pathogen sampling and molecular typing have shown strong similarities but also occasional differences between population genetic structures in Northern Africa and France:

- *Rhizoctonia solani* populations in France and Algeria are dominated by one single genetic group, AG3-PT.
- The complex of soft-rot bacteria in France includes both *Pectobacterium* and *Dickeya* species, the latter genus being absent from Morocco. Within *Pectobacterium*, the French complex includes *P. atrosepticum*, *P. carotovorum*, *P. wasabiae* and *P. brasiliensis* (Hélias *et al*., 201?), which is also present and emerging in Morocco (Kettani-Halabi *et al*., 2013) alongside *P. carotovorum* (Faquihi *et al*., 2015).
- *Phytophthora infestans* populations in France and Algeria include mainly clonal lineages 13_A2 on potato and 23_A1 on tomato; lineage 6_A1 is also present in France, but was not detected in Algeria so far. By contrast, lineage 2_A1, now very rare in continental Europe, is still widespread in Algeria (Corbière *et al*., 2015).

Adaptation patterns and mechanisms

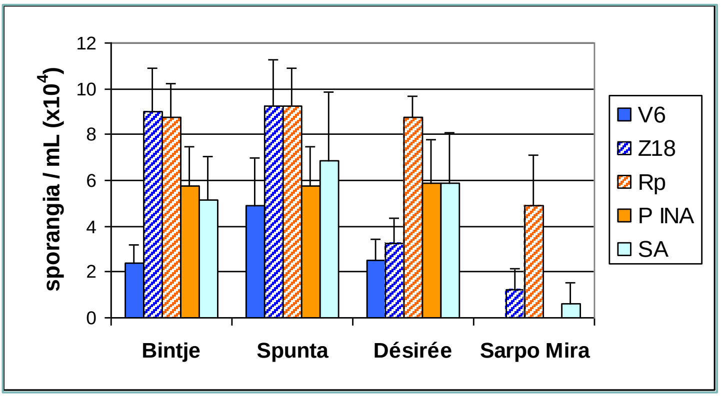


Figure 4. Spore production by five *P. infestans* isolates on four potato cultivars, showing specific adaptation of isolate *Rp* to the resistant clone Sarpo Mira (Belkhiter *et al.*, 2013)

- To survive and thrive, pathogens, like all living beings, must adapt to the diverse environments they occupy. For pathogens, an essential part of the environment is their hosts, and their eventual resistance.
- We showed through controlled biotests that natural isolates of *P. infestans* can adapt rapidly to the highly complex resistance of cultivar sarpo Mira, although this genotype is still seldom deployed in agriculture (Figure 4). This fast adaptation potential makes sustainable control more difficult to achieve, and imposes that every new control method be integrated in a comprehensive strategy combining multiple means to prevent rapid breakdown through pathogen evolution.

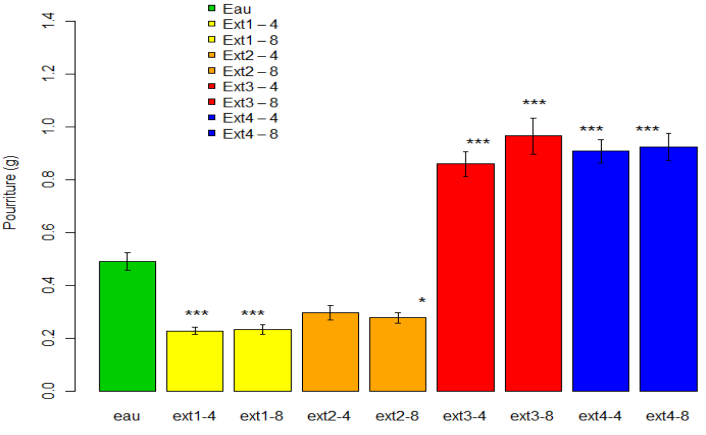


Figure 5. Total rot weight induced by *Pectobacterium atrosepticum* in half tubers of potato cv. Spunta previously treated with olive (Ext. 1 and 2) or carob (Ext. 3 and 4) at different doses prior to inoculation with the pathogen. Olive extracts significantly reduced rot weight, contrary to carob extracts which tended to increase disease severity

Innovative control solutions

- We focused on biocontrol solutions based on two types of natural products: 1) Native plant extracts and 2) Molecules secreted by the pathogen and recognised by the plant. The rationale is to use these as signal molecules to trigger defence reactions in the plant, able to reduce the severity of infection upon subsequent attacks by the pathogens.
- This approach allowed in particular to show that olive extracts, and particularly one of the molecules present there – hydroxytyrosol – reduces the severity of bacterial soft rot compared to water treated controls (Figure 5; Ouanas *et al*., 2016). However, other plant extracts either did not affect or even increased disease severity. These results provide good perspectives for the production of new agrochemicals while exploiting natural resources locally abundant.
- We also looked for genetic resistance to local pathogen populations: Figure 6 below shows a cultivar evaluation trial set up in Algeria for investigating the resistance to late blight (*P. infestans*) in 2015.

Figure 6. Cultivar evaluation trial set up in Algeria for resistance to late blight (*P. infestans*) in 2015

ACHIEVEMENTS

Training

- PoH-MED supported experimental activities in several PhD theses that were started just before or during the project by S. Belkhiter, M. Terta, L. Beninal, N. Mariette and S. Ouanas.

- PoH-MED promoted long-term studentships in France, in particular those from M. Terta to University Paris VII (3 months) and of S. Ouanas to INRA Rennes (18 months).

- PoH-MED encouraged the participation of researchers to international conferences and workshops, including the last two Euroblight meetings in Cyprus (2013) and Romania (2015).

Figure 7. PoH MED as a budding network of collaborations. Participants to the PoH-MED meeting in Rennes, 2014

Dissemination

- PoH-MED generated a number of scientific and technical publications (Figure 2), some of which are listed below. Further manuscripts have been recently submitted or are currently being drafted.

Next steps

- Since the project was granted an extension until August 2016, it is ongoing and several experiments are still underway. We are planning to have the final meeting during the autumn of 2016, possibly next to the Microbiod3 conference in Mohammedia, on 24-26 October 2016. Discussions are underway to assess the practicality of such an organisation.

- After the project administratively ends, we plan to continue collaborations (Figure 7) on population monitoring, and resistance elicitation and management. The joint supervision of Algerian PhD students (Ms S. Belkhiter and Mr L. Beninal) is already in place, and an application for a mobility grant (PROFAS B+) has been prepared to finance the 10-month stay of Ms Belkhiter at INRA Rennes in 2016-2017. Several joint papers are also being prepared, and should be submitted for publication in the coming months.

Do you want to know more?

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For more information on the ARIMNet2 Network

www.arimnet2.net

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Reference: ANDRIVON D., 2016. PoH-MED – Potato Health - Managed for Efficiency and Durability. *ARIMNet2 Highlights Series*

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Selected publications

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- Belkhiter *et al*., 2014. PPO Special Report 16: 297-298
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- Faquihi H., Terta M., Amdan M., Achbani E.H., Ennaji M.M., Ait Mhand R., 2015. Phenotypic and genotypic diversity of *Pectobacterium carotovorum* subsp. *carotovorum* causing soft rot disease of potatoes in Morocco. European Journal of Plant Pathology 143:801-811
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- Ouanas *et al*., 2016 – Plant Pathology *(under revision)*