



Phytoplasma diseases in Lebanon

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Introduction - Objective

During the last decade, the evaluation of the sanitary status of main agricultural crops in Lebanon, field visits and inspections was carried out in commercial fruit trees orchards in both traditional and new cropping areas of the country, in vineyards and in main solanaceous crops. We describe in this paper the main phytoplasma diseases presently known in Lebanon.

Diseases Survey

- Leaf samples were collected from almond trees showing yellow leaves on proliferation shoots in various orchards of the Bekaa Valley, north and south regions of the country.
- o Other leaf samples were taken from symptomatic peach plants, mainly proliferating shoots with succulent light green leaves.
- Concerning pome fruits, symptoms of pear decline have been observed in different commercial orchards of pear cultivars California and Coscia in Bekaa Valley.
- ❖ Samples of *Vitis vinifera* cv. Chardonnay and Alicante Bouschet showing yellows were collected in different vineyards in order to characterize the putative phytoplasma involved.
- A survey for phytoplasma diseases was conducted during the years 2003-2004 in tomato and pepper fields where tomato plants with stunting, yellowing or purplish leaves, proliferation of lateral buds, hypertrophic calyxes and virescent flowers and pepper plants displaying stunting and yellowing of leaves were found.
- ✓ Within the frame of the evaluation of the incidence of phytoplasma diseases in Lebanon, symptoms of excessive stem and shoot proliferation in Cactus (*Opuntia monacantha*) were observed in Saghbine, west Bekaa.

Almond Witches'-brooms



Bois noir on Chardonnay



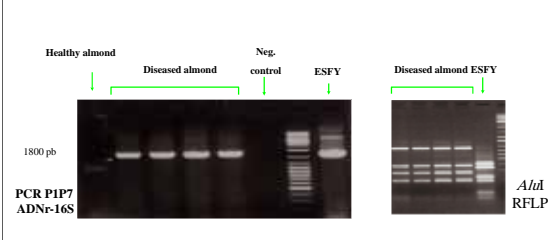
Big bud on infected Tomato plant



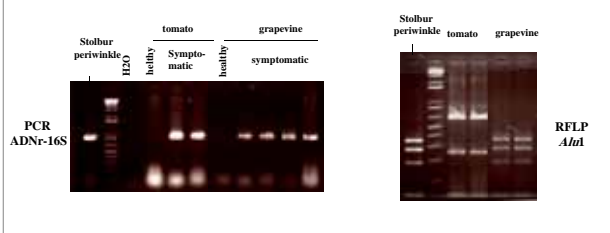
Pear decline



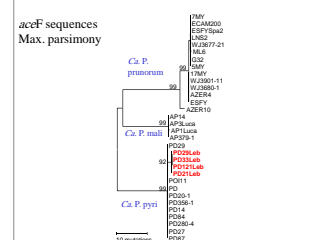
Detection of *Candidatus* Phytoplasma phoenicium in almond



Detection of grapevine bois noir phytoplasmas (groupe 16SrXIIA) and group 16SrVI phytoplasmas in tomato and pepper plants



Genotyping of *Ca. P. pyri* isolates detected in Lebanon



Results and Discussion

- The complete sequence of P1/P7 amplified fragments determined that a phytoplasma closely related to Pigeon pea Witches'-brooms cluster (PPWB) was found in almond infected trees. In order to distinguish the almond phytoplasma from others in the PPWB group, a specific PCR test was developed. The almond phytoplasma from Lebanon was shown to be identical to a phytoplasma inducing a disease called 'almond brooming' in Iran. Based on its unique properties, the name '*Candidatus* Phytoplasma phoenicium' had been proposed for the phytoplasma associated with almond witches'-broom in Lebanon and Iran (Verdin *et al.*, 2003, Int. J. Syst. Evol. Microbiol.).
- o The results of PCR amplification with specific primers (AlmF1/AlmR1) showed that the same phytoplasma of almond is detected in peach infected trees.
- A nested-PCR with primers fU5/rU3 after a first PCR with primers pair P1/P7 confirmed the presence of phytoplasmas in declining pears (Choueiri *et al.*, 2007, J. Plant. Pathol.). AceF amplification (Danet *et al.*, 2008, Acta Hort.) and sequencing confirmed the presence of isolates of *Ca. P. pyri* specific to Lebanon (one single nucleotide polymorphism by comparison to common European isolates) (Choueiri *et al.*, 2007, J. Plant Pathol.).
- ❖ The results of molecular analysis indicated that the phytoplasma of all diseased grapevines belonged to the stolbur group known to induce "Bois noir disease".
- After transmission by dodder from a diseased tomato plants to a periwinkle and analysis of 16S-rDNA, a '*Candidatus* Phytoplasma trifolii' was associated with the diseased plants (Choueiri *et al.*, 2007, Eur. J. Plant Pathol.).
- ✓ A phytoplasma belonging to 16SrII group was associated with shoot proliferation of a Cactus (Choueiri *et al.*, 2005, Plant Dis.).

Although a preliminary inventory of insects was conducted, further studies on Epidemiology and Vector Ecology should be done in Lebanon of both the insect vector (s) and reservoir plant (s) in order to manage the diseases and reduce their incidence.