

'*Candidatus Liberibacter*' spp.: Emerging Threats for Agriculture in the European and Mediterranean Region

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One negative consequence of the increase in international trade of plants and plant products is the risk of plant pests being introduced into new countries. Plant pests can result in unacceptable level of damage to both cultivated and uncultivated plants. The European and Mediterranean region is currently threatened with several new phytopathogens. The intergovernmental organization "European and Mediterranean Plant Protection Organization" (EPPO) drafts Pest Risk Analysis and compiles a list of quarantine organisms distinguishing between those that are absent (A1) from the EPPO region from those that are present but are considered to be highly dangerous (A2) [<http://www.eppo.int/QUARANTINE/quarantine.htm>]. The most important risk factor for the introduction of new phytopathogens is the importation of infected yet symptomless plant material (such as plants, plantlets, seeds or propagative plant material) and phytopathogen vectors, mostly, insects.

Among phytopathogens a potential threat is represented by the '*Candidatus Liberibacter*' pathogenic species. They are phloem-limited, Gram-negative, α -Proteobacteria that infects a variety of agriculturally important crops. They are transmitted by psyllids and by grafting, but have not been demonstrated to be transmitted by seeds [1]. The most noteworthy '*Ca. Liberibacter*' species are '*Ca. L. solanacearum*' (EPPO A1 list for *Solanaceae*) [2] and those causing Citrus Huanglongbing (HLB): '*Ca. L. asiaticus*' '*Ca. L. africanus*' and '*Ca. L. americanus*' (EPPO A1 list) [3].

'*Ca. L. solanacearum*' (LS) is transmitted by the leaf psyllid *Bactericera cockerelli* (EPPO A1 list as the vector of LS). It has been associated with diseases of potato, tomato and other *Solanaceae* crops in the Americas and New Zealand. In particular, it is associated with 'zebra chip' disease which reduces both the yield and quality of potato crops, causing significant economic losses. For example, in Texas and in New Zealand, the annual potato loss was estimated at US\$33 m (equivalent to €25 m) and NZ\$50 m (equivalent to €30 m), respectively [2]. To date, in the European and Mediterranean area, LS and *B. cockerelli* have not yet been detected in *Solanaceae* plants. However, the bacterium was recently found on carrots in Finland, Norway, Sweden and Spain; in Spain it was also detected on celery [4]. The vector on carrots in the Scandinavian area is *Trioza apicalis*, while in Spain it is *Bactericera trigonica*. At least in the near future, there does not seem to be a pathway between carrot and plants [5], but such a scenario cannot be ruled out *a priori* and continuous surveillance is required.

HLB is the most destructive and feared disease of citrus and practically all commercial citrus species and cultivars are sensitive, regardless of the rootstocks [3]. No effective disease control has been found and no genetic resistance traits have been identified in citrus germplasm. There has thus been a decline in citrus species in all areas where the disease occurs. HLB is endemic in Asia and Africa, where it has a long history [6] and although the first records in the Americas is more recent (2004 and 2005 in Brazil and Florida, respectively); the list of countries there is increasing year by year.

At the moment HLB is not present in the EPPO region. As

mentioned above, the disease is associated with three bacterial species, which are named after the places where they were first found: '*Ca. L. asiaticus*' (Las), '*Ca. L. africanus*' (Laf) and '*Ca. L. americanus*' (Lam). These liberibacters are transmitted from tree to tree by the citrus psyllids: *Diaphorina citri* (EPPO A1 list) in Asia and America, and *Trioza erythrae* in Africa (EPPO A2 list). Both the bacteria and their vectors are absent from the Mediterranean basin. Thus the report of *T. erythrae* on islands in the Atlantic Ocean -Madeira (Portugal) and the Canaries (Spain) [4]-has aroused great concern. In fact, a few years after the introduction of the vector into a new area, the pathogen generally appears as well. In addition, not only citrus propagation materials for plantation but also ornamentals or plants brought home by tourists or sold on the internet could represent a serious threat. In this context, hosts of psyllids and reservoirs of bacteria could be, for example, rutaceous ornamental plants that were found naturally infected by Las and Lam [6].

Finally, a new liberibacter species '*Ca. Liberibacter europaeus*' has been recently associated with *Cacopsylla pyri* and pomaceous plants in northwest Italy and Hungary [7]. Apparently it behaves like an endophyte rather than a pathogen. Nevertheless, *Ca. L. europaeus* has been associated with diseased *Cytisus scoparius* and the broom psyllid *Arytainilla spartiophila* in New Zealand [8].

It is thus clear that the potential agronomic and economic impacts of most, if not all, species of '*Candidatus Liberibacter*' in Europe and the Mediterranean basin are of major importance. Moreover, new hosts could be found in new habitats, thus facilitating the spread of pathogens.

Areas that are currently free of '*Candidatus Liberibacter*' are thus attempting to prevent liberibacters and their vectors from being introduced. In the absence of the vectors, early interception in nurseries can lead to effective eradication and containment. Any preventative measures clearly entail awareness of the disease among operators regarding the possible impact and severity of the disease. This can be achieved by setting up in advance validated diagnostic laboratory tests along with a monitoring network for the vectors and diseased plants. Some Mediterranean countries, such as Spain, have already started to set up such programmes. Nevertheless, one country alone cannot prevent the entrance of liberibacters and their vectors, as they could be introduced from other countries.

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In this era of globalization in order to deal with the spread of new phytopathogens, such as liberibacters, every country needs to be on the alert and controls should be harmonized and coordinated amongst all the nations involved.

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