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IT platform based on smart device and web-application for the survey of *Xylella fastidiosa*

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The identification of the first outbreak of *Xylella fastidiosa* in Puglia, South of Italy (Saponari *et al*., 2013), poses a serious threat to the agriculture and landscape in Europe and in the Mediterranean region. The assessment of the bacterium in the host plants, primarily on olive trees which show the Olive Quick Decline Syndrome (OQDS), and the control of its spread throughout Puglia have raised attention on the importance of early identification of the infection in the surveillance programme on large scale. Therefore, the timely collection of information on the host plant species, their geographical position, presence of symptoms, presence of the vector(s), characteristics of the surrounding environment and pathogen detection is the first step for the survey and statistical forecast of the infection.

At the beginning, the survey on *X. fastidiosa* in Puglia was managed through the traditional approach based on field data collection with the use of GPS devices, maps, etc. This method brought up wrong data in time and space, inconsistent statistics mainly due to the huge mass of geographic and alphanumeric information acquired and their processing by operators.

A new approach was set up on the use of Information and Communication Technology (ICT) for the management and processing of survey data for *X. fastidiosa* with a focus on the sample collection, coding, transmission, storage, phytosanitary analysis, management and visualization on a map (Santoro *et al.*, 2014; D'Onghia *et al.*, 2014). The IT architecture is made up of two specific types of software, XylApp and XylWeb, developed for Android mobile clients and for the web-based data collection unit (server), respectively, as reported in the Figure 1.

Figure 1. Client server architecture: XylApp - XylWeb.

XylApp, installed on tablet/smartphone, combines the acquisition of field data with the GPS-GLONASS satellite positioning; it is thus possible to overlap vectorial maps or rasters, grids having different cartographic scale or official demarcation areas, which are available in the mobile terminals both off-line and on-line (2G/3G/4G/WiFi). Once data are acquired, the application generates an encryption, stores it and transfers it to the server in real time through functions, which make the app user-friendly, robust and accurate.

In particular, XylApp includes five modules: (i) “Sample”, which allows to acquire data and geolocalize the samples taken from the field without any cartographic support; (ii) “Sail and Sample” to acquire data from the samples taken from the field with cartographic support; (iii) “Find” which allows to find one or more samples knowing the geographic coordinates; (iv) “Archive”, to store and transfer data to XylWeb; (v) “Vademecum” to provide guidelines on the most important notions on the monitoring activities (equipments, host species, symptoms, vectors, spy insects, etc.). The software is run on-line; a registered user (Phytosanitary Observatory, inspector, lab manager/technician, etc.), can remotely access the server to get information and make relevant operations on data (data entry, modification, processing, display, export, etc.) through a system of differentiated access keys. Data generated during the survey converge into XylWeb through XylApp (position of plants and/or caught insects, field technicians, survey date); XylWeb collects data from the application of remote sensing techniques, results from accredited laboratories for analyses, the manual entry of external samples which are not codified by the App. This enables to facilitate, harmonize, standardize and keep track of the flow of data, which are associated to the sampling in the surveyed sites. XylWeb, is made up of five independent modules (“Sample”, “Processing”, “Management”, “Downloads” and “Links”), which allow to archive, manage and process large amounts of information. In particular, the web-based application generates statistical elaborations and reports, makes available an updated version of information from monitoring activities as both figures and geographical representation of data on maps or graphs. The IT architecture, developed for the whole Puglia area, was tested starting from the official survey of *X. fastidiosa* in 2015. The phytosanitary inspectors and the technicians involved could identify olive plants and other host species, with or without symptoms, in a simple, accurate, effective and real-time way. Data acquired with XylApp were then transferred to the regional cartographic service, which has been in charge of the on-line publication, updating of all the sampling steps since the first outbreak of this disease in Puglia.

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