GPS-assisted monitoring of *Diabrotica* and other pests and diseases using smartphones

GPS-unterstütztes Monitoring von Diabrotica *und anderen Pflanzenschädlingen und -krankheiten mit Hilfe von Smartphones*

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In case of occurrence of the quarantine pest *Diabrotica virgifera virgifera*, a comprehensive monitoring has to be established. Around a place of finding, up to several hundred pheromone traps have to be set up in a dense grid and to be examined on a weekly basis. By the conventional procedure, where the trap locations are marked on printed maps, an exact positioning is as difficult as the relocation, especially by persons wo did not set up the traps themselves.

In order to make this process more efficient, the Central Institution for Decision Support Systems in Crop Protection (ZEPP) and the Information System for Integrated Plant Production (ISIP) have jointly developed a mobile assistant for the monitoring of the *Diabrotica*. Using the GPS capabilities of a modern smartphone, the trap locations are determined and in the next step relocated again. The date and the number of trapped beetles can be entered directly into the device and transferred online to the server. For technological reasons a native Android application has been developed.

The process of GPS-assisted monitoring is divided into two steps.

At first, a systematic grid of trap locations is generated around the place of finding. When setting up the traps, these 'theoretical' trap locations are replaced by the actual locations according to the local conditions. The trap is then fixed to the maize plant, its coordinates are retained from the smartphone's GPS receiver and it is labelled with a system generated identifier. These data are saved to the SD card of the device ensuring that no permanent internet connection is needed. Finally, the data are sent to the ISIP server, in the ideal case directly via mobile internet, otherwise later when the device is online again.

In the second step, the traps have to be revisited to record the catch results. When starting the application, the traps to be monitored are provided in a drop-down list. The relocation of the trap is supported by maps for an overview as well as a radar-like tool for the last meters. When a trap has been visited, its identifier is deleted from the list and this continues until all traps have been assessed. The order in which the traps were visited is saved thus incrementally optimizing the route for the next monitoring cycles. The monitoring results are again stored on the SD card and can be sent to the ISIP server whenever online. On the server, the data are stored and – if desired – forwarded into the reporting chain. Back in the office, the user can log in to the ISIP system and access the trap locations and latest monitoring results displayed in a WebGIS. Apart from the mere presentation, a tool for trap management was integrated to distribute trap data among other users of the system. This includes the opportunity that one group of people will set up the traps while another can do the monitoring.

The system was tested experimentally in 2010 in Rhineland-Palatinate and has been used under practical conditions in 2011 both in Rhineland-Palatinate and North Rhine-Westphalia. In 2012 the federal state of Saxony joined this monitoring approach and contributed to the total number of 447 managed traps by September 20th. Due to the successful introduction of the system, further developments aim at (1) making the mobile application independent of the operating system of the smartphone and (2) extending the range of monitored pests and diseases.