Emerging technologies for Integrated Pest Management

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OBJECTIVES

We will develop new technologies that combine detection and monitoring at field scale and at nano scale. Decision support systems link these scales for proper action at the right time and scale. Airborne and optical sensing methods are developed at field scale. DNA diagnostic tools are developed for nano scale technologies. Mating disruption is developed for biological control. Precision crop protection is developed to reduce inputs during action.

APPROACH

To close the precision agriculture loop, methods for monitoring and detection have to be integrated into decision support engines and innovative crop protection solutions. These solutions include mating disruption technologies both for protected vegetables and for grapevine. Furthermore precision spraying technologies to apply adequate amounts of crop protection products.

FIRST RESULTS

In the first years spores have been trapped in fields and at rooftop locations (*Fig 1*). Spores are emitted by crops and also by certain pests that are in the fields. Spores from rusts or other diseases are very harmful for the wheat crops in the region. Therefore spores have also been trapped at rooftop locations to provide information on a more regional level.

Figure 1. Left : Field air sampling picture; Right: Rooftop sampling picture

The spores have been collected from these traps. At Rothamsted, DNA has been extracted from these samples. DNA has been sent to Aarhus University in Denmark and to Plant Research International in The Netherlands where it has been analyzed for the presence of certain

pathogens.

For the decision support system multiple dose-effect trials have been established and analyzed for weed control in Maize. These data were input in the first prototype decision engine and the results were made available to the partners on a website. The proposed crop protection measures are now presented to the Maize field trials.

Mating disruption (*Fig 2*) by vibration was introduced to grapevine pathogens in season 2012 and 2013. Trials were performed to find out the correct vibration signals to interact with female and male insects. These vibrations cannot be heard by the human ear, though can be detected by the male and female insects, so that they get confused and cannot generate any offspring, thereby the pest is controlled in the field.

Figure 2. Mating disruption in grapevine

Pheromone dispensers (*Fig 3*) were used in a similar way to confuse mating Tuta insects. Male and female insects could not find each other due to the odour dispensed by the pheromone dispenser. Humans cannot smell the odour, though it is very specific to certain insects and thereby an effective way of controlling insects in fields.

Figure 3. Pheromone dispensers to control Tuta

For precision control and minimum application amounts a cell sprayer was developed and adjusted for use in vegetables. This sprayer (*Fig 4*), tested in field, only applies crop protection on places where it is required instead of broadcast spraying the whole surface area.

Figure 4. Cell sprayer for specific spraying in vegetables

For precision spraying in orchards a canopy density sprayer (Fig 5) was developed and further tested. This sprayer is measuring the width and height of the fruit trees and adjusts the number of spray nozzles that are active. This helps the farmer in applying the right and minimal amount of crop protection products in the orchard. It also minimizes the residue on the fruit, and probably in, but no residue evaluation was conducted.

Figure 5. Canopy density sprayer for orchards

INTERACTION WITH CROPPING SYSTEMS ACTIVITIES

Each task and topic in emerging technologies activities links to one or more of the cropping systems activities. The spore sampling and DNA technologies are developed for wheat cropping and in cooperation with researchers and on-station experiments in the wheat activity.
The decision support system is developed in close cooperation with the maize activity. The maize activity provides a lot of data to the researchers working on the development of the decision support system for weed control in maize.
Vibration mating disruption is developed for the grapevine cropping system and the trials are performed at research stations. The mating disruption for *Tuta Absoluta* is developed for the tomato cropping system and tested in cooperation with that activity.
The precision spraying techniques are developed for and with vegetables and fruit cropping systems activities.

NEXT STEPS

The prototypes of technologies that have been delivered for wheat, maize, vegetables, fruit, tomato and grapevine Cropping systems activities. These prototypes are now tested on stations where field trials

	are performed. Next steps are to validate the prototypes of technologies and get them into the stage where aspects of the technologies can be put into practice and into commercial solutions for the farmers.
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