3. PARALLEL SESSION 3.3 – BIOTIC STRESS AND CROP PROTECTION

PS-3.3-01

Alternatives for Herbicide Reduction with Examples on Oilseed Rape and Sugar Beet

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Abstract: Weed control is crucial to attain high productivity and quality in field crops. The application of chemical herbicides has been the major strategy to control weeds during the last decades in most European countries. However, herbicides can have negative impacts on the environment and traces of herbicides can be found in food and in surface and ground water. Public concerns due to these negative impacts have led to an increasingly political pressure to reduce herbicide use.

In 2016, Agroscope, the Swiss federal center for agricultural research, started a project to support the development of an autonomous weeding robot for the selective and precise application of herbicides. The first activities consisted in training an algorithm to recognize weeds and in 2017 the first field trials were conducted. The objective of this contribution is to share first experiences based on preliminary results obtained from experiments with sugar beet and oilseed rape.

The efficacy of the robot to control weeds was monitored in areas of 2 m^2 in a field cultivated with sugar beet. Additional, experiments with spring and winter oilseed rape were conducted in plots of 13.5 m^2 and weeds and volunteers were monitored in subplots of 0.25 m^2. Oilseed rape and quinoa (Chenopodium quinoa) were planted perpendicularly to the crop rows to simulate volunteers and *Chenopodium* sp. weeds, respectively. In the experiments with Oilseed rape the efficacy of the robot was assessed for three different strategies to control weeds: i) application of a selective herbicide after crop emergence, ii) application of a pre-emergence herbicide and a broad spectrum post-emergence herbicide, and iii) post-emergence application of a broad spectrum herbicide. In addition, the experiment included treatments with no-weed control and three additional weed control treatments: i) conventional post-emergence control, ii) mechanical control and iii) biological control using a non-winter hardy cover crop.

The rate of recognition of weeds and volunteers by the robot was above 60% for specific treatments which suggests a promising potential for autonomous weeding robots to become useful tools for integrated weed management systems. The fact that recognition efficacy depended on weed or volunteer density suggests that different robot settings and utilization strategies need to be considered according to densities of weeds and volunteers. Agronomic research is needed to optimize the use of weeding robots and to properly integrate them into cropping systems.

Keywords: weed control, smart farming, weeding robot.

PS-3.3-02

Advances in Remote Sensing & Other Biological Phenotyping Approaches: Shifting the Paradigm in Small Molecule Discovery

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Abstract: The substantial changes in modern agriculture set new challenges for the crop protection industry. The R&D part of the industry has to respond by continuously adjusting the innovation and optimization processes for new crop protection solutions. In recent years, the discovery and development of new chemical crop protection solutions relied on the so-called design-synthesis-test-analysis (DSTA cycle) paradigm, which was originally developed for the pharmaceutical industry. In other words, new molecules can be conceived through a rational design, synthetized and then tested in relevant testing systems. The outcomes of the test can be analyzed using advanced meta-analysis techniques. This is an iterative approach and led to a substantial streamline in the discovery process.

Even if we witnessed significant technological and methodological advancements in the DSTA cycle such as increasing of computational power, easy accessibility of crystal structures for biologically relevant receptors and the high-throughput phenotyping systems, there are still some aspects which are limiting the entire cycle. Particularly the testing step, which is still relying on a hierarchical screening cascade, encompassing in-vitro and in-vivo assays, and working from cellular level up to the plant population level. Here we present a new integrated testing platform with a clear cascade from lab, greenhouse, semi-field and field. In order to highlight the different phenotyping and remote sensing approaches at multiple investigation scales, we present a specific case study: the evaluation of damage on sugar beets caused by beet cyst nematodes. The advantages and limitations of each approach, in relation to the specific agronomical context and the technology processes are presented. Finally, the value of public-private research collaboration in this area will be addressed as a desirable scenario to find new, effective and environmental sustainable crop solutions.

Keywords: phenotyping, remote sensing, semi-field test system, sugar beet, nematode, crop protection.

PS-3.3-03

Grain resistances against mycotoxin accumulation in wheat, barley and oats

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Abstract: Fusarium head blight (FHB) is one of the most devastating diseases of small grain cereals. Beside serious impacts on the yield, the disease produces misshapen, shrivelled grains and contaminates the produce with different types of mycotoxins, representing a severe threat to food and feed safety. Infection occurs during flowering with rain and generally elevated humidity conditions. A large number of different *Fusarium* species can cause infections on all small grain cereals. Yet, *Fusarium graminearum* (Fg) has a predilection for wheat and barley, while *F. langsethiae* (Fl) and *F. poae* (Fp) are frequently isolated from oats. Consequently, grains of wheat and barley are commonly contaminated with the mycotoxins deoxynivalenol and zearalenone, while oats are spoiled with T-2/HT-2 toxins or nivalenol (NIV), when infected with Fl or Fp, respectively Some cereals are able to withstand to a certain degree to the infection and to the accumulation of mycotoxins in the grains. The resistance is inherited and quantitative and thus depending on the resistance capacity of the plant and on environmental conditions. In the present project, we have studied the resistance of wheat, barley and oats grains against kernel deformation, and mycotoxin accumulation, after infection by *Fusarium* spp. The experiments were conducted with 8 varieties of each species at 3 experimental sites during 2 to 3 years. The results highlight the genetic component of resistance against FHB and mycotoxin accumulation in all three cereals. Generally, oats and barley were more resistant than wheat. However, heritability of resistance was higher in wheat