DECISION SUPPORT SYSTEM 2.0: COMBINING PLANT GENETIC RESISTANCE WITH MONITORING OF VIRULENCE

Theo van der Lee, Geert Kessel, Piet Boonekamp

Wageningen UR, Plant Research International

Business Unit 'Biointeractions & Plant Health'

piet.boonekamp@wur.nl

The development of a high level of Integrated Pest Management (IPM) is a mandatory part of the National Action Plans, as to comply to the new EU-directive. Corner stones of IPM are Decision Support Systems (DSS). For many crop-disease combinations DSS have been developed. The present generation of DSS (DSS 1.0) comprise an early monitoring devise of the presence of a pathogen in a certain crop and monitoring if occurring weather conditions favour infection. Does the combination lead to a sufficient high risk of virulence, the DSS gives an advice for appropriate measures. In general pesticide-spraying within a limited time period will be advised. When using DSS 1.0 a farmer will only spray when there is a realistic infection probability, leading in general to a decrease in the use of pesticides during the growing season.

More than 50% of the total Dutch fungicides volume was used 10 years ago against *Phytophthora*, in potatoes, implicating the threat of this Late Blight disease. Combined research on the epidemiology and population biology of *Phytophthora* and on infection routes in leaves and tubers in a so-called Umbrella Program, has recently fine-tuned DSS 1.0 substantially, leading to a large reductions of fungicides application over the last 10 years. Some results of this 10 year program will be presented.

In 2006 another research program started on Durable Resistance against *Phytophthora* (DuRPh). In the past breeding of single resistance genes from wild species in the culture potato was never successful as resistant potato cultivars stimulated *Phyophthora* to select for genotypes in their field population which were able to overcome ('break') the resistance. Therefore the approach in the DuRPH program is to stack more resistance genes in one cultivar in a temporal and spatial dynamic way, leading to a field of an agronomical uniform potato crop, but with a mosaic of potato clones harbouring different resistance genes. The rationale for this multiple resistance approach is that it will be harder for *Phytophthora* to 'break' multiple than single resistance. The mechanism of resistance is the matching of one specific effector gene of *Phytophthora* with the corresponding resistance gene in potato. In our DuRPh approach we combine about 4 resistance genes knowing that *Phytopthora* in a field population has a very large variety of effector genes including the ones for the 4 resistance genes, leading to resistance. However, *Phytophthora* has a very flexible genome and able to change its effector genes easily.

Even the multiple resistance approach cannot prevent that eventually *Phytophthora* genotypes are formed under field conditions with inactivated corresponding effectors. Such genotypes will be able to break the deployed resistance genes in the potato field, if they get the chance to take over the *Phytophthora* population.

To prevent resistance breaking we are developing the next generation of DSS, DSS 2.0 to assist farmers growing resistant potatoes. In DSS 2.0 not only early warning for favourable *Phytopthora* infection conditions are given (= DSS 1.0), but also if new *Phytopthora* genotypes emerge in the occurring *Phytophtora* field population with modifications in the effector genes corresponding to the deployed resistance genes in the field. Very versatile molecular assays have been developed that in a few hours can give the results from field samples of *Phytophthora*. If DSS 1.0 would give an advice to farmers to spray as infection conditions are high, but DSS 2.0 shows that no 'breakers' are present in the *Phytophthora* population, the farmer gets an additional advice not to spray yet. The first field results of DSS 2.0 will be discussed.

To our knowledge the DSS 2.0 we are developing for the potato – *Phytophthora* combination is the first worldwide. However similar DSS 2.0 can be developed for other pathogen – crop combinations. The role of DSS 2.0 to reduce fungicide use, to preserve the limited available resistance genes and therefore to form a cornerstone of future sustainable IPM, will be discussed.