Partners include:
- Biosciences east and central Africa (BCEA) for developing and testing resistance to late blight in potato plants.
- Kachwakano Zonal Agriculture Research and Development Institute of RIMD, Uganda for testing resistance to late blight in transformed potato plants including a confined field trial.
- DuPPIF-Wageningen University in The Netherlands and NESPPII Cornell University in the USA for gene technology and biosafety risk assessment.

This research is funded through a grant from the United States Agency for International Development (USAID) and by the CGIAR Research Program on Roots, Tubers and Bananas (RTB). It represents a long-term commitment to develop disease-free potato as stated in CIP Strategy and Corporate Plan 2014 - 2023.

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Development of late blight resistant potato biotech varieties

Phytophthora infestans is still a devastating disease of the potato all around the world. Through genetic transformation, we intend to develop potato varieties that have durable resistance to late blight by introducing resistance genes from wild Solanum species. Our research involves the production of transgenic events with R genes with high level of resistance to late blight and the assessment of durability of this resistance through the characterization of the pathogen diversity and virulence.

What have we learned so far?
Genetic transformation with R genes of susceptible varieties can produce highly resistant plants to P. infestans. However, the pathogen diversity and its ability to overcome R-gene-mediated resistance recommended in depth study of the pathogen dynamics, adding other R genes, and testing different deployment strategies.

What can we achieve?
High level of resistance to Late blight conferred by single resistance (R) genes from Solanum demissum has been shown to be rapidly overcome. However, new R genes have been identified in other wild potato species which confer a strong and wide spectrum resistance to Phytophthora infestans. Genetic transformation offers the possibility to produce multiple transgenic events from the same variety with different combinations of R genes without changing the intrinsic properties of the variety. Our goal is to develop durable resistance to late blight using potato varieties bearing several R genes deployed judiciously in time and space in developing countries.

Where are we working?
The genetic transformation is underway at CIP facility in Peru and at the Biosciences east and central Africa hub/International Livestock Research Institute (BecA hub/ILRI) in Kenya. Early on, we have conducted a regional consultation to identify the level of interest and capacity to partner with CIP to conduct research in confined field trials. Although a regional approach will be eventually needed, the proof-of-concept activities will first be conducted with the Kachwakano Zonal Agricultural Research and Development Institute (KazARDI) in Uganda.

How far are we?
Three R genes (RB, Rpi-blb2 isolated from Solanum bulbocastanum, and Rpi-vnt1.1 isolated from S. venturii) are being transformed into the susceptible varieties ‘Désirée’ and ‘Victoria’ which are grown in Kenya and Uganda. Genetic transformation of these varieties with each R gene separately as well as stack of these 3 R genes resulted in the production of highly resistant transgenic events using greenhouse assays and various P. infestans isolates. Other locally relevant varieties are undergoing genetic transformation at BecA. The highly resistant events bearing the 3 R genes will be soon tested under field conditions to determine their level of resistance to late blight and other agronomic characteristics.

What do we want to achieve?
High level of resistance to Late blight conferred by single resistance (R) genes from Solanum demissum has been shown to be rapidly overcome. However, new R genes have been identified in other wild potato species which confer a strong and wide spectrum resistance to Phytophthora infestans. Genetic transformation offers the possibility to produce multiple transgenic events from the same variety with different combinations of R genes without changing the intrinsic properties of the variety. Our goal is to develop durable resistance to late blight using potato varieties bearing several R genes deployed judiciously in time and space in developing countries.
Phytophthora infestans is still a devastating disease of the potato all around the world. Through genetic transformation, we intend to develop potato varieties that have durable resistance to late blight by introducing resistance genes from wild Solanum species. Our research involves the production of transgenic events with R genes with high level of resistance to late blight and the assessment of durability of this resistance through the characterization of the pathogen diversity and virulence.

1. What is the problem?
Late blight disease caused by the oomycete Phytophthora infestans responsible for the Irish potato famine in 1845 is still affecting more than 1 million hectares of potato causing economic losses estimated at 2.75 billion USD a year. Pesticides are costly and are isolated from potato and their resistance is not durable. Conventional potato breeding is extremely slow and unpredictable. For example, it took about 45 years to release the variety ‘Bionica’ starting from the original wild potato Solanum bulbocastanum, which is highly resistant to late blight.

2. What do we want to achieve?
High level of resistance to late blight conferred by single resistance (R) genes from Salanum demissum has been shown to be rapidly overcome. However, new R-genes have been identified in other wild potato species which confer a strong and wide spectrum resistance to Phytophthora infestans. Genetic transformation offers the possibility to produce multiple transgenic events from the same variety with different combinations of R-genes without changing the intrinsic properties of the variety. Our goal is to develop durable resistance to late blight using potato varieties bearing several R-genes deployed judiciously in time and space in developing countries.

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4. How far are we?
Three R-genes (RB, Rpi-blb2 and Rpi-vnt1.1) isolated from Solanum bulbocastanum, and Rpi vnt1.1 isolated from S. venturii are being transformed into the susceptible varieties ‘Desiree’ and ‘Victoria’ which are grown in Kenya and Uganda. Genetic transformation of these varieties with each R-gene separately as well as stack of these 3 R-genes resulted in the production of highly resistant transgenic events using greenhouse assays and various P. infestans isolates. Other locally relevant varieties are undergoing genetic transformation at BecA. The highly resistant events bearing the 3 R-genes will be soon tested under field conditions to determine their level of resistance to late blight and other agronomic characteristics.

5. What have we learned so far?
Genetic transformation with R-genes of susceptible varieties can produce highly resistant plants to P. infestans. However, the pathogen diversity and its ability to overcome R-gene-mediated resistance recommended in depth study of the pathogen dynamics, adding other R-genes, and testing different deployment strategies.

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