Diversification of host targets to promote resistance against Potyvirus and Begomovirus in tomato

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Tomato (*Solanum lycopersicum*) is one of the most cultivated vegetable in the world, but suffers from important yield losses caused by viral diseases. Therefore, the development and use of cultivars that are genetically resistant to viruses has become a critical factor of competitiveness for both breeders and producers and one of the key stakes for sustainable agriculture. In this context, generating new resistance alleles using biotechnological approaches (e.g., TILLING) appears as a powerful tool to diversify host targets to promote resistance against viruses.

Most characterized recessive resistances to potyviruses so far are natural variant of the translational initiation factor eIF4E. Those variants often encode functional eIF4E proteins but have lost the ability to interact with the viral protein VPg (Charron et al., 2008). In tomato, a broad-spectrum resistance to Potyvirus is associated with the natural resistance allele *pot1-eIF4E1* from *Solanum habrochaites* PI247087 (Ruffel et al., 2005). More recently null *eIF4E* alleles were obtained by TILLING (Piron et al., 2010) but strikingly, the resistance spectrum associated with the null *eif4e1* allele is considerably narrower than the one associated with the natural resistance allele *pot1-eIF4E1*. Understanding the apparent discrepancies between those two –natural and induced- resistances could be important to help developing more efficient TILLING-based resistances to pathogens. Therefore, we are investigating the differences between lines harbouring those alleles, focusing both on putative background effects as well as on the effect that the eIF4E1 knock-out might have on the eIF4E family redundancy.

Begomoviruses are much more damaging to tomato culture. However, even if some resistance QTL from wild species and several candidate genes have been characterized so far, the genes underlying those resistances remain unknown. We focused on three candidate genes that encode proteins interacting with the viral proteins Rep and REn as they might be hijacked by the virus to perform its replication. Protein-protein interactions with the viral proteins were checked and 3 to 4 null-allele or alleles showing change in amino-acid were isolated by TILLING for all each candidate. Among the 10 alleles assessed for resistance to Begomoviruses, a single one appears to confer partial resistance to TYLCV. These results have to be confirmed during further assays. We are further characterizing a transcription factor (TF) because it co-localized with the recessive resistance QTL *ty-5* (Anbinder et al, 2009), using a combination of protein-protein interaction studies, gene polymorphism analysis as well as generating dominant-negative TF-expressing plants using the CRES-T technology (Hiratsu et al., 2003).

1. Charron, C. *et al.* Natural variation and functional analyses provide evidence for co-evolution between plant eIF4E and potyviral VPg. *The Plant Journal* **54**, 56–68 (2008).
2. Ruffel, S., Gallois, J. L., Lesage, M. L. & Caranta, C. The recessive potyvirus resistance gene pot-1 is the tomato orthologue of the pepper pvr2-eIF4E gene. *Molecular Genetics and Genomics* **274**, 346–353 (2005).
3. Piron, F. *et al.* An Induced Mutation in Tomato eIF4E Leads to Immunity to Two Potyviruses. *PLoS ONE* **5**, e11313 (2010).
4. Anbinder, I. *et al.* Molecular dissection of Tomato leaf curl virus resistance in tomato line TY172 derived from Solanum peruvianum. *Theoretical and Applied Genetics* **119**, 519–530 (2009).
5. Hiratsu, K., Matsui, K., Koyama, T. & Ohme-Takagi, M. Dominant repression of target genes by chimeric repressors that include the EAR motif, a repression domain, in Arabidopsis. *The Plant Journal* **34**, 733–739 (2003).