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satellite oral presentation

#107: Natural variation and functional analysis provide evidence for co-evolution between pepper eIF4E and potyviral VPg

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Amino acid (AA) substitutions in the eukaryotic translation initiation factor eIF4E result in recessive resistance to potyviruses in a range of plant species, including pepper and tomato [Robaglia and Caranta, 2006, Trends in Plant Science]. Correspondingly, AA changes in the viral protein VPg are responsible for the potyvirus's ability to overcome eIF4E-mediated resistance. With the aim to characterize selection pressures exerted on eIF4E genes in relation to resistance and mRNA translation functions, comparative analyses of polymorphism and functional analyses were conducted in pepper and Arabidopsis thaliana.
Polymorphism analyses show that A. thaliana eIF4E genes are very well conserved, under negative selection, similarly to house-keeping genes. Conversely, polymorphism analysis at the pvr2-eIF4E coding sequence in a worldwide sample of 25 C. annuum accessions identified ten allelic variants with exclusively non-synonymous variations. Resistance and genetic complementation assays demonstrated that pvr2 variants, each with signature amino acid changes, corresponded to potyvirus resistance alleles. Systematic analysis of the interactions between eIF4E proteins encoded by the ten pvr2 alleles and VPgs of virulent and avirulent Potato virus Y (PVY) and Tobacco etch virus (TEV) strains demonstrated that resistance phenotypes arose from the disruption of the interaction between eIF4E and VPg, and that viral adaptation to eIF4E-mediated resistance resulted from the restored interaction with the resistance protein. Complementation of an eIF4E knock-out yeast strain by C. annuum eIF4E proteins further shows that amino acid changes did not impede essential eIF4E functions. Moreover, eIF4E gene from C. annuum presents positive selection traces and AA under positive selection correspond to residues involved in PVY resistance. Altogether, these results argue in favour of a coevolutionary arms race between Capsicum eIF4E and potyviral VPg [Charron et al., 2008. Plant J].