Engineering Resistance to Plant Viruses

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A Recipe For Resistance

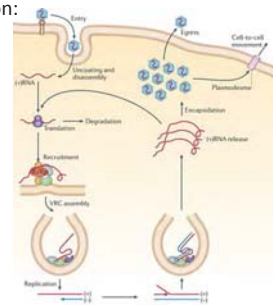
A **new viral disease** has emerged in a **major food crop** and is spreading fast. It threatens huge financial costs and food security in a politically unstable region. What can you do?

1. Isolate and characterise the viruses causing the disease. How **variable** are they and which parts of the viral genome are **conserved**? These sites are likely to be the most effective targets for producing resistance

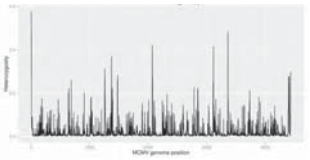
2. Reprogramme part of the plant immune system, **RNA silencing**, to target conserved regions of the viral genome for **degradation**

3. Test to confirm the reprogrammed plant is **resistant** and begin field trials

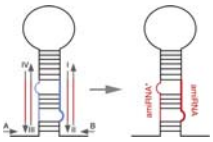
Viral Infection:



Survey diversity:



Reprogramme:



From top: Typical RNA virus infection, Diversity across MCMV genome, Reprogramming RNA silencing

A farmer inspects his maize crop, infected with Maize Lethal Necrosis

Sequence Mediated Resistance is:

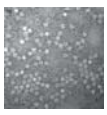
- **Specific** – Only sequences matching those targeted will be degraded
- **Versatile** – All plant viruses have genetic material, so can be targeted
- **Portable** – Multiple varieties can be given the same resistance construct

Maize Lethal Necrosis in Kenya

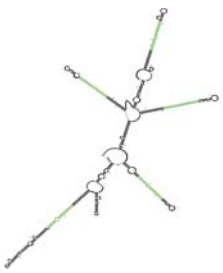
MLN is caused by the interaction of two viruses and has spread rapidly across East Africa in the last five years:

- MLN caused the loss of an estimated 10% of Kenya's total maize crop in 2014/2015, at a cost of $50 million
- *Maize chlorotic mottle virus* was introduced to East Africa and interacts with local viruses to cause MLN
- Sampling conducted in August 2014 allowed the design of a construct to produce robust MCMV resistance
- Transformation of Kenyan maize varieties should take place in early 2016 in collaboration with Kenyatta University and the Kenyan Agriculture and Livestock Research Organisation

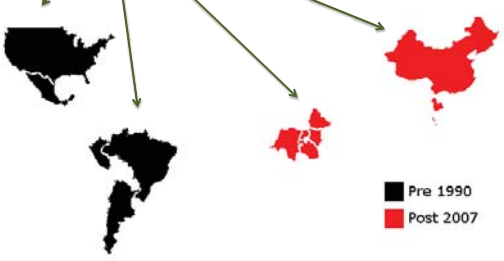
Maize chlorotic mottle virus



Resistance provided by:



Spreads via:



Top: MCMV, how it spreads, and the resistance construct we have designed. Bottom: MCMV's spread across the world

Sources: Viral infection – Nagy and Pogany, 2012
Xie *et al.*, 2011