Title	Taming *Striga hermonthica* by upgrading lignification of secondary cell walls of maize roots through two biotechnology approaches
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Purpose	To create *Striga hermonthica* resistance in tropical maize through genetic transformation with genes up-grading lignification bio-synthesis in root cell walls, and through *in vitro* embryo rescue after reciprocal crossing of susceptible maize lines and a resistant (SAR) sorghum cultivar.
Project Summary/Abstract	Among the small scale farmers who produce over 80% of the total maize in sub-Saharan Africa, *Striga hermonthica* and other weeds are managed by physical weeding, often achieved by hand hoeing and sometimes animal ploughing. Weeding therefore constitutes about 60% of the total labour input in maize production. It is time consuming and uncomfortable yet in sub-Saharan Africa, the labour force consists mainly women with babies strapped on their backs working under intense tropical radiation and using rudimentary implements. In spite of these women's efforts, *S. hermonthica* escape the weeding frequency because the weeds emerge above ground late in the crop season when weeding has long been ceased. The maize suffer the pernicious injury of the parasites while the unconscious farmers hope and wait for a harvest that obviously is not forthcoming. Selective herbicides can be

	applied in farms or coated to the seeds during planting, however, the intimate relationship between the two plants make it very difficult to selectively target using systemic herbicides for instance Imazapyr. In the first approach to deal with the *Striga hermonthica* menace, up-regulated genes involved in secondary cell wall fortification in *Striga* resistant *Sorghum bicolor* have been connected to heavy lignification and phenylpropanoids modification and deposition, processes that mechanically stop the parasites from infiltrating the host. It has been found that down-regulating particular monolignol biosynthetic genes, such as those encoding CCR, HCT and CAD enzymes, selectively affect spatial deposition of lignin in cellulose fibre, xylem cells and within the secondary cell wall. Accordingly, the spatial and temporal expression of the monolignol biosynthesis enzymes, transporters and their substrate specificity greatly contribute to tissue and cell-type-specific lignification. CAD and HCT enzymes and their driving transcription factors MYB n46 and MYB 83 are to be over-expressed in maize roots using root specific promoters to enhance lignification. In the second approach, maize and sorghum belong to the grass family with 10-11 chromosomes each and their genes cluster together in the family *Panicoideae.* Therefore, compatibility in cross-pollination is very feasible. Although pre-embryos produced from such interspecies parents abort, excised immature embryos can be rescued on various media regimes *in vitro* and if possible, impart the cell wall bio-fortification trait to the maize-sorghum hybrid progeny (*MAYGHUM*). In this project at least 10 tropical maize inbred lines will be crossed (pollinated with pollen from a *Striga* resistant sorghum cultivar N13) and the immature zygotic embryos rescued 10 to 20 days after pollination.
Country and Specific Location(s)	Kenyatta University, Plant Transformation Laboratory, Nairobi Kenya.
Participating Institutions	• Kenyatta University Plant Transformation Laboratory, Nairobi, Kenya • BecA-Hub International Livestock Research Institute Nairobi Kenya • Kenya Agricultural and Livestock Research Organisation (KALRO), Nairobi Kenya

Start Date	1st November, 2014
End date	31st October 2016
Amount of Funding	$65, 000

Mgutu, Allan Jalemba (PhD)

Dr. Mgutu's research journey begun with determining active biochemical target sites in parasitic weeds (*Orobanche aegyptiaca* and *Striga hermonthica*) that could be harnessed for developing novel herbicides based on evidential physiology (MSc); at the Weizmann Institute of Science, Rehoboth (Israel). He gained research skills in plant biochemistry that became a spring board for exploring protein-protein interactions between a plant virus–maize streak virus and host maize plant with the view of developing broad-spectrum resistance to maize streak virus disease (PhD) using synthetic peptide aptamers. Together with scientists at the North Carolina State University (NCSU), they identified peptide aptamers that could selectively bind and interfere with viral replication proteins, thus conferring resistance to the virus and ultimately MSD. Dr. Mgutu is a budding scientist having won two government grants from the National Commission for Science, Technology and Innovation (Kenya); a multi-institutional innovation joint Grant and Post-Doctoral Grant to establish protocols for maize genetic engineering against biotic (drought and salinity) and abiotic (viral disease) stresses. Recently, Dr. Mgutu won a Competitive Graduate Research Grant (CGRG) research grant from Regional Universities Forum for Capacity Building in Agriculture (RUFORUM; RU/CGS/GRG/30/03/14) for developing maize tolerant to *Striga hermonthica* through embryo rescue of maize (susceptible) x sorghum (resistant) zygotic hybrids (*MAIGHUM*) and engineering enhanced lignification in the root secondary cell walls. His prospective research interests revolve around making better protocols for tropical maize tissue culture and *Agrobacterium*-mediated transformation particularly the inbred lines. Together with scientists at Iowa State University-USA and ILRI-BeCa Hub, Dr. Mgutu are developing concepts for harnessing genome-editing tools (TALENS & CRISPS-Cas9) to design broad resistance against maize streak virus disease in tropical maize.

Selected publications

Previously funded projects