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Protecting Food Legumes from Insects

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Legumes in World Agriculture

- High Protein Food for Humans, Animals
- Low GI Starch
- Reduce N Fertilizer Requirement
- N for Rotations and Companion Crops
- Reclaim Acid Soils
- Crop Diversity
- Enhance Disease and Pest Control
- Weed Control via Cover Crop
- Improve Phosphorus Cycling



Gene Technology for Food Legumes

Systems now available for:

Soybean

Bean

Chickpea

Peanut

Pea

Cowpea

Faba bean

Pigeonpea

Lentil

Lupin

Blackgram

...

Useful for:

- **Functional Genomics**
- **Genetic Improvement by GM**



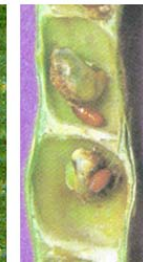
World Production of Food Legumes

	MT	%	Major Producer
Soybean	217	71	Americas
Peanut	36	12	China
Dry Bean	18	6	Brazil
Pea	11	4	EU
Chickpea	7	2	India*
Cowpea	4	1	Nigeria
Faba bean	4	1	China
Pigeonpea	3	1	India*
Lentil	3	1	India*
Lupin	1	<1	Australia*
	304	100	



Gene technology for cowpea

- develop a transformation system for cowpea
- introduce insect resistance genes
- complement traditional cowpea breeding programmes in Africa



Project partners



Bruchids and Maruca are top targets



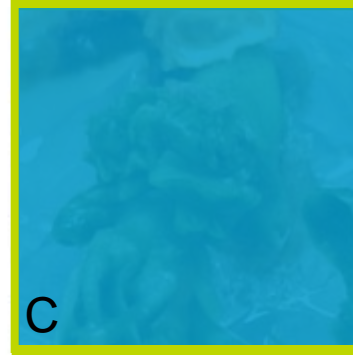
Genetic transformation system for cowpea

Based on;

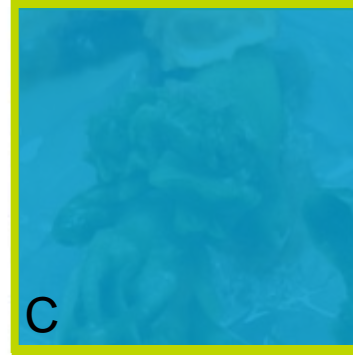
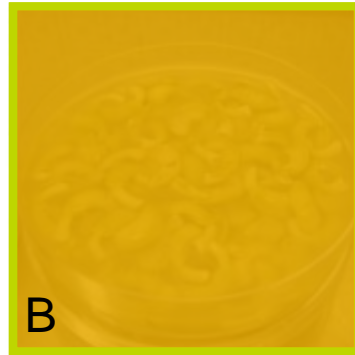
- ★ ***Agrobacterium tumefaciens***
- ★ **Binary vector system for gene delivery**
- ★ **Antibiotic or herbicide selection**
- ★ ***Npt II* and geneticin or *Bar* and Liberty**
- ★ **Explants from cotyledons of mature seed of cv Sasaque or IT86D-1010**



Cowpea transformation

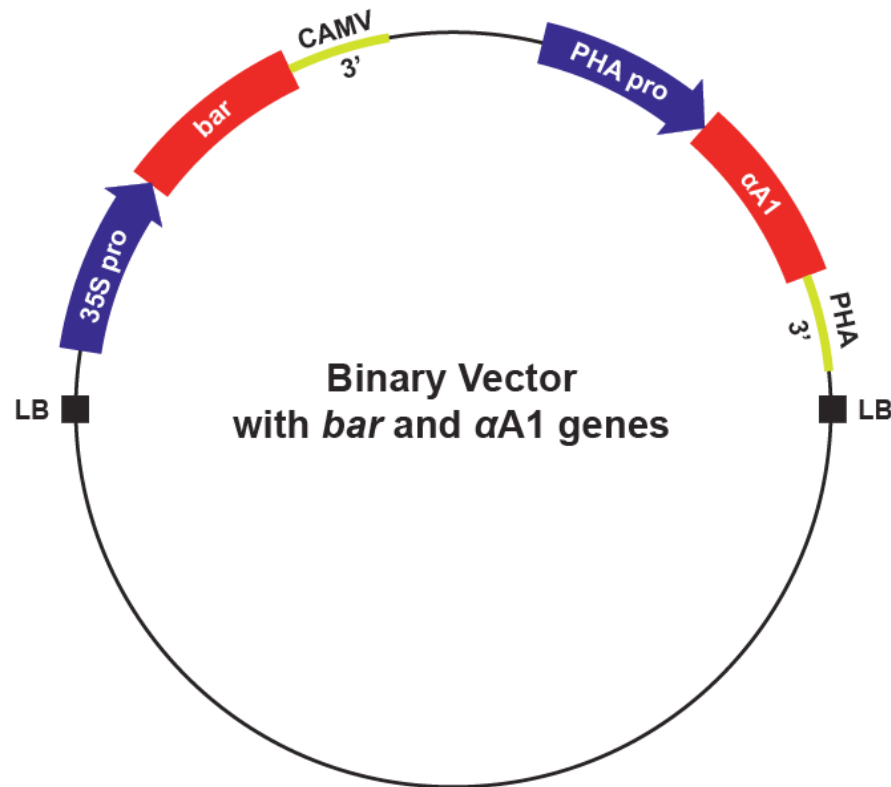


Cowpea transformation



Genes for cowpea transformation

α A1 Gene for Protection Against Bruchids



Cowpea weevil emergence delayed in seed α -AI cowpea lines

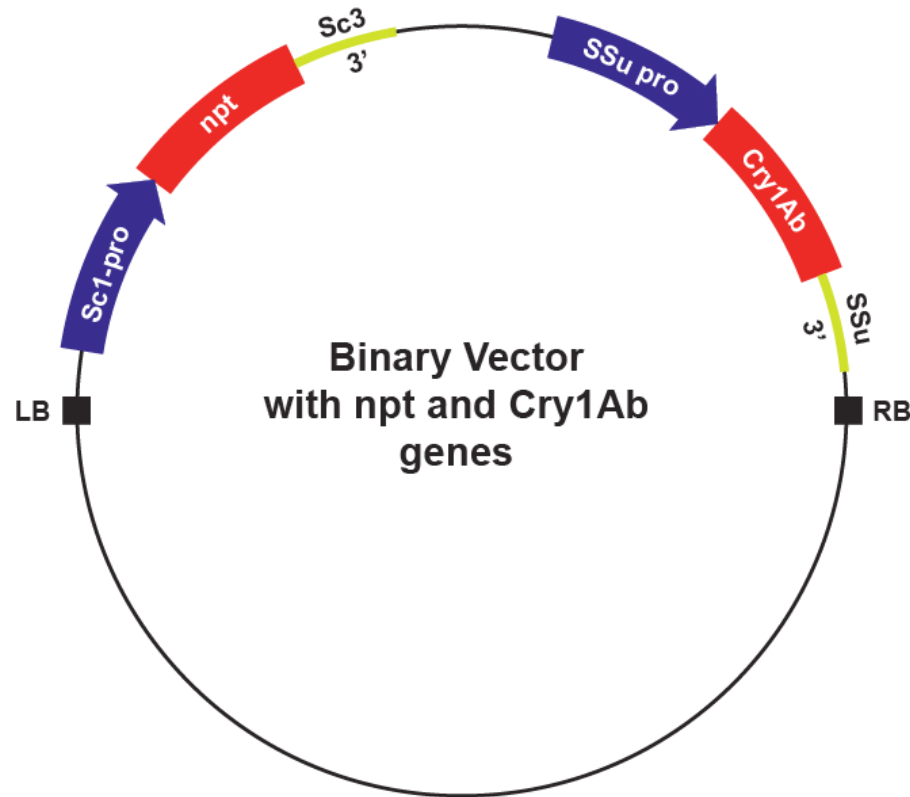
	Days to emerge as adults
Non-Transgenic IT86D-1010	26.6
Transgenic Line 170	>120
Transgenic Line 250	55
Transgenic Line 263	>120
Transgenic line 288	>120
Transgenic Line 310	>120
Transgenic Line 14	>120
Non-Transgenic TVU2027	38.7

Maruca caterpillars damage cowpea pods



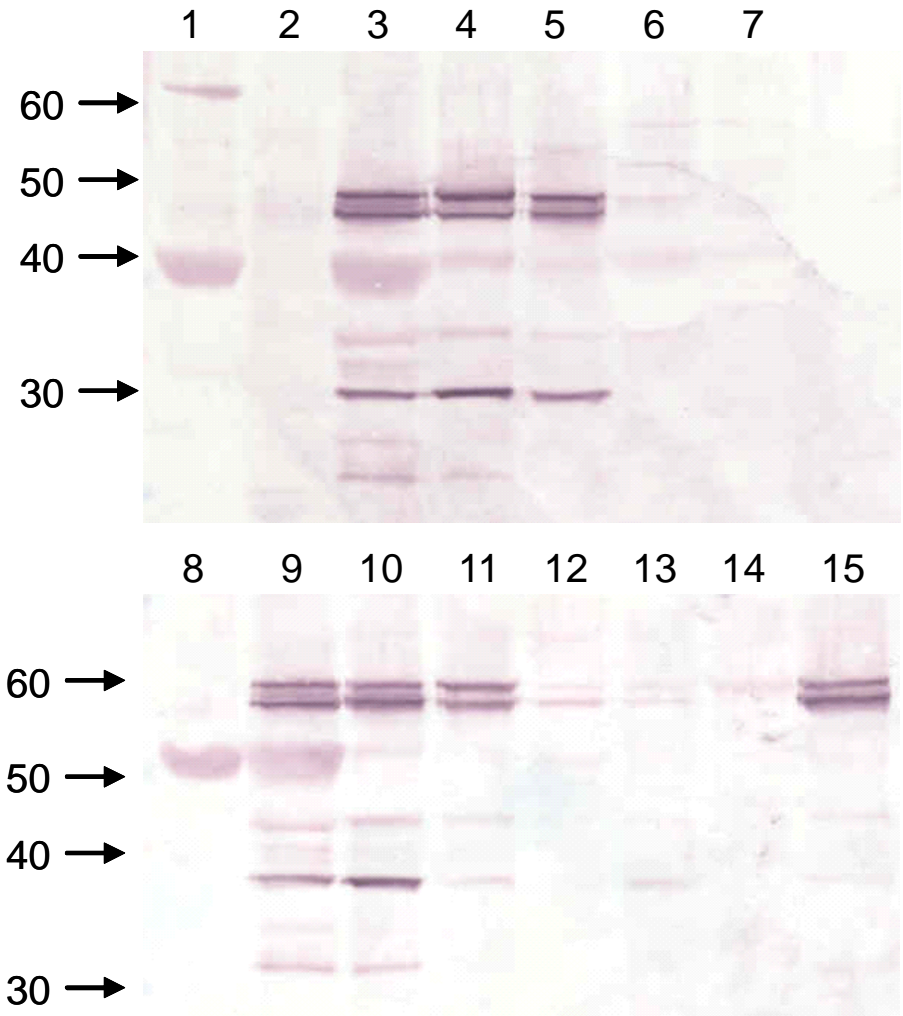
Construct for cowpea transformation with Bt gene

Cry1Ab Gene for Protection Against Pod Borer



Cry1Ab expressed in different cowpea organs

1. NT leaf
2. Root
3. Leaf
4. Petiole
5. Pod wall
6. Immature cot
7. Dry cot
8. NT leaf
9. Transgenic leaf
10. Sepal
11. Petal
12. Anther filaments
13. Anther wall
14. Pollen
15. Style and stigma

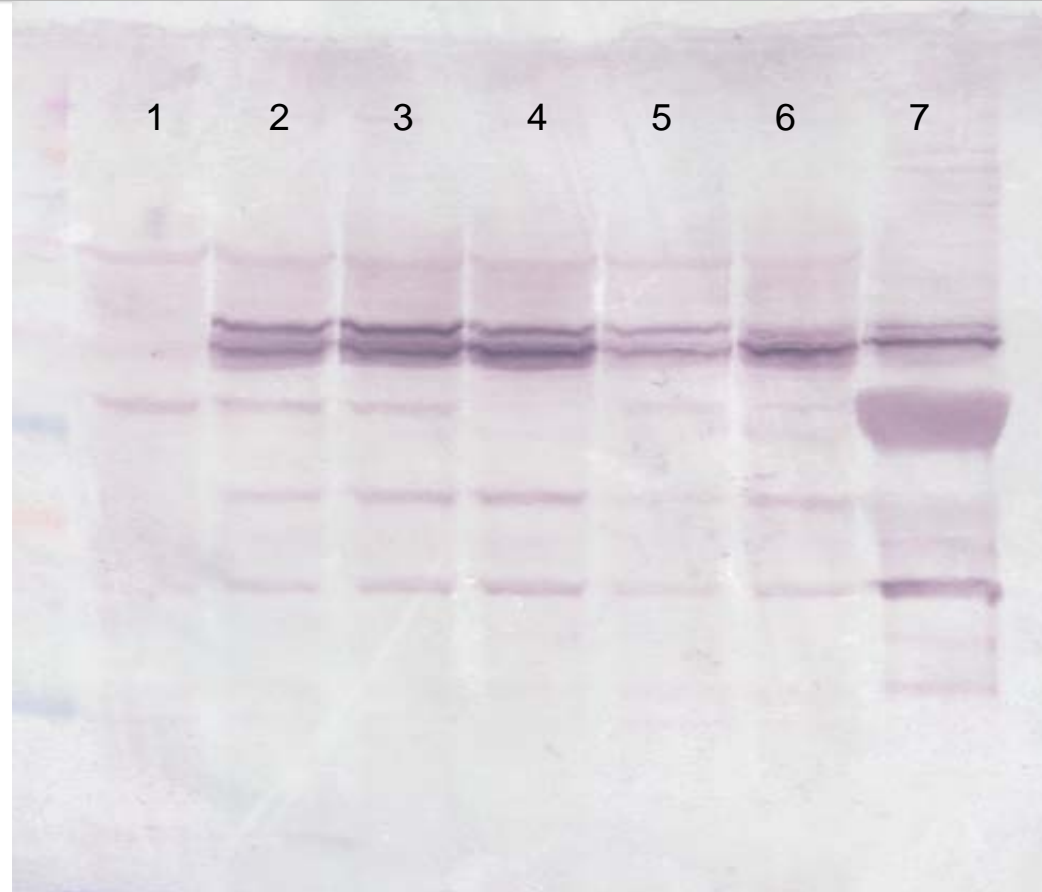


Bt cowpeas are protected from *Helicoverpa armigera*



Cry1Ab in cowpea flowers results in 100% mortality of 2nd instar Maruca larvae within 3 days

Cry 1Ab



Cowpea line

Mortality

1. IT86D-1010	0
2. CP147A2	100%
3. 704E	100 %
4. 708A	100%
5. 705C	100%
6. 710B	100%
7. 710B leaf	0

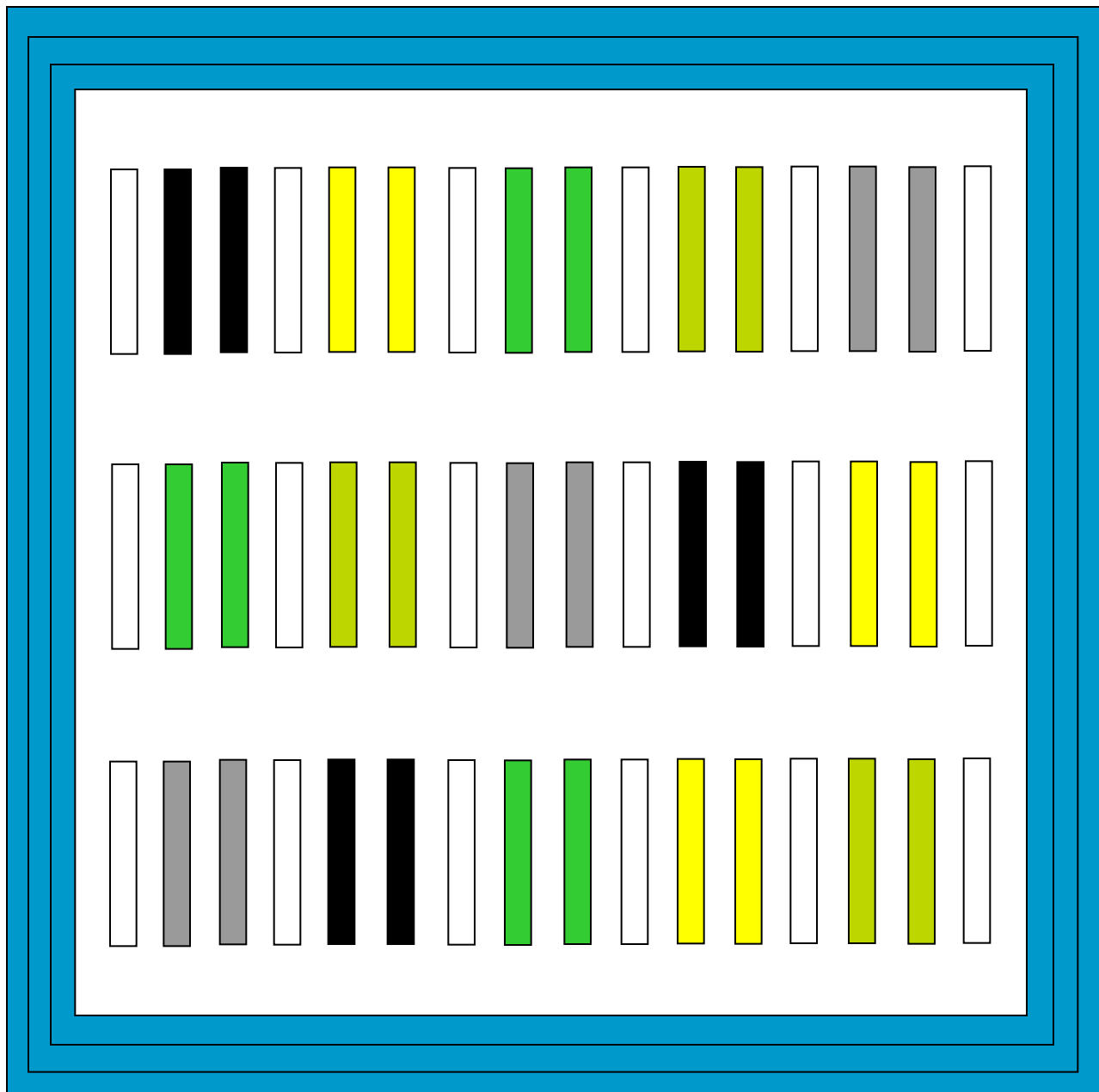
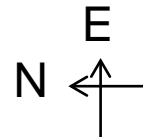
Bt cowpea in field trial in Nigeria








Secured Storage



Secured Fence





-  Border Rows
IT86 D-1010
-  Spreader Rows
-  IT 90K-76
-  709A
-  709B
-  721C2
-  IT86 D-1010

Maruca Resistant Cowpea in Field Trial, 2010



Levels of Cry 1A protein in several transgenic crops

Crop	Leaf	pollen	root	seed	petal	style	pod	cot
Soybean MON87701 Cry1Ac	12-110	1.8-3.1	<LOD	3.1-5.0				
Corn MON810 Cry1Ab	10.34	<90ng/g DW	NS	0.19-039				
Cotton Cry1Ac	2.04	11.5ng/g DW	NS	1.62				
Cowpea Cry1Ab	3.2-68.8	07-5.6	0.01-0.07	0.03-0.8	1.2-5.2	9.3-21	0.7-7.6	0.3-8.4

ng of Bt protein per mg of tissue FW

Conclusions

- Genes for Protection Against Insects Active in Cowpeas
- Proof of Concept of Insect Protection in Lab Studies

Challenges

- **Complete Screen of Existing Bt Transgenics**
- **Repeat of Field Trial to Test for Efficacy in the Field:**
 - Nigeria CFT 2
 - Ghana
 - Burkina Faso
- Permission to Operate
- Biosafety and Regulation
- Gene Introgression and Seed Dissemination

Thank you

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