

# Ongoing aflatoxin related projects at CIMMYT

George Mahuku (*[g.mahuku@cgiar.org](mailto:g.mahuku@cgiar.org)*)

# Ongoing projects

- USAID project (2012-2015): **Breeding and mapping of aflatoxin genetic resistance in maize**
- MAIZE CRP project (2011 – 2016): documenting the incidence and prevalence of mycotoxin contamination in maize.
- MASAGRO – Mexico (2011-2016):
  - validate the response of advanced inbred lines and soon to be released hybrids.
  - Biological degradation
- Insect Resistant Maize for Africa (IRMA) project:
  - Breeding – combining insect & mycotoxin resistance using DH technology
- Drought Tolerant Maize for Africa (DTMA) III (2011-2015):
  - multi-location trials and the assaying of mycotoxins in advanced inbred lines and hybrids
- Effective grain storage project:
  - Validating metal silos and hermetic storage structures (super bags) for storage insect management and aflatoxin.

# Promising tropical maize inbred lines resistant to

## Aflatoxin accumulation

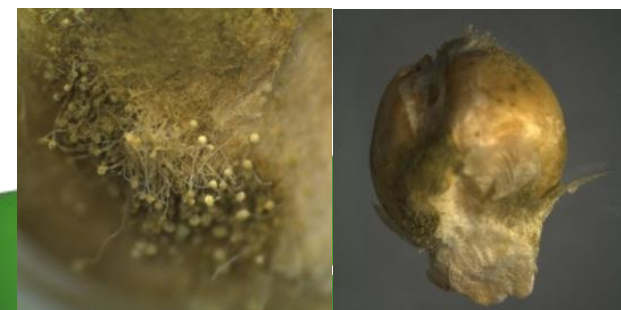
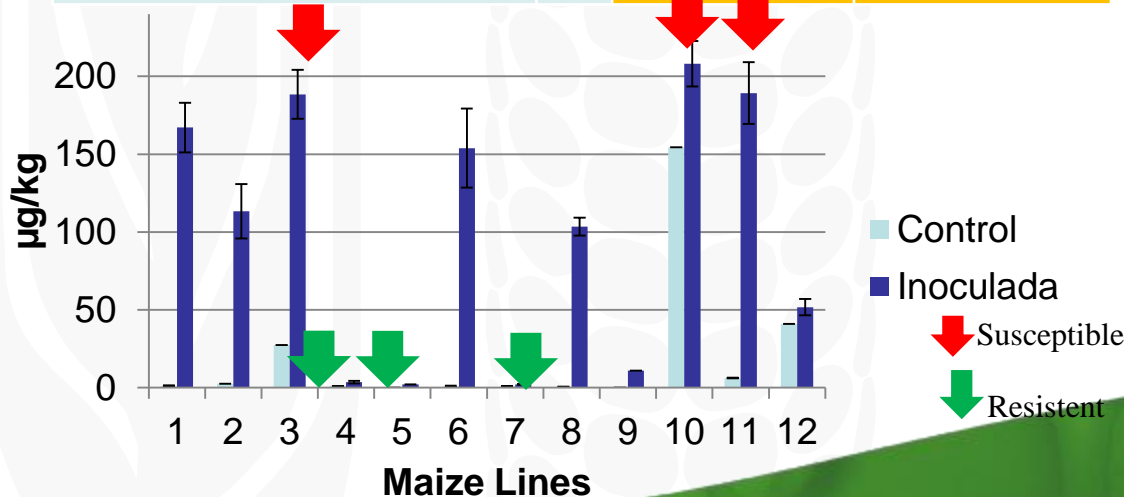
Pedigree	ID	Response to <i>Aspergillus flavus</i> / aflatoxin	
		Natural Field Conditions	Artificial Field Inoculation
CML 52	MS3	R	S
(P36STE-28*36STE-38)-BBBB-###-B*8-B	MS7	R	S
CL-02510	MS4	R	S
CML 495. CL-RCW01	MR1	R	R
CML 247	MR2	R	R
CML-155	MS5	R	S
DERRC2 15-3-1-#2-#1-1-#-# -B	MR3	S	R
DTPWC9-F115-1-2-1-2-B-B-B	MS8	S	S
S.AM.TSR-76-1-1-B-1-BBBB-5-##-B*9-B-B -B	MS6	S	S
90[SPMATC4/P500(SELY)]#-B-4-2-B-B	MR4	S	R
P502c1F9-2-2-1-B-B-1-3-1-1-B-1-B-B-1-B-B-B-B	MS1	S	S
DTPWC9-F67-2-2-1-B-B-B	MS2	S	S

### Aflatoxin B1 levels

Maize ID	AFB1 (ppb)
MR1	3.52 <sup>a</sup>
MR2	2.06 <sup>a</sup>
MR3	2.07 <sup>a</sup>
MR4	10.90 <sup>a</sup>
MS1	208.14 <sup>b</sup>
MS2	189.21 <sup>b</sup>
MS3	167.10 <sup>b</sup>
MS4	188.40 <sup>b</sup>
MS5	153.85 <sup>b</sup>
MS6	51.70 <sup>b</sup>
MS7	113.32 <sup>b</sup>
MS8	103.51 <sup>b</sup>

Means followed by same letter are not significantly different ( $P=0.05$ ). Data is for two years of field evaluation.

Level of AFB1

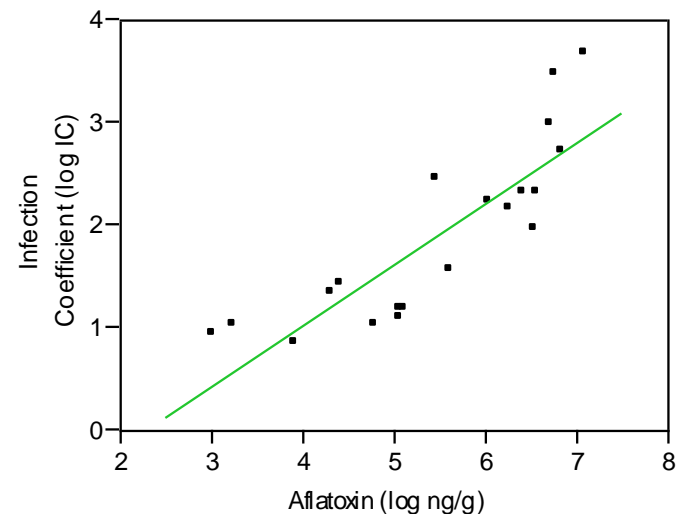
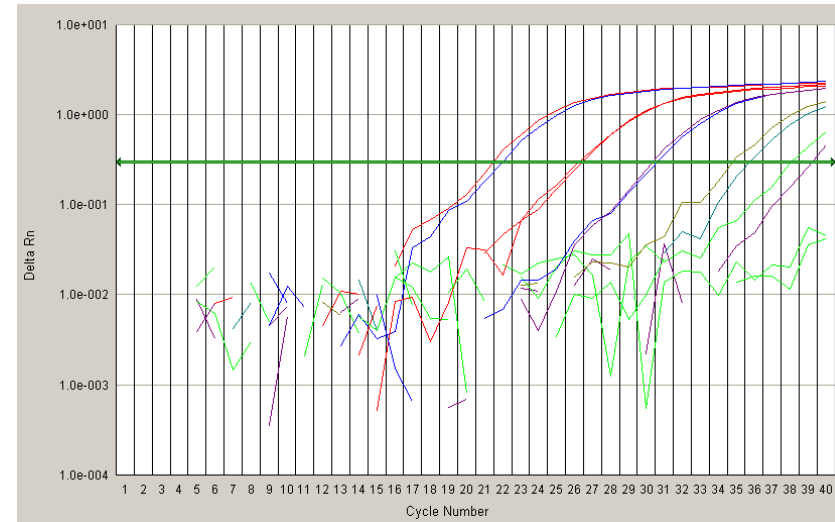


# Tools for reliable identification of resistant lines (Quantifying Fungal Biomass to identify Aflatoxin resistant lines)

- Using real time PCR (qPCR) to measure *Aspergillus* colonization of maize
- Correlation between fungal biomass and aflatoxin B1 levels

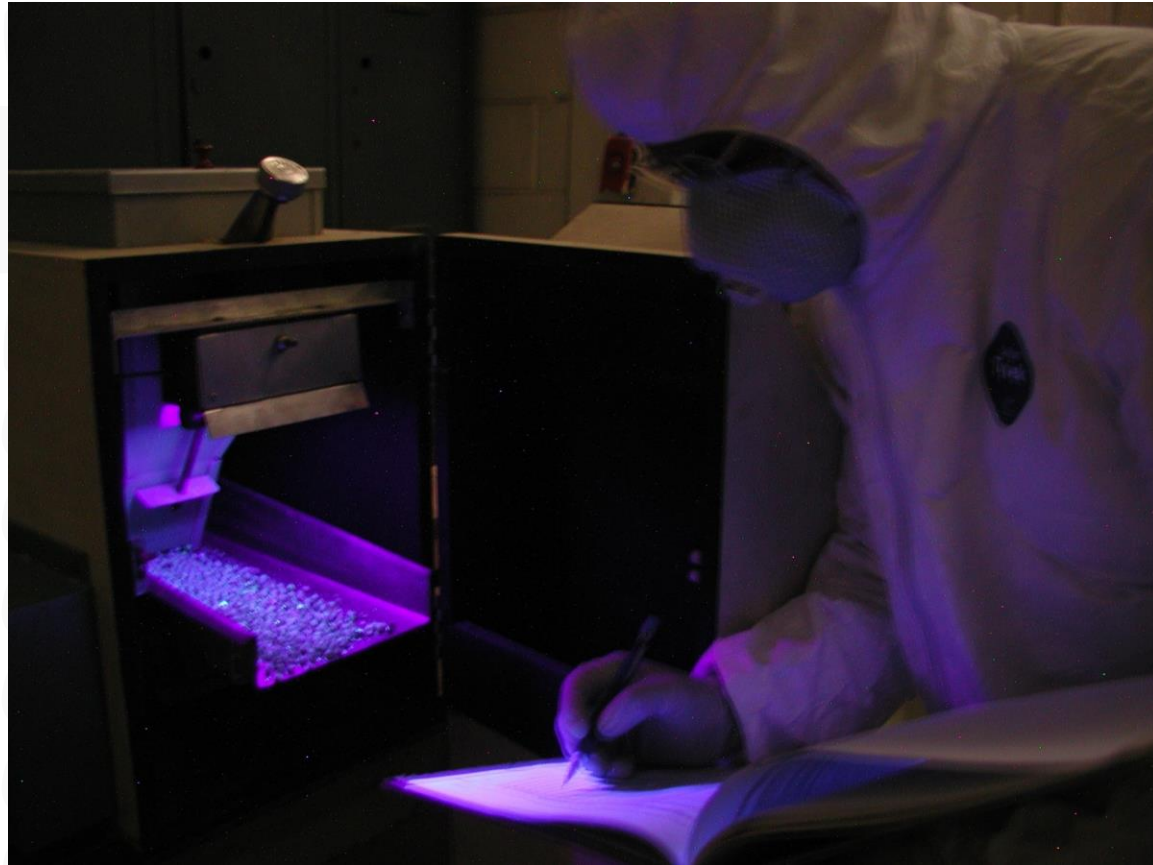
## Correlation between AFB1 and

Maize Line ID	Aflatoxin		Correlation Coefficient
MR1	2.70	9E-05	0.2
MR2	3.69	5E-04	1
MR3	1.32	1E-04	0.46
MS1	48.55	5E-02	0.90
MS3	40.35	8E-03	1
MS4	26.00	3E-03	1



# Black light assay for *A. flavus*

- Prescreening of *Aspergillus* ear rot infection
- Uses black light assay to observe fluorescence from kojic acid, a secondary metabolite observed in colonized grain.
- Entries with the lowest levels will be run in assays to quantify aflatoxin B1 levels.



# DH lines combining DT and ear rot / mycotoxin resistance

	Pedigree	Number of DH lines
1	(DTPWC9-F16-1-1-1-1-B-B-B-B / CML-495)	39
2	(DTPYC9-F46-1-2-1-2-B-B-B / CML-451 )	139
3	(DTPYC9-F65-2-2-1-1-B-B-B /CML-451)	28
4	(DTPYC9-F74-1-1-1-1-B-B-B-B / CML-451)	124
5	(DTPWC9-F104-5-4-1-1-B-B-B-B / CML-449 )	15
6	(DTPWC9-F115-1-2-1-2-BBB / CML-449)	69
7	(La Posta Seq C7-F71-1-2-1-1-B-B-B-B / CML-449 )	10
8	(La Posta Seq C7-F86-3-1-1-1-B-B-B-B / CML-495)	69
9	(LA POSTA SEQ.C7-F180-3-1-1-1-BBB / CML-449 )	78
10	(LA POSTA SEQ. C7 F64-2-6-2-2-B-B-B / CML-495 )	246
	<b>Total</b>	<b>817</b>



# Evaluation of DH lines for response to *Fusarium* and *Aspergillus* ear rots and mycotoxins



(LA POSTA SEQ. C7 F64-2-6-2-2-B-B-B / CML-495 )

246 lines

# Artificial inoculation with *Aspergillus flavus*



Silk channel inoculation  
technique



Kernel puncher inoculation  
technique



# Aflatoxin resistant germplasm

- Sources of mycotoxin resistance
  - 30 inbred lines from USDA received in CIMMYT and IITA
  - Line increase and Test crosses generation
  - Multiple location testing in Africa (Kenya , Zimbabwe and Nigeria)
  - Identified sources will be used for line development using the DH technology.

# Mycotoxin analysis from regional trials - ILPOP

Site	# of Samples	Mean	Minimum	Maximum	Samples <10 ug/kg	Samples >10 ug/kg
3	58	9.051	0.56	42.92	67.2	32.8
27	60	17.54	0.31	209.35	83.3	16.7
28	41	4.690	0.08	76.16	92.7	7.3
29	56	9.53	0.24	169.45	75	25
30	50	1622.25	1.76	53066.5	34	66
31	49	601.95	0.76	9837.09	38.8	61.2
33	60	0.91	0.02	11.34	98.3	1.7
34	41	0.08	0.01	0.32	100	0
35	51	1142.44	0.03	58239.75	98	2
37	60	15.06	0.09	573.52	90	10
38	56	4.30	0.001	32.61	85.7	14.3

# SAMPLES

Trial	Number of sites	# of Samples	
ILHYB	12	1869	
EIHYB	10	1352	
ILPOP	11	457	
EPOP	7	1430	
Total	33	3678	