Development of high yielding aflatoxin resistant maize hybrids for improved nutrition and health in Ghana

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Introduction

- Maize is Ghana's number cereal providing food for millions of Ghanaians daily. The productivity of the crop in farmers fields is generally low compared to the global average. Aflatoxin contamination in maize is common in farmers fields. Aflatoxins affects human health and is an impediment to the export potential of the crop. Developing high yielding maize hybrids with low levels of aflatoxin contamination will positively impact productivity and general wellbeing of the entire Ghanaian populace and also boost its export potential.

Research Approach:

❖ Aflatoxin resistant donor lines provided by the CHPRRU of the USDA ARS Starkville MS were incorporated into elite local inbred lines, using marker assisted selection (SSR and SNP markers)

❖ The hybrids produced were evaluated in multi-locational trials to identify high yielding aflatoxin resistant genotypes.

One of the Schematic designs of breeding approach:

Make Top-cross hybrids of the introduced inbred lines with 6 high yielding local varieties

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Evaluate F1 hybrids in a multi-locational trials and Phenotype high yielding genotypes for aflatoxin resistance

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Select parents of high yielding hybrids with low levels of aflatoxin For further evaluation for eventual release as variety(ies)

Parameters estimated:

❑General and specific combining abilities determined from the F1 hybrids
❑ Percentage heterosis estimated from F1 hybrids
❑ Yields of hybrids obtained were compared with local existing best performing hybrids
❑ Promising hybrids with high accumulation of aflatoxin resistance QTL will be further evaluated across locations with farmer participation.

❑Data Collected:

•Plant height (PH)
•Ear height (EH)
•Anthesis-silking interval (ASI)
•Yield per hectare (Yld/ha in kg)
•Incidence of blight, rust, MSV, etc.
•Level of aflatoxins was detected/quantified in (ppb)
•SSR and SNP data

Other Project Activities:

Capacity building: supply of equipment

Capacity building activities undertaken by the project include provision of VICAM aflatoxin detection set up, a plate reader for SNP analyses, computers and reagents

Capacity building: Human Resource;

❖ The project developed the human resource base of the Institute including training a PhD in Maize breeding

Some results from field experiments

Table 1a. Grain yield and other agronomic traits of some selected hybrids (best 14 and 9 checks) evaluated in three environments (Fumesua, Wenchi and Akomadan) during the major season in 2017

Genotype			Grain Yield (Kg/ha)	Days to (50% Pollen)	Days to (50% Silking)	Anthesis Silking Interval	Ear Per Plant	Ear Height	Plant Height	Cob Aspect	Base Index
M0826-7F	x	TZI-8	11073.21	47.9	49.78	1.89	1.03	111.34	200.37	1.65	22145.51
TZEEI-15	x	MP-715	10937.71	47.34	50.22	0.33	0.78	112.42	202.38	2.6	21873.35
M0826-12F	x	CML-176	10688.27	51.36	53.56	2.22	1.12	121.03	230.81	1.91	21375.44
ENTRY-5	x	CML-11	10682.01	50.87	54	3.11	1.02	99.58	198.74	1.67	21362.8
ENTRY-85	x	CML-247	10661.02	48.21	51.33	3.11	1.01	124.94	231.15	1.98	21320.98
ENTRY-5	x	CML-287	10217.87	50.77	52.89	2.11	1.1	125.24	227.64	1.78	20434.71
M0826-7F	x	CML-11	10191.01	50.36	53.56	3.22	1.12	116.54	215.31	1.85	20380.89
M0826-12F	x	CML-343	10101.31	49.94	53.32	3.34	0.93	116.86	235.28	1.77	20201.39
M0826-7F	x	CML-343	9756.17	52.9	55.56	2.67	1.1	109.02	215.47	2.01	19511.38
ENTRY-5	x	KI-3	9691.46	48.32	50.11	1.78	0.96	94.62	189.83	2.13	19381.52
ENTRY-5	x	TZI-8	9550	49.02	50.89	1.89	0.94	106.17	196.15	1.92	19098.74
TZEEI-6	x	CML-11	9493.08	48.29	51.33	3	1.15	117.32	219.73	1.98	18984.98
ENTRY-70	x	CML-247	9347.85	50.69	53.78	3.11	0.99	97.07	194.82	1.76	18694.53
M0826-7F	x	CML-5	9296.19	50.21	53.33	3.11	1.04	110.53	220.71	1.9	18591.24

Table 1b. Grain yield and other agronomic traits of some selected hybrids (9 checks) evaluated in three environments (Fumesua, Wenchi and Akomadan) during the major season in 2017

Genotype		Grain Yield (Kg/ha)	Days to (50% Pollen)	Days to (50% Silking)	Anthesis Silking Interval	Ear Per Plant	Ear Height	Plant Height	Cob Aspect	Base Index
OBAATANPA	(Check)	3651.06	52.95	55.44	2.44	0.94	118.96	234.44	1.95	7300.9
AFRIYIE	(Check)	3948.57	46.43	49.05	2.56	1.05	95.52	182.13	2.11	7895.4
TINTIM	(Check)	4299.25	52.06	54.35	2.22	1.17	103.88	192.86	2.11	8597.2
AHODZIN	(Check)	4932.32	53.19	56.02	3.22	1.01	108.08	208.13	2.33	9863.2
HONAMPA	(Check)	5151.27	50.89	54.22	3.33	0.96	110.06	195.34	2.11	10301
ABONTEM	(Check)	5358.48	50.77	53.27	2.33	1.04	113.11	200.37	2.56	10715
Mamaba	(Check)	6020.58	49.8	51.8	2.11	0.89	102.76	197.2	2	12040
ABUROHEMAA	(Check)	6118.45	47	49.78	2.78	1.08	100.2	299.74	1.89	12235
Etubi	(Check)	6991.75	49.99	52.23	2.44	0.96	115.47	206.22	2	13982
MAX		11073.2	53.19	56.02	4.66	1.26	116.73	236.78	2.6	
MIN		3651.06	43.43	45.89	0.33	0.89	94.62	169.85	1.53	
SED		1217	1.61	1.59	0.48	0.51	29.15	49.2	0.38	

❑ **Top next steps for the project:**

❖ Promising high yielding hybrids with low levels of aflatoxin contamination will further be evaluated for eventual release as varieties for use in Ghana and beyond.

❖ New findings will be published in peer review journals.

❑ **How data and results from your project will impact stakeholder decisions and the development problem:**

❖ Data generated from this work can help in identifying genotypes/hybrids with low levels of aflatoxin contamination and are high yielding which can be made available maize consumers in Ghana and beyond

❑ **Challenges you have faced in collecting meaningful data:**

❖ The major challenge has been manual collection of data from the field especially during unfavorable conditions and costs associated with importing equipment and reagents from outside Ghana