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Evaluation of GEM Germplasm for Resistance to Aflatoxin Accumulation 2007 Results

Contamination of corn grain with aflatoxin, a toxin produced by the fungus *Aspergillus flavus*, is a major impediment to profitable corn production in the southern United States. ARS breeding programs at Tifton, Georgia and Mississippi State have been engaged in a long-term effort to identify sources of resistance and to develop germplasm with resistance to aflatoxin accumulation. In recent years, the GEM project has been a primary source of new germplasm for resistance screening. Results of some of the 2007 evaluations follow.

1. Evaluation of inbreds for resistance to aflatoxin accumulation at Mississippi State in 2007 (Table 1). Entries 1-11 were provided by Mike Blanco. They exhibited excellent resistance to Fusarium ear rot in an evaluation conducted in California. Entries 12-22 had been selected for resistance to aflatoxin accumulation by Matt Krakowsky at Tifton, Georgia. Entries 23-33 were selected for resistance to aflatoxin accumulation by Michael Clements, Gary Windham, and Paul Williams at Mississippi State. Entries 34-37 are resistant checks and 38-40, susceptible checks. These lines were grown in a randomized complete block design with four replications. Ears were inoculated with an *A. flavus* spore suspension 7 days after midsilk using the side needle technique. Aflatoxin concentration in the grain was determined by the Vicam Afla Test. Data were transformed [ln (y+1)] for statistical analysis.

2. Evaluation of top crosses for aflatoxin accumulation at Mississippi State in 2007 (Table 2). Top crosses of the inbreds exhibiting Fusarium ear rot resistance in California were obtained from Mike Blanco (entries 1-11). They were evaluated along with crosses of lines selected for resistance to aflatoxin contamination at Mississippi State; some of the lines were derived from GEM germplasm. The crosses were evaluated in a randomized complete block design with four replications. Ears were inoculated with an *A. flavus* spore suspension 7 days after midsilk using the side needle technique. Aflatoxin concentration was determined by the Vicam Afla Test procedure. Data were transformed [ln (y+1)] before statistical analysis.

3. Multi-location evaluation of top crosses for resistance to aflatoxin accumulation (Table 3). Lines selected from GEM germplasm for resistance to aflatoxin accumulation were evaluated in top crosses at Raleigh, NC; Tifton, GA; and Mississippi State, MS, in 2007. The top crosses were grown in a randomized complete block design with four replications at each location. At Raleigh and Mississippi State, developing ears were inoculated with *A. flavus* using the side needle technique. At Tifton, ears were inoculated with a knife dipped in an *A. flavus* spore suspension. Aflatoxin concentration in the grain was determined by using the Vicam Afla Test. Data were transformed [ln (y +1)] for statistical analysis. The entry × location interaction was highly significant.

Table 1. Evaluation of lines for aflatoxin accumulation at Mississippi State in 2007.

Entry	Pedigree	Aflatoxin	
		ln (y+1)[a]	ng/g[b]
1[c]	(1881-002/98_DKXL370AN11F2S3_7521-05)-B-B	5.54	255
2	(1883-002/98_DKXL370AN11F2S3_7521-05)-B-B	5.78	324
3	(1883-001/98_DKXL370AN11F2S3_7521-05)-B-B	4.43	83
4	(1886-003/98_DKXL370AN11F2S3_7521-05)-B	5.46	232
5	(1895-001/98_DKXL370AN11F2S3_7521-29)-B-B	7.18	1317
6	(1507-001/98_DK212TN11F2S3_7431-03)-B-B	6.70	808
7	BR51721:N2012-397-001-B-B	7.81	2461
8	AR16026:S17-10-1-B-B	5.46	234
9	PE001n16F2S2-239-B-B-B	6.56	703
10	AR16026:S17-237-002-B-B-B-B-B	6.90	994
11	DKXL370:N11a20-322-001-B-B-Sib-B	5.56	258
12[d]	AR16026:S17-10-1-B-B-B-1	7.43	1683
13	AR16026:S17-10-1-B-B-B-3	7.56	1918
14	(2086-01_DK212T_S11_F2S4_9154-Blk20/00-sib)-1	5.80	330
15	(2086-01_DK212T_S11_F2S4_9154-Blk20/00-sib)-2	5.93	377
16	(2250-02_XL370A_S11_F2S4_3363-Blk03/00-sib)-1	3.58	35
17	(2258-03_XL380_S11_F2S4_71/97_Bulk/98-sib)-1	7.72	2254
18	(2258-03_XL380_S11_F2S4_71/97_Bulk/98-sib)-2	7.20	1337
19	(2258-03_XL380_S11_F2S4_71/97_Bulk/98-sib)-3	7.91	2715
20	CUBA117:S15-101-1-B-B-B-1-1	5.81	332
21	CUBA117:S15-101-1-B-B-B-2-1	4.23	68
22	CUBA117:S15-101-1-B-B-B-5-1	4.92	136
23[e]	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-4-4-1-B	4.54	93
24	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-4-9-3-B	5.26	191
25	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-4-11-1-B	6.18	482
26	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-4-11-2-B	6.55	702
27	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-5-1-2-B	4.60	98
28	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-5-1-3-B	4.22	67
29	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-5-4-2-B	4.22	67
30	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-1-4-1-B	6.38	589
31	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-1-6-1-B	6.47	642
32	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-1-7-2-B	3.42	29
33	(2250-01_XL370A_S11_F254_9214_Blk21/00-#)-1-9-1-B	5.41	223
34[f]	Mp 313E (Resistant)	4.53	91
35	Mp 420 (Resistant)	6.54	690
36	Mp 717 (Resistant)	5.38	215
37	NC 300 (Resistant)	5.25	189
38	Va 35 (Susceptible)	7.84	2551
39	GA 209 (Susceptible)	9.17	9652
40	SC 212M (Susceptible)	8.88	7206
	LSD (0.05)	1.17	
	Mean	5.95	
	CV	13.36	

[a] Data were transformed [ln (y+1)] before statistical analysis.

[b] Geometric means were calculated by converting transformed means to the original scale.
[c] Entries 1-11 were previously selected for resistance to Fusarium ear rot.
[d] Entries 12-22 were selected for resistance to aflatoxin accumulation at Tifton, GA.
[e]Entries 13-33 were selected for resistance to aflatoxin accumulation at Mississippi State, MS.
[f]Check inbreds.

Table 2. Evaluation of top crosses for aflatoxin accumulation at Mississippi State in 2007.

Entry	Pedigree	Aflatoxin	
		ln (y+1)[a]	ng/g[b]
1[c]	1881-002/98 DKXL 370AN11F2S3xT1	5.26	192
2	1883-002/98 DKXL 370AN11F2S3xT1	5.73	306
3	1883-001/98 DKXL 370AN11F2S3xT8	4.97	143
4	1886-003/98 DKXL 370AN11F2S3xT8	4.61	100
5	1895-001/98 DKXL 370AN11F2S3xT8	6.31	548
6	1507-001/98 DK212TN11F2S3xT8	6.82	915
7	BR51721:N2012-397-001 x HC33	6.39	593
8	AR16026:S17-10-1-B x LH283	5.13	169
9	PE001n16F2S2-239 x LH200	5.61	273
10	AR16026:S17-237-002-B-B-B-B x DKXL370:N11a20-322-001-B-B-B-B	5.29	197
11	[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-5] x LH210	6.05	422
12[d]	[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-4-11-1-1] x Va35	5.56	258
13	[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-1-1-1] x Va35	4.56	94
14	Mp 04:96 x LH210	5.36	213
15	Mp 04:97 x LH210	3.45	31
16	Mp 04:97 x Va35	3.97	52
17	Mp 04:97 x NC 388	3.72	40
18	Mp 04:97 x Mo18W	4.63	102
19	B110 x Mp 04:110	4.65	103
20	B110 x Mp 04:96	5.15	172
21	B110 x Mp 04:97	4.20	65
22	(CUBA:S15)F7-1a-1-1-1-1 x MP 04:110	4.94	139
23	(CUBA:S15)F7-1a-1-1-1-1 x MP 04:96	4.76	116
24	(CUBA:S15)F7-1a-1-1-1-1 x MP 04:97	4.40	80
25	Mp 04:104 x B110	5.60	270
26	S2B73 x Mp 04:110	5.07	158
27	S2B73 x Mp 04:96	5.48	238
28	S2B73 x Mp 04:97	5.92	373
29	Mp 313E x Mo18W (Resistant ck)	3.72	40
30	Mp 313E x Mp717 (Resistant ck)	2.05	7
31	T173 x LH219 (Susceptible ck)	6.09	442
32	T173 x Va35 (Susceptible ck)	7.04	1141
33	GA209 x SC212m (Susceptible ck)	6.45	631
34	Dk679 (commercial ck)	7.66	2122
35	3310 (commercial ck)	7.81	2464
	LSD (0.05)	1.14	
	Mean	5.40	
	CV	15.11	

[a] Data were transformed [ln (y+1)] before statistical analysis.

[b] Geometric means were calculated by converting transformed means to the original scale.
[c] Entries 1-11 were top crosses previously screened for Fusarium ear rot in California.
[d] Entries 12-28 are top crosses and other crosses among lines selected for resistance to aflatoxin accumulation at Mississippi State.
[e]Entries 29-35 are hybrid checks..

Table 3. Aflatoxin accumulation in testcrosses of lines selected from GEM germplasm and evaluated at Raleigh, NC; Tifton, GA; and Starkville, MS, in 2007.

Pedigree	Aflatoxin							
	Raleigh		Tifton		Starkville		Overall	
	ln(y+1)[a]	ng/g[b]	ln(y+1)[a]	ng/g[b]	ln(y+1)[a]	ng/g[b]	ln(y+1)[a]	ng/g[b]
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-4-4-1-1] × Va35	4.11	60	5.18	177	4.02	55	4.44	84
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-4-10-1-1] × Va35	4.43	83	5.27	193	3.81	44	4.50	89
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-4-11-1-1] × Va35	6.23	507	4.98	144	5.34	207	5.52	247
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-5-1-1-1] × Va35	3.67	38	5.18	176	4.27	71	4.37	78
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-5-3-1-1] × Va35	4.31	73	4.33	75	3.85	46	4.16	63
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-5-4-1-1] × Va35	5.45	232	4.85	127	5.14	170	5.15	171
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-1-1-1] × Va35	3.38	28	5.06	156	3.90	49	4.11	60
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-2-B-1] × Va35	4.54	93	4.95	140	4.70	109	4.73	112
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-3-1-1] × Va35	4.98	145	4.99	145	3.77	42	4.58	96
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-4-1-1] × Va35	6.41	608	5.41	224	5.72	305	5.85	346
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-5-1-1] × Va35	4.31	73	4.07	58	4.71	111	4.37	78
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-6-1-1] × Va35	6.22	500	6.01	406	6.16	473	6.13	458
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-7-1-1] × Va35	4.65	103	5.32	203	4.34	76	4.77	116
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-8-1-1] × Va35	2.83	16	5.07	158	3.70	40	3.87	47
[(2250_01_XL370AS11-F254_9214_Blk21/00-#)-1-9-1-1] × Va35	4.77	117	4.77	117	4.53	92	4.69	108
Mp04:97 × Va35	6.46	641	4.70	109	3.99	53	5.05	155
Mp313E × Va35	6.25	517	4.95	141	3.29	26	4.83	124
Mp715 × Va35	6.21	495	5.62	276	5.51	247	5.78	323
Mp717 × Va35	5.69	294	5.32	203	4.90	133	5.30	200
GA209 × Va35	7.13	1242	5.97	390	5.90	365	6.33	561
LSD(0.05)	1.50		0.97		1.27		0.72	
Mean	5.10		5.10		4.58		4.93	
CV	20.6		13.45		19.57		18.05	

[a]Data were transformed [ln(y+1)] before statistical analysis.
[b]Geometric means were calculated by converting transformed means to the original scale.