

BREEDING CULTIVARS AND GERMPLASM WITH ENHANCED YIELD AND QUALITY, 2012

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Introduction

The classical breeding component of the University of Georgia cotton improvement program works to develop germplasm with traits that can be used to meet the requirements of both producers and consumers. Higher and more stable yields combined with the fiber properties requested by yarn and textile manufacturers are the goals for profitable production and processing to support the Georgia cotton industry. The objective of this report is to update progress made toward meeting these goals during the 2012 production season.

Materials and Methods

Our crosses mate elite University of Georgia breeding lines with promising germplasm and non-transgenic commercial cultivars to produce 12 sets of 6 half-sib families for 2012. These F_2 -bulk populations from crosses made in the previous year and advanced at the counter-seasonal nursery in Tecoman, MX are evaluated for lint yield in 2-replicate, randomized complete block designs, with each set of half-sib F_2 families, the GA breeding line parent, and the check cultivar, GA 230, constituting a test. Of the F_2 -bulk populations evaluated, the highest yielding populations are advanced in to F_3 for single plant selection.

The first level of selection of the F_3 plants are decided by visual determination with more individuals selected from the best populations, fewer individuals from the better populations, and perhaps none from the poorer populations. If a segregation of a desirable and non-desirable class is evident in the poorer populations, individual desirable plants are selected from each of these populations. Of the approximately 1,000 selected F_3 plants, the plants with lint fractions less than 39% are discarded and then further selected on the basis of HVI fiber properties.

Selections normally are advanced to F_4 progeny rows in Plains, GA, for evaluation in an un-replicated grid design, with the middle row of each 9 row set of the trial assigned to the University of Georgia cultivar GA 230 with two secondary check cultivars. The F_4 test is machine harvested and the seed-cotton yield of each F_4 progeny row is compared with the seed-cotton yield of the nearest row of GA 230 which is, in turn, modified depending on the distribution of the yield values across the test field. Further selections of the F_4 are based essentially on the fiber quality measures of length, strength, and fineness and on lint percentage to promote for testing in the F_5 preliminary yield trials (PTs).

Separate, later-planted seed increase plots that are grown in isolation near Tifton, GA allow additional visual selection and hand harvest of seed-cotton to maintain genetic purity of the F_4 , F_5 , F_6 , and elite generation experimental lines. Additional increases are planted at the University of Arizona's Maricopa Agriculture Center in Maricopa, AZ to provide excellent quality seed for the field tests in the subsequent years.

The six 2012 PTs were conducted at the William Gibbs Research Farm, UGA – Tifton Campus, Tifton, GA in fields 04211, 04213, 04253, 04261, 04262, 04263, and 04264. Each PT had between 14 and 31 F_5 breeding lines and 2 commercial conventional checks (GA 230 and Deltapine DP 493) in a three replicate, randomized complete block designs for a total of 111

experimental entries. The Advanced Trials (AT1 and AT2) were conducted at the University of Georgia – Tifton campus, Tifton, GA (at the William Gibbs Research Farm, fields 04240, 04241, and 04242) and Southwest Georgia Research and Education Center, Plains, GA (in fields 25/26). The AT1 consisted of 28 experimental F₇ entries retested from 2011 because of poor emergence. The AT2 consisted of 25 F₆ entries considered the best from the PTs grown in 2011. The trials were planted in a three replicate, randomized complete block design with GA 230, GA 2004303, GA 2004143, and Monsanto DP 493 as the four checks. Prior to machine harvest of all trials except the F₂ and F₄ generations, 25 unweathered, open bolls from the middle of the fruiting zone were harvested from each plot, and subsequently ginned on a 10-saw laboratory model gin to determine lint percentage.

Fiber samples of the PTs and ATs were submitted to Cotton Incorporated in Cary, NC for HVI fiber analysis. The elite (material > F₇) germplasm lines with high potential were tested in the 2012 Georgia Official Strains Trial (OST) and Official Variety Trials (OVTs) (Day and Thompson, 2013).

Results and Discussion

Seven of our lines (GA 230, GA 2007095, and GA 2008083 with the later maturing varieties and GA 2004143, GA 2006106, GA 2008057, and GA 2009100 with the earlier maturing varieties) were tested in the 2012 GA OVTs (Day and Thompson, 2013). The following is a general synopsis of these lines with further details found in the Georgia 2012 Peanut, Cotton, and Tobacco Performance Tests (Coy et al., 2013).

In the irrigated Earlier Maturity Trial, GA 2009100 and GA 2004143 were ranked 9th and 10th over all of the locations for lint yield out of 30 entries. All of the entries that we entered have a superb fiber quality package. GA 2009100 appears to perform better than most of its competitors in a dry condition; it ranked 3rd overall in lint yield this year within the dryland trial. It was decided to give GA 2006106 another chance in 2012, but as it did in 2010 and 2011, it was good in 2012 but not good enough. GA 2008057 also again compared poorly to the best yielding variety this year, but even with its excellent strength (2nd ranking overall), it won't be tested further. GA 2009100 and GA 2004143 had some excellent yields and ranked toward the top of the test, thus showing the eliteness of our program.

In the Later Maturity Trial, the three GA entries (GA 230, GA 2007095, and GA 2008083) ranked overall from the middle to the bottom third of the trial, respectively. GA 230 and GA 2007095 persist in showing solid fiber packages in the irrigated trial while there was some separation in the dryland trial. GA 230 continues to show excellent length under all conditions with very good uniformity, strength, and micronaire except for one instance in the dryland test in Plains. Oddly enough it appeared normal (i.e., among the longest cotton) in the irrigated test in Plains. GA 2008083 did not fare well enough in yield or quality and will be dropped.

Five lines were retested last year in the 2012 Georgia OSTs (GA 2008016, GA 2009037, GA 2009147, GA 2009148, and GA 2009180) with one new line GA 2010098 (Day et al., 2013). The other line from 2011 GA 2009100 was promoted to the 2012 GA OVTs. The entire group has solid to excellent fiber packages, as good as or better than the competition. The new entry GA 2010098 was the best yielder of our material and ranked 4th across the three locations (Midville, Plains, and Tifton) though significantly less than the top entry. Our next best yielders GA 2009037 and GA 2008016 will also be promoted to the 2012 GA OVTs with GA 2010098.

The 2011 AT1 trial was replanted as the 2012 AT1 trial and the 2012 AT2 trial was of promoted lines from the 2011 PT tests, both of which were in our two standard locations Tifton and Plains. Both of the trials had interactions between the cultivars and the locations, and oddly enough the traits that did not have the interactions were not the same across AT1 and AT2 except for the length measure UHM (Table 1 and Table 2). Tables 3 to 6 show the individual performances of the lines within their locations. This also shows the variability of the response of the lines to the two differing locations. An additional trial called the Elite Trial will be planted in 2013 with the best 25 lines of these two AT trials (a weaker selection pressure than we normally use at this stage) so the proper selections can be made with these lines.

From the 2012 PTs, twenty-six lines were selected for testing in the 2013 AT1 trial based primarily on lint yield and fiber qualities as compared to checks. Higher lint % and uniformity index as well as of course increased lint yield are the primary components of the selection within these populations looking to develop a cultivar better than our GA 230.

Based on lint yield comparisons and fiber quality measures, one hundred thirty-eight F_4 progenies were selected for placement in the 2013 PTs, more than we normally have had in total. Twenty populations from the 2012 F_2 yield test were selected for placement in the 2013 F_3 nursery for single plant selections.

Seventy-one F_1 crosses were sent to the USDA-ARS Cotton Winter Nursery in Tecoman, Mexico for selfing to the F_2 generation. These will be placed in replicated 2013 F_2 yield tests to determine the suitability of the germplasm populations to be further tested.

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References

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Table 1. Results of 2012 Advanced (F₇) Trial 1.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2010019	1475	42.0	1.22	85.5	4.7	32.6
GA 2010076	1469	41.7	1.23	84.9	5.1	35.7
GA 2010102	1463	40.0	1.24	85.4	5.1	34.8
GA 2004143	1413	43.5	1.23	84.9	4.8	34.0
GA 2010085	1409	43.5	1.27	85.0	4.6	33.1
GA 2010079	1400	41.4	1.23	84.6	5.1	33.6
GA 2010074	1399	42.9	1.21	84.9	5.2	33.4
GA 2010064	1385	41.6	1.25	85.8	4.7	33.6
GA 2010002	1376	41.9	1.27	85.9	5.0	34.5
GA 2010052	1371	41.9	1.22	85.2	4.6	32.8
GA 2004303	1370	42.3	1.19	84.8	5.1	33.4
GA 2010032	1369	42.8	1.28	84.9	4.5	32.7
GA 2010106	1362	41.9	1.24	85.6	4.6	33.2
GA 2010070	1362	43.2	1.23	85.3	4.7	33.9
DP 493	1357	41.9	1.22	84.6	4.9	32.2
GA 2010063	1354	43.3	1.22	85.4	5.0	33.5
GA 2010016	1326	40.6	1.24	85.2	4.7	33.0
GA 2010069	1326	42.2	1.24	85.8	4.9	33.4
GA 2010038	1314	41.4	1.24	85.6	4.5	34.7
GA 230	1299	40.2	1.21	85.1	4.8	33.2
GA 2010098	1291	39.8	1.23	85.2	5.1	32.6
GA 2010047	1287	42.4	1.22	85.8	4.9	32.7
GA 2010086	1283	41.9	1.24	85.7	4.8	32.4
GA 2010068	1273	42.1	1.23	85.6	4.6	33.0
GA 2010024	1262	41.2	1.27	85.7	4.5	33.0
GA 2010030	1253	41.3	1.27	85.7	4.6	32.5
GA 2010049	1249	40.2	1.27	85.3	4.9	33.7
GA 2010050	1249	39.3	1.24	85.1	4.9	33.1
GA 2010067	1213	41.3	1.25	86.3	4.8	34.4
GA 2010021	1168	40.2	1.24	85.3	4.5	32.8
GA 2010015	1095	41.4	1.24	85.5	4.9	33.2
GA 2010058	1054	42.5	1.23	84.7	4.6	32.1
Cultivar by Location interaction	**	†	NS	*	***	NS
LSD_{0.10}			1.26			34.9

When location by entry interaction is significant, the locations cannot be combined to compare for significant differences; **NS (no significance)**, **† (10%)**, ***** (5%), **** (1%)**, & ***** (0.1%)**. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 2. Results of 2012 Advanced (F₆) Trial 2.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2011004	1444	45.7	1.18	84.8	5.2	31.1
GA 2011191	1442	43.6	1.19	84.7	5.1	31.3
GA 2011113	1405	42.8	1.19	85.0	5.2	31.4
GA 2011156	1392	44.0	1.20	84.8	5.2	31.2
GA 2011093	1391	42.5	1.21	85.9	5.2	32.5
GA 2011005	1375	44.6	1.19	85.7	5.0	32.3
GA 2011158	1370	44.3	1.18	85.0	5.3	31.8
GA 2011124	1364	44.4	1.17	84.8	5.3	30.7
GA 2011042	1334	43.8	1.21	84.2	4.9	32.0
GA 2004303	1322	43.2	1.20	84.7	5.0	32.1
GA 230	1319	43.0	1.19	85.1	5.1	31.1
GA 2011167	1309	41.1	1.17	84.8	5.1	32.5
GA 2004143	1307	45.0	1.19	84.8	4.9	33.0
GA 2011021	1275	43.1	1.23	85.3	4.9	32.0
DP 493	1264	44.0	1.17	83.9	5.0	32.0
GA 2011013	1261	46.6	1.18	85.5	4.9	32.8
GA 2011181	1259	43.3	1.17	84.5	5.4	31.9
GA 2011061	1253	44.6	1.16	84.8	5.2	30.4
GA 2011174	1222	41.7	1.17	84.9	5.4	33.0
GA 2011015	1216	42.6	1.25	85.8	4.6	33.7
GA 2011030	1211	41.9	1.21	85.2	5.0	32.0
GA 2011108	1205	41.7	1.20	85.0	5.0	32.7
GA 2011121	1200	44.7	1.23	83.4	5.0	34.9
GA 2011057	1165	41.4	1.20	84.7	5.1	31.4
GA 2011044	1143	42.8	1.12	84.3	5.5	29.9
GA 2011038	1132	42.1	1.22	85.2	4.8	30.8
GA 2011051	1044	44.7	1.20	85.1	5.0	31.8
GA 2011001	1044	40.2	1.21	85.0	4.7	32.4
GA 2011090	1028	39.6	1.18	85.0	5.1	31.9
Cultivar x Location Interaction	*	NS	NS	†	NS	*
LSD _{0.10}		0.92	0.02		0.15	

When location by entry interaction is significant, the locations cannot be combined to compare for significant differences; **NS (no significance)**, **† (10%)**, ***** (5%), **** (1%)**, & ***** (0.1%)**. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.15 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 3. Results of 2012 Advanced (F₇) Trial 1 in Tifton.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2010074	1369	44.8	1.22	85.8	5.5	35.0
GA 2010102	1336	41.3	1.25	86.2	5.4	35.9
GA 2010002	1335	43.6	1.24	86.2	5.3	36.0
GA 2010052	1300	43.4	1.21	86.2	4.9	34.0
GA 2010030	1293	43.7	1.26	86.0	4.8	33.3
GA 2010085	1291	46.6	1.24	85.3	5.0	34.1
GA 2010032	1271	45.4	1.26	85.1	5.1	33.2
GA 2010069	1268	43.3	1.23	85.7	5.0	34.7
GA 2010063	1268	44.8	1.22	86.1	5.2	34.5
GA 2010019	1265	43.9	1.20	86.0	5.1	33.3
GA 2010024	1250	42.8	1.25	85.7	4.9	34.1
GA 2010070	1240	45.1	1.22	85.6	4.9	35.0
GA 2004143	1231	44.8	1.20	84.8	5.2	35.6
GA 2010016	1227	42.5	1.23	85.4	5.1	33.6
GA 2010038	1222	42.3	1.23	85.7	4.8	35.3
GA 2010079	1193	41.8	1.21	85.2	5.5	35.6
GA 2010068	1184	44.7	1.24	85.6	4.9	34.2
GA 2010047	1166	44.5	1.23	86.1	5.0	34.0
GA 2010076	1162	43.1	1.23	85.1	5.2	37.4
GA 2010049	1150	43.3	1.27	86.7	5.2	35.7
GA 2010021	1139	42.5	1.26	86.0	4.9	33.1
GA 2004303	1136	43.8	1.18	85.1	5.5	33.6
GA 230	1124	41.0	1.21	85.8	5.1	34.2
GA 2010064	1117	43.3	1.23	86.4	5.3	34.1
GA 2010098	1116	41.5	1.22	85.6	5.3	34.1
DP 493	1105	43.6	1.18	84.8	5.4	32.9
GA 2010106	1038	43.4	1.24	85.6	4.9	33.9
GA 2010050	1015	41.3	1.22	85.6	5.3	34.2
GA 2010015	989	43.3	1.19	85.0	5.5	34.3
GA 2010086	985	42.5	1.26	87.1	5.0	33.8
GA 2010067	865	42.9	1.25	86.8	5.0	35.1
GA 2010058	814	44.9	1.22	84.6	4.9	33.3
LSD_{0.10}	158	1.18	ns	0.68	0.15	1.27

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.15 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 4. Results of 2012 Advanced (F₇) Trial 1 in Plains.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2010076	1732	40.3	1.24	84.8	5.0	34.1
GA 2010079	1640	40.9	1.25	84.0	4.7	31.6
DP 493	1640	40.3	1.26	84.4	4.3	31.5
GA 2010074	1630	41.0	1.20	84.0	5.0	31.9
GA 2010019	1622	40.1	1.25	85.1	4.3	31.9
GA 2004143	1600	42.2	1.25	85.0	4.4	32.3
GA 2010106	1586	40.4	1.25	85.7	4.3	32.5
GA 2010067	1586	39.7	1.26	85.9	4.7	33.7
GA 2010070	1560	41.3	1.24	85.0	4.5	32.7
GA 2004303	1534	40.7	1.21	84.6	4.6	33.2
GA 2010064	1534	39.9	1.27	85.2	4.1	33.1
GA 2010102	1531	38.7	1.23	84.5	4.7	33.7
GA 2010086	1522	41.2	1.22	84.3	4.5	30.9
GA 2010085	1494	40.5	1.30	84.7	4.2	32.1
GA 2010052	1478	40.4	1.23	84.2	4.3	31.6
GA 2010016	1426	38.7	1.26	84.9	4.3	32.4
GA 2010098	1412	38.1	1.25	84.9	5.0	31.2
GA 2010032	1409	40.1	1.30	84.7	3.9	32.1
GA 2010050	1409	37.4	1.26	84.6	4.5	32.0
GA 2010049	1390	37.0	1.28	84.0	4.6	31.7
GA 2010069	1364	41.1	1.25	85.8	4.7	32.2
GA 2010063	1361	41.8	1.22	84.8	4.8	32.6
GA 230	1361	39.5	1.22	84.5	4.6	32.3
GA 2010038	1329	40.6	1.25	85.5	4.1	34.1
GA 2010047	1325	40.2	1.21	85.6	4.8	31.4
GA 2010002	1322	40.1	1.29	85.6	4.7	33.0
GA 2010068	1283	39.5	1.22	85.7	4.4	31.9
GA 2010058	1209	40.1	1.25	84.8	4.3	30.9
GA 2010030	1158	38.9	1.28	85.3	4.5	31.7
GA 2010015	1114	39.5	1.29	86.0	4.4	32.1
GA 2010024	1095	39.6	1.30	85.7	4.2	32.0
GA 2010021	968	37.8	1.23	84.7	4.1	32.5
LSD_{0.10}	264	1.54	0.03	ns	0.28	1.12

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.28 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 5. Results of 2012 Advanced (F₆) Trial 2 in Tifton.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2011042	1290	45.1	1.18	84.7	5.2	33.7
GA 2011158	1244	46.0	1.15	85.1	5.5	33.5
GA 2011113	1225	44.5	1.17	85.3	5.5	32.1
GA 2011191	1207	45.6	1.17	84.5	5.4	32.6
GA 2011093	1182	44.0	1.19	86.1	5.5	33.8
GA 2004143	1143	46.7	1.15	85.4	5.3	34.6
GA 2011108	1141	44.3	1.17	84.8	5.3	33.6
GA 2011124	1114	46.5	1.13	84.8	5.6	31.6
GA 2011004	1105	46.8	1.16	85.5	5.4	32.3
GA 2011005	1088	45.7	1.16	85.8	5.3	34.6
GA 2011044	1078	45.5	1.09	85.0	5.8	31.0
GA 2011057	1053	41.7	1.20	85.6	5.3	32.7
GA 2004303	1043	44.6	1.18	84.3	5.4	32.9
GA 230	1034	44.6	1.16	84.9	5.3	31.9
GA 2011156	1029	44.7	1.18	85.0	5.5	32.9
DP 493	999	44.6	1.14	84.5	5.3	32.6
GA 2011013	991	47.4	1.18	85.5	5.2	34.8
GA 2011038	989	42.7	1.21	85.9	5.1	32.1
GA 2011090	981	41.0	1.17	84.5	5.2	34.3
GA 2011174	981	43.0	1.14	84.8	5.6	34.8
GA 2011030	970	42.6	1.20	85.2	5.2	34.2
GA 2011021	956	44.3	1.20	85.3	5.3	33.8
GA 2011181	949	44.0	1.14	84.4	5.6	32.2
GA 2011061	924	45.6	1.15	84.4	5.4	32.3
GA 2011167	915	41.9	1.17	84.8	5.2	33.4
GA 2011001	894	42.1	1.20	85.5	4.9	34.5
GA 2011015	892	44.3	1.23	86.5	5.2	35.5
GA 2011121	883	45.6	1.20	83.9	5.1	35.6
GA 2011051	763	46.6	1.20	85.9	5.2	33.2
LSD_{0.10}	150	1.07	0.04	0.60	0.20	1.20

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.2 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.

Table 6. Results of 2012 Advanced (F₆) Trial 2 in Plains.

ENTRY	Lint Yield, lbs./acre	Lint %	UHM in.	UI %	mic	Str g/tex
GA 2011004	1782	44.5	1.20	84.0	5.0	29.9
GA 2011156	1754	43.3	1.23	84.7	5.0	29.6
GA 2011167	1703	40.3	1.17	84.9	5.0	31.6
GA 2011191	1678	41.6	1.21	85.0	4.7	30.0
GA 2011005	1663	43.6	1.22	85.6	4.8	30.1
GA 2011124	1613	42.3	1.21	84.8	5.0	29.9
GA 230	1604	41.4	1.23	85.4	4.9	30.4
GA 2004303	1602	41.9	1.23	85.2	4.7	31.4
GA 2011093	1600	41.0	1.23	85.7	4.9	31.1
GA 2011021	1594	41.9	1.26	85.4	4.6	30.2
GA 2011113	1586	41.1	1.22	84.7	4.9	30.7
GA 2011061	1583	43.7	1.18	85.2	4.9	28.5
GA 2011181	1568	42.6	1.20	84.7	5.1	31.5
GA 2011015	1541	40.9	1.28	85.2	4.1	31.9
GA 2011013	1532	45.7	1.19	85.6	4.7	30.8
DP 493	1529	43.5	1.21	83.4	4.8	31.4
GA 2011121	1516	43.7	1.26	82.9	4.8	34.1
GA 2011158	1496	42.6	1.20	84.9	5.0	30.1
GA 2004143	1471	43.4	1.23	84.3	4.6	31.5
GA 2011174	1464	40.3	1.20	85.1	5.2	31.2
GA 2011030	1452	41.3	1.23	85.3	4.7	29.9
GA 2011042	1377	42.5	1.24	83.8	4.6	30.4
GA 2011051	1325	42.9	1.20	84.3	4.8	30.3
GA 2011057	1278	41.1	1.20	83.8	5.0	30.2
GA 2011038	1276	41.5	1.23	84.6	4.5	29.5
GA 2011108	1269	39.2	1.24	85.2	4.8	31.9
GA 2011044	1209	40.1	1.15	83.7	5.3	28.9
GA 2011001	1193	38.4	1.23	84.5	4.6	30.2
GA 2011090	1076	38.3	1.18	85.5	4.9	29.4
LSD_{0.10}	245	1.52	0.03	ns	0.23	0.94

ns (no significance) among any of the particular cultivar measure. The bold type indicates the measures that are not significantly different from the best when the location data is properly pooled. Exception: acceptable micronaire (mic) is a range; so the significant differences above 5.0 that are considered unacceptable are highlighted (i.e. > 5.23 is significant). DP 493, GA 230, GA 2004143, and GA 2004303 are check varieties for comparison purposes.