2006 Arizona Cotton Growers Association Breeding Program Advanced and Preliminary Strain Testing Program

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Abstract

A series of experiments were conducted across two locations in Arizona to evaluate 32 advanced and preliminary strains from the Arizona Cotton Growers Breeding Program. These trials were conducted in Yuma, AZ (130 ft. above MSL) and Maricopa, AZ (1170 ft. above MSL). Strains were planted in four row plots extending 38 feet in a randomized complete block design with a minimum of four replications. Each location had three commercial cotton varieties included as control treatments for comparison. Data collected on these trials included a series of plant measurements at three growth stages over the course of the season and yield and fiber quality data. All data was subjected to statistical analysis to test for differences among strains for yield and fiber quality. Both locations produced high yields despite high levels of heat stress in the lower deserts. Statistically significant differences were observed in yield and all fiber quality parameters at each location. Yield was down in Yuma as compared to previous years ranging from 1100 to 1800 lbs lint/acre. Yield at Maricopa was up significantly from last year with yields ranging from 1400 to 2100 lbs lint/acre. Significant increases in staple length was observed with several ACGA lines over control varieties at both locations with one line in particular producing a staple length of nearly 40 (ACGA 107). Several ACGA lines possess excellent fiber quality and performed well in terms of yield at both locations.

Introduction

One of the most critical decisions a cotton producer will make during the course of the season is which variety is best suited to the region and growing style of a particular operation. With the advent of transgenic technologies and the introduction of new varieties that decision can be very difficult. The decision of a seed company to bring a variety to market and release it for general consumption is made after several years of testing through a breeding program. One of the last steps of a breeding program prior to commercial release is testing of the advanced strains across environments.

The Arizona Cotton Growers Association (ACGA) breeding program is currently in a state of transition without a breeder under contract. However a significant amount of germplasm exists that was developed by the previous breeder which has not been extensively evaluated. The purpose of this project is to continue with the evaluation of preliminary and advanced strain genetic materials that have been developed from the Arizona Cotton Growers Association breeding program. The data generated from these projects has and will continue to provide valuable information to the current breeding program. It allows for decisions to be made with respect to current and future advances in germplasm based upon yield and fiber quality performance characteristics of the genetic material.

Conducting this program in conjunction with, but independent of, the Arizona Upland Cotton Advanced Strains testing program allows for a cost effective method of conducting the evaluations. It also provides quality, unbiased data to support the decision making of the ACGA breeding program. A testing program conducted at multiple locations provides for a powerful database to evaluate the genetic material in question with an opportunity to examine the stability of the strains across varying yield potential conditions. This program will be expanded in the 2007 season to include an additional location in Safford.

Materials and Methods

Two field trials were conducted in 2006 across the cotton producing regions of Arizona. These locations included Yuma (130 ft above MSL) and Maricopa (1170 ft. above MSL). Plots consisted of four rows wide and extended 38 feet in length. Row spacing varied among locations with 40 and 42 inch row spacing at Maricopa and Yuma respectively. All plots were arranged in a randomized complete block design with four replications. Plots were planted at a rate of 25 lbs of seed per acre. Upon post-seedling emergence, all plots were thinned to a consistent stand of 3 to 4 plants per foot. Further details of each experiment are contained in Table 1.

A series of plant growth measurements were collected across all strains at each location three times over the course of the season. Data collected included plant height, number of mainstem nodes, position of first fruiting branch, number of aborted or missing fruiting positions, and number of nodes above the top first position fresh bloom. This data allows for evaluation of plant growth and development, fruiting distribution, plant vigor, and progression toward maturity and is also critical in evaluating how a variety responds under a particular set of growing conditions.

Data collected at harvest included plot yield by harvesting the center two rows of each experimental unit. A 50-boll hand sample was collected from each experimental unit in a random fashion. This sample was used for determination of percent lint and seedcotton weight per boll which gives an indication of boll size. A large grab sample was also collected from each experimental unit from which fiber quality was determined by the USDA classing office in Phoenix, AZ. A premium or discount for each strain was determined based upon fiber quality data and the USDA CCC (Commodity Credit Corporation) loan schedule. This premium/discount was then applied to a base price of 52 cents/lb and a final crop value was calculated by multiplying the base price plus the premium/discount by the total lint yield of the strain.

All data collected was summarized and analyzed according to statistical procedures as outlined by the SAS Institute.

Results and Conclusions

Yuma

Results from the Yuma location were off slightly from last year. Lint yield ranged from 1100 to over 1800 lbs lint/acre (Table 2). Deltapine DP432R was the highest performing control variety with one ACGA line performing better in yield. The other two control varieties placed near the bottom of the other lines in terms of yield. A graphical representation of the yield and fiber quality data may be found in Figures 1-4. Many of the ACGA lines possess high quality fiber with fiber length being significantly longer than the control varieties. Fiber strength and length uniformity were also higher in many of the ACGA lines than the control varieties. Deltapine DP164B2RF has a good fiber package and many of the ACGA lines performed just as well or better than this control variety. Plant growth and development trends are plotted in Figures 5 and 6. Fruit retention levels were fairly consistent across all lines when compared to the control varieties with final fruit retention levels near 50 percent (Figure 5). Plant vigor as measured by height to node ratio (Figure 6) was significantly higher than normal for all entries over the course of the season. High levels of vigor and vegetative growth may explain the slight drop in yield levels from 2005. These plots may have benefited from an application of a plant growth regulator to help control vegetative growth.

Maricopa

Results in lint yield from the Maricopa location were significantly higher than anticipated. High levels of heat stress resulted in average or below average levels of fruit retention throughout the primary fruiting cycle (Figure 11). In an attempt to recover from mid-season fruit loss the crop was carried later into the fall with a final irrigation in late September. Fruit retention levels ended the season near average (Figure 11) and produced an excellent crop yield with a range of 1400 to over 2100 lbs lint/acre (Table 3). Two of the ACGA lines performed better than the highest performing control (DP449BR) in terms of yield. Graphical representations of all yield and fiber quality data are found in Figures 7-10. Fiber quality results were similar to those at Yuma. Many of the ACGA lines performed well in terms of fiber length, strength, and length uniformity when compared to the commercial varieties. Plant vigor was at or slightly below average for most of the season (Figure 12) which is an interesting response particularly in light of the fact that fruit retention levels were near average most of the season.

Table 1. Planting, plant measurement, and harvest dates for each ACGA advanced and preliminary strain evaluation location along with lines entered at both locations.

Location:		**Yuma**	**Maricopa**
Planting Date:		13 February 2006	19 April 2006
Plant Measurement Sample Dates		30 May 2006	6 June 2006
		20 June 2006	14 July 2006
		25 July 2006	9 August 2006
Harvest Date:		13-14 August 2007	28-29 November 2006
Strain	**Strain ID#**		
0101-2100-301	ACGA94	X	X
0101-2100-302	ACGA95	X	X
0101-2100-307	ACGA96	X	X
0101-2141-301	ACGA97	X	X
0101-2165-303	ACGA98	X	X
0106-2022-2B	ACGA99	X	X
0106-3004-B	ACGA100	X	X
0112-2016-303	ACGA101	X	X
0112-2033-309	ACGA102	X	X
0112-2067-302	ACGA103	X	X
0112-2086-302	ACGA104	X	X
0112-2086-303	ACGA105	X	X
0115-2B-304	ACGA106	X	X
0116-2011-308	ACGA107	X	X
0116-2012-307	ACGA108	X	X
0116-2018-307	ACGA109	X	X
0116-2B-301	ACGA110	X	X
0116-2B-308	ACGA111	X	X
0116-2B-326	ACGA112	X	X
0122-2004-303	ACGA113	X	X
0122-2014-305	ACGA114	X	X
0122-2033-303	ACGA115	X	X
0122-2033-307	ACGA116	X	X
0122-2039-303	ACGA117	X	X
0122-2053-308	ACGA118	X	X
0139-2001-302	ACGA119	X	X
0144-2036-303	ACGA120	X	X
0144-2036-304	ACGA121	X	X
0144-2086-4B	ACGA122	X	X
0145-2008-301	ACGA123	X	X
0157-303-B	ACGA124	X	X
0116-2016-301	ACGA125	X	X
DP164B2RF	Control	X	X
DP432R	Control	X	X
DP449BR	Control	X	X

Table 2. Lint yield and fiber quality results for the ACGA breeding program preliminary and advanced strain trial conducted in Yuma, AZ, 2006.

Strain		Lint Yield	Means Separation*	Percent	HVI	Staple	Strength	Uniformity	Micronaire	Leaf Grade	Boll Wt.	Premium	Value
		lbs/acre		Lint	Color	32nds	g/tex	g/tex			g/boll	cent/lb	$/acre
0122-2033-307	ACGA116	1890.0	a	41.7	11	36.6	30.1	80.8	4.25	1	5.18	6.76	1111.18
DP432R	DP432R	1779.1	a b	42.5	11	36.0	31.2	82.7	4.65	2	4.01	5.65	1026.57
0122-2033-303	ACGA115	1777.6	a b	42.3	21	36.3	31.7	82.2	4.05	1	5.05	5.43	1018.08
0144-2086-4B	ACGA122	1757.0	b c	41.4	11	36.7	32.1	81.9	4.23	2	4.14	7.30	1042.11
0122-2039-303	ACGA117	1746.6	b c	40.1	11	36.3	31.8	82.7	4.13	1	5.42	7.33	1035.47
0112-2067-302	ACGA103	1734.7	b c d	40.5	11	35.5	30.1	82.0	4.25	1	4.90	5.75	1001.61
0112-2033-309	ACGA102	1723.2	b c d	39.5	11	36.3	30.3	80.9	4.33	1	4.79	6.61	1009.76
0101-2141-301	ACGA97	1710.1	b c d	40.0	11	36.2	27.1	79.0	4.15	1	5.39	6.01	991.69
0144-2036-303	ACGA120	1702.0	b c d e	41.7	11	36.7	32.5	81.7	4.08	1	3.79	7.43	1011.35
0122-2014-305	ACGA114	1680.8	b c d e f	39.5	21	37.0	30.8	82.0	4.08	1	4.71	7.18	994.78
0112-2086-303	ACGA105	1666.0	b c d e f g	40.0	11	35.2	28.2	80.2	4.40	1	4.64	4.30	938.77
0101-2165-303	ACGA98	1650.7	b c d e f g h	41.1	11	36.6	30.2	81.0	3.48	1	4.32	5.45	949.05
0157-303-B	ACGA124	1645.8	c d e f g h	41.7	11	37.7	30.8	82.4	4.18	1	4.48	7.60	980.92
0145-2008-301	ACGA123	1614.9	d e f g h i	41.4	11	36.5	31.8	81.1	3.78	2	4.76	7.13	954.40
0122-2053-308	ACGA118	1577.5	e f g h i j	41.0	11	36.9	30.1	81.7	4.33	1	4.39	7.33	936.04
0101-2100-302	ACGA95	1573.6	e f g h i j	40.1	11	37.8	27.7	79.4	3.68	1	5.05	6.64	922.62
0112-2086-302	ACGA104	1563.9	f g h i j k	38.0	11	35.8	29.0	81.4	4.15	1	4.80	5.91	906.70
0106-3004-B	ACGA100	1555.8	f g h i j k	42.3	11	36.9	31.3	81.0	4.05	1	4.27	7.43	924.43
0101-2100-307	ACGA96	1549.5	g h i j k	40.8	11	37.6	28.2	80.7	4.03	1	4.78	7.21	917.58
0139-2001-302	ACGA119	1549.2	g h i j k	39.9	11	36.0	31.3	81.4	3.90	1	5.46	6.49	906.61
0122-2004-303	ACGA113	1527.7	h i j k l	40.8	11	35.8	29.9	81.2	4.13	1	5.51	5.96	884.34
0116-2012-307	ACGA108	1527.1	h i j k l	39.8	12	36.5	30.6	81.4	4.88	1	6.90	2.90	850.93
0106-2022-2B	ACGA99	1493.1	i j k l m	38.2	11	37.8	31.3	81.0	3.90	1	4.90	7.60	889.91
0115-2B-304	ACGA106	1490.8	i j k l m	40.3	11	37.4	31.3	82.3	3.93	1	4.33	7.60	888.54
0101-2100-301	ACGA94	1462.9	j k l m n	38.7	11	37.2	29.1	80.7	3.80	1	5.00	7.25	866.74
0116-2B-308	ACGA111	1439.8	k l m n	36.6	11	37.4	31.4	82.0	3.88	1	5.17	5.85	831.64
0116-2B-301	ACGA110	1408.4	l m n	38.0	11	37.6	32.0	83.0	4.48	1	4.78	5.98	817.76
0112-2016-303	ACGA101	1383.9	m n	37.5	11	37.4	30.5	81.0	3.70	1	4.54	7.36	821.52
0116-2011-308	ACGA107	1383.6	m n	36.0	11	39.5	32.8	82.4	3.70	1	4.76	6.88	814.44
DP449BR	DP449BR	1347.6	n	39.6	11	36.7	31.5	82.0	3.99	1	4.60	7.31	799.21
DP164B2F	DP164B2F	1346.3	n	39.2	11	38.2	30.1	82.2	3.73	2	4.03	7.51	801.20
0144-2036-304	ACGA121	1196.0	o	34.8	21	38.2	32.9	81.5	3.63	2	4.30	7.30	709.03
0116-2B-326	ACGA112	1139.4	o	38.4	21	35.8	33.0	82.1	4.05	2	4.36	6.04	662.18
0116-2018-307	ACGA109	1137.9	o	37.7	22	36.0	31.4	82.0	4.35	2	5.33	3.59	632.58
0116-2016-301	ACGA125	1111.1	o	37.1	11	37.8	32.0	82.9	3.78	1	4.42	7.66	662.84
LSD§		130.1		1.1	---	0.8	1.5	1.2	0.30	0.5	0.90	1.7	79.18
OSL†		0.0001		0.0001	---	0.0001	0.0001	0.0001	0.0001	0.0364	0.0001	0.0001	0.0001
CV‡		6.1		1.9	---	1.6	3.6	1.1	5.0	32.5	13.5	18.7	6.3

*Means followed by the same letter are not statistically different according to a Fisher's least significant difference means separation test.

§ Least Significant Difference

† Observed Significance Level

‡ Coefficient of Variation

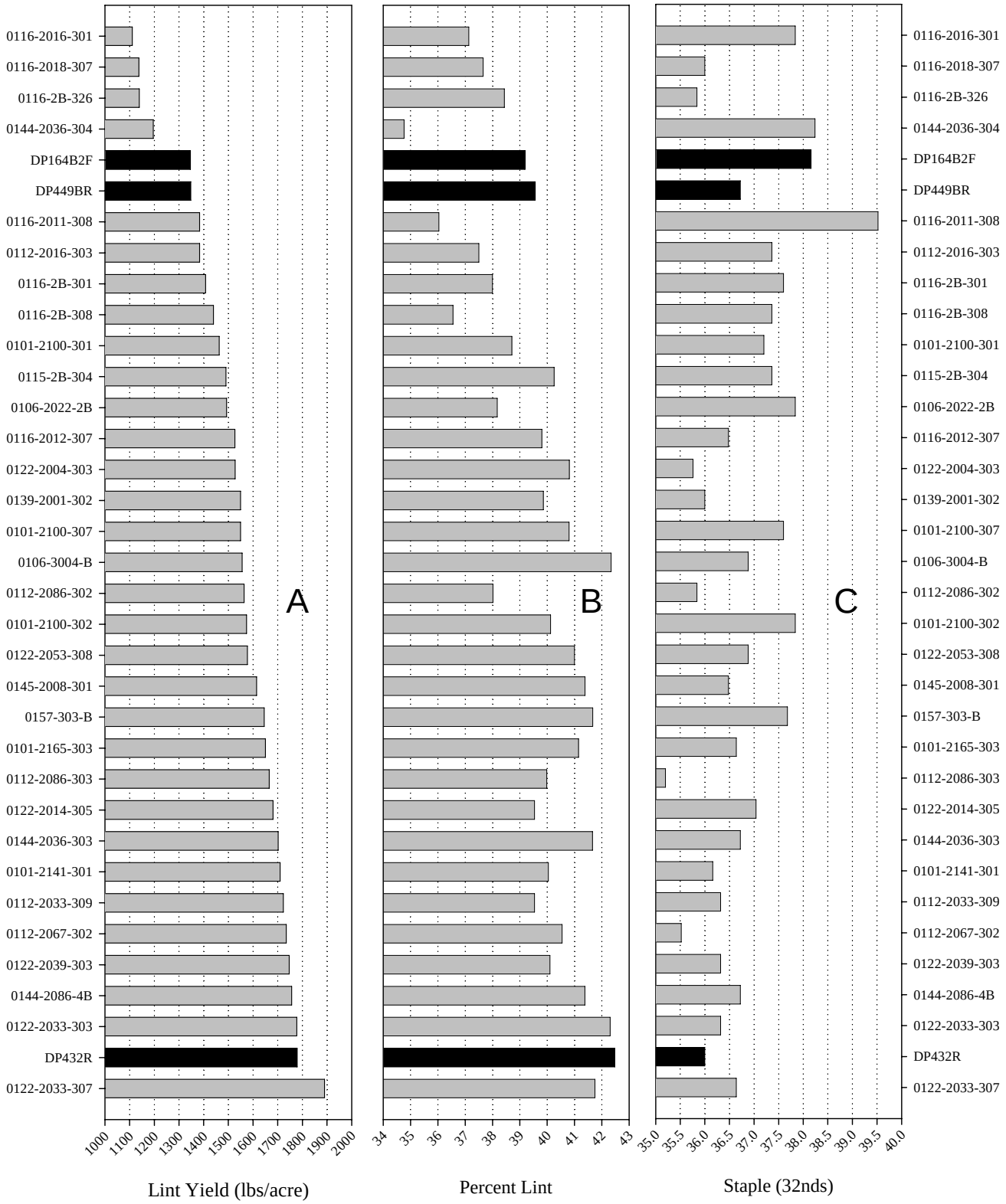

Figure 1. Lint yield (a), lint turnout (b), and fiber staple (c), for each of the advanced strain lines entered at Yuma, AZ, 2006. Black bars represent control varieties.

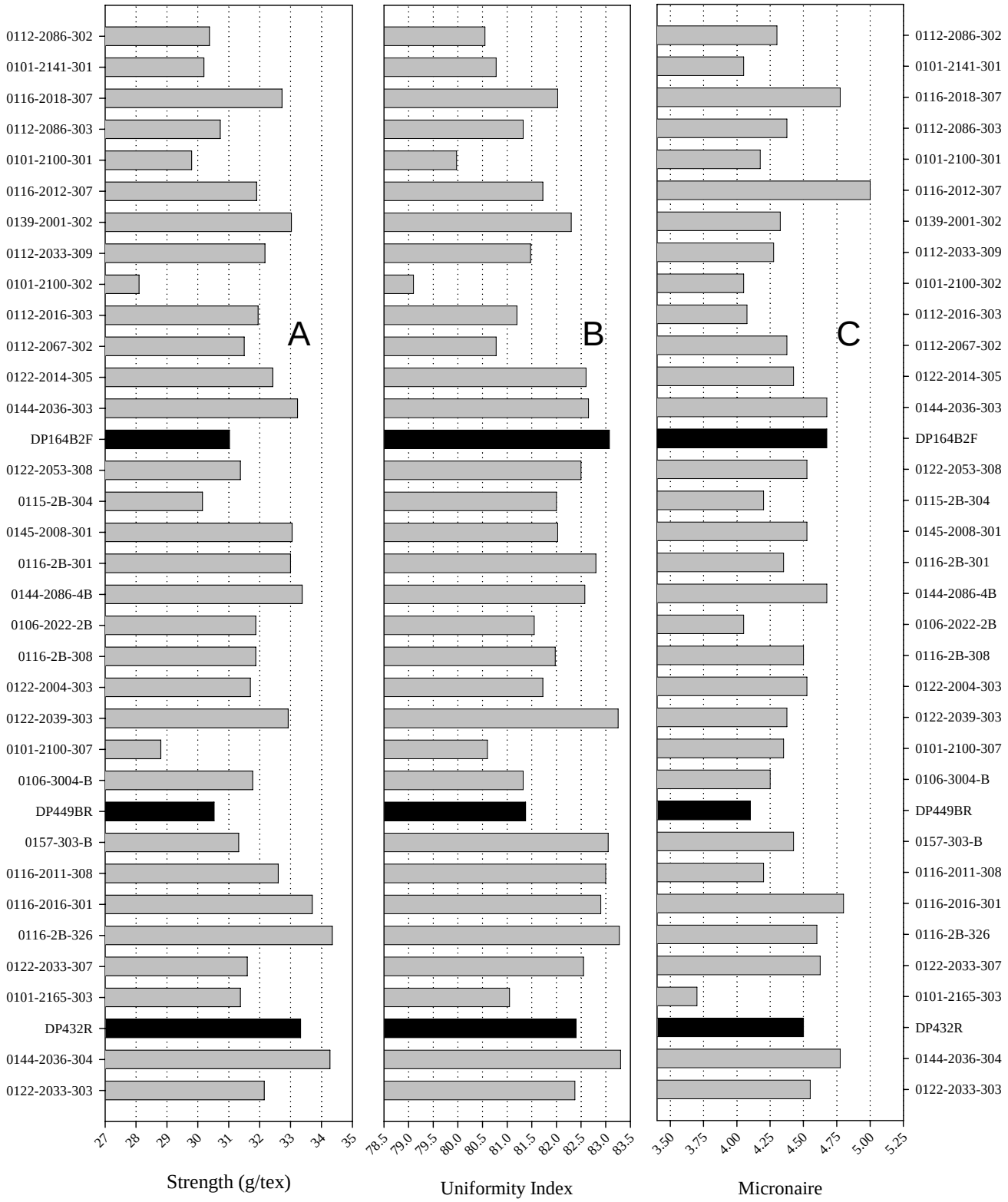

Figure 2. Fiber strength (a), fiber uniformity (b), and fiber micronaire (c), for each of the advanced strain lines entered at Yuma, AZ, 2006. Black bars represent control varieties.

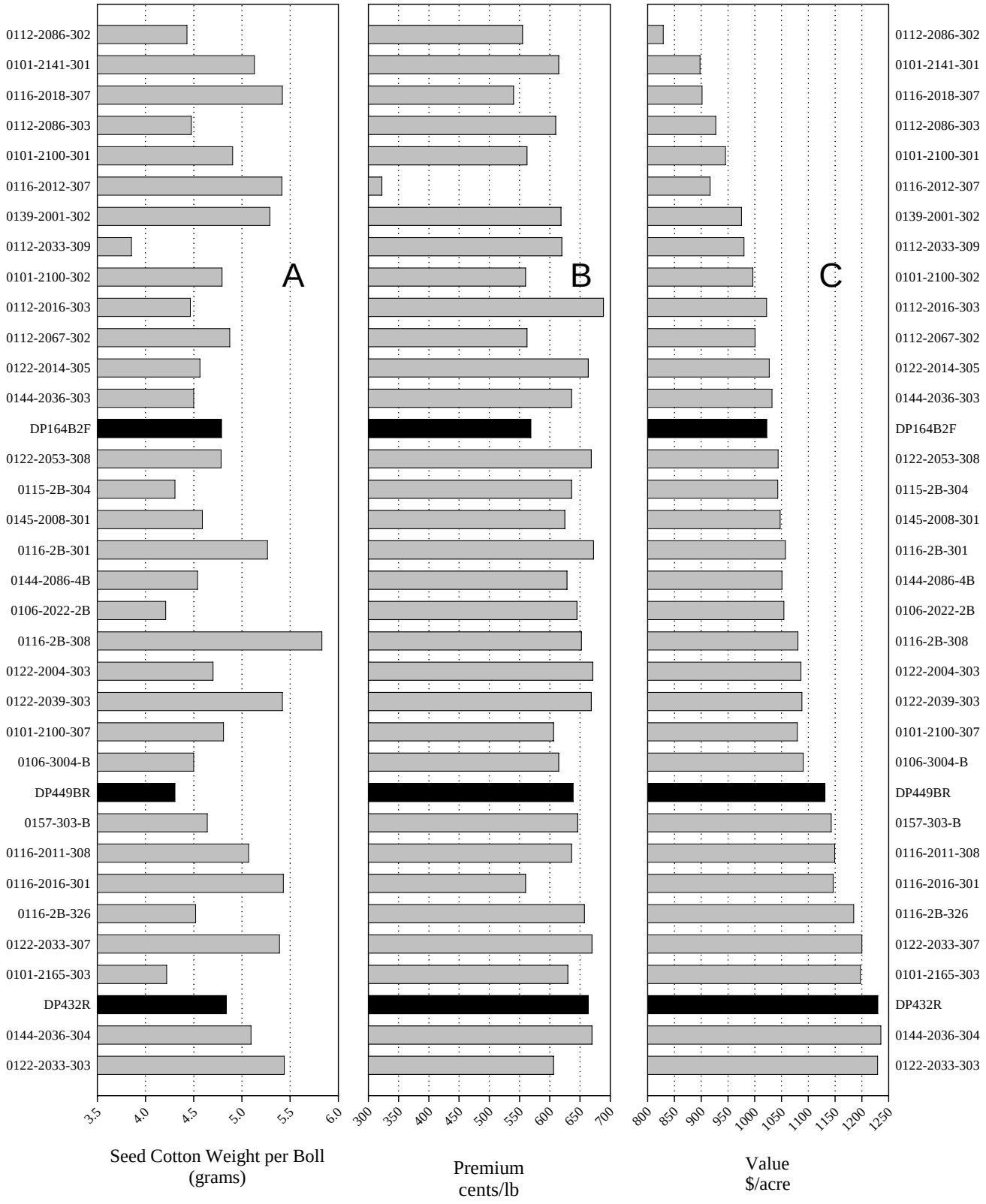

Figure 3. Seed cotton weight per boll (a), fiber quality premium (b), and value of crop (c), for each of the advanced strain lines entered at Yuma, AZ, 2006. Black bars represent control varieties.

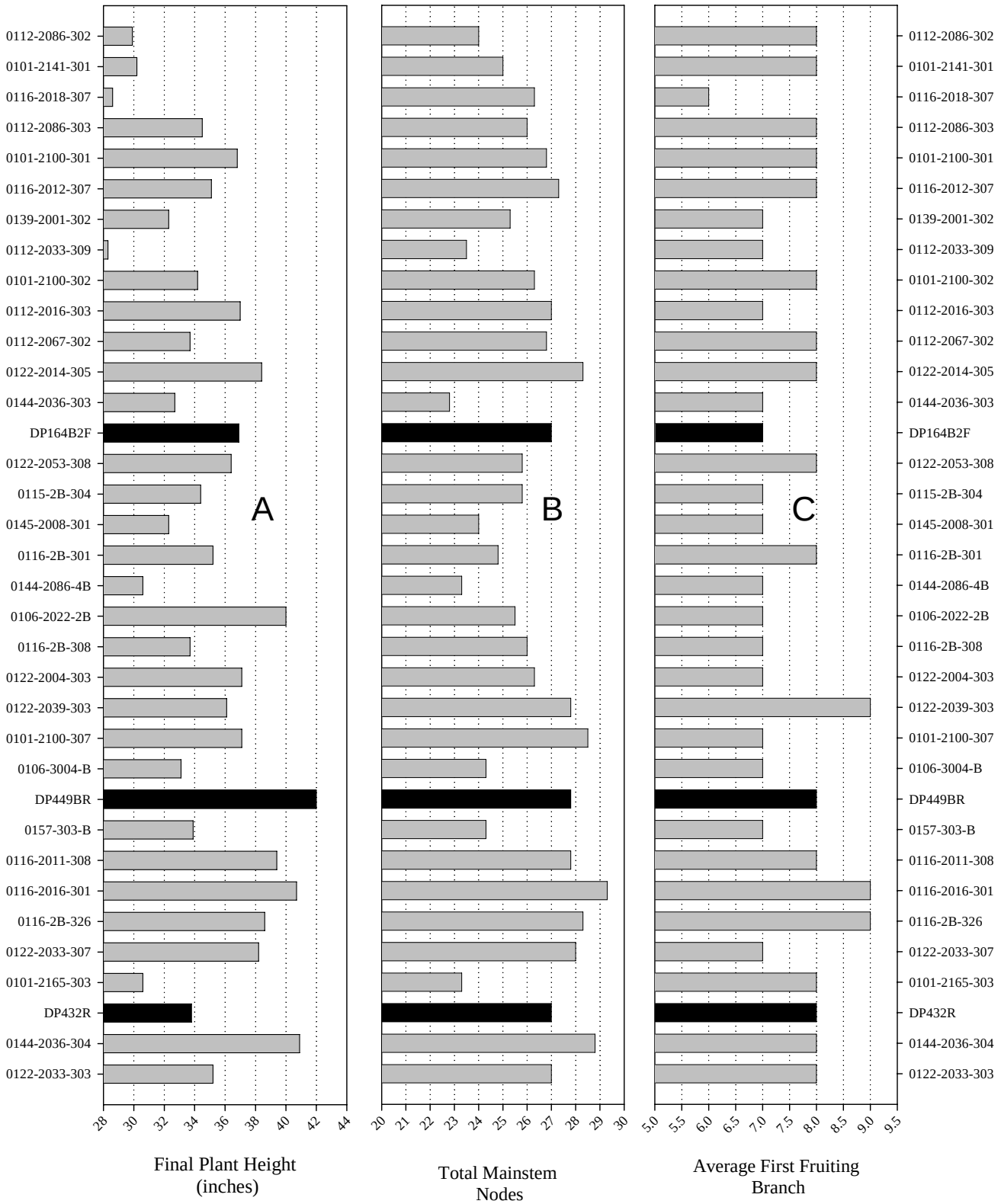

Figure 4. Final plant height (a), total mainstem nodes (b), and average position of first fruiting branch (c), for each of the advanced strain lines entered at Yuma, AZ, 2006. Black bars represent control varieties.

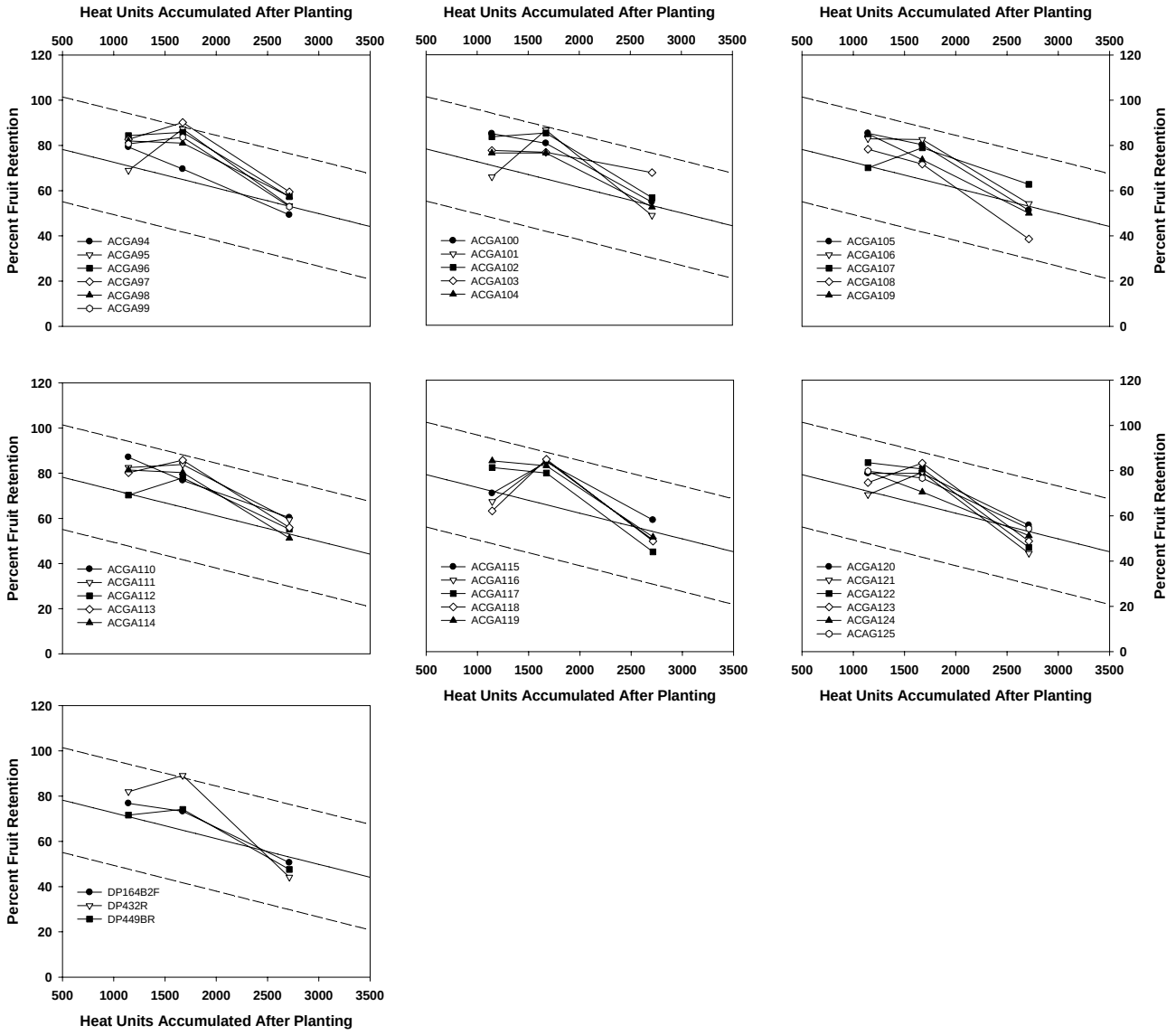

Figure 5. Percent fruit retention trends as a function of heat units accumulated after planting (HUAP) for each of the advanced strain lines entered at Yuma, AZ, 2006. Control varieties are plotted in the lower left graph.

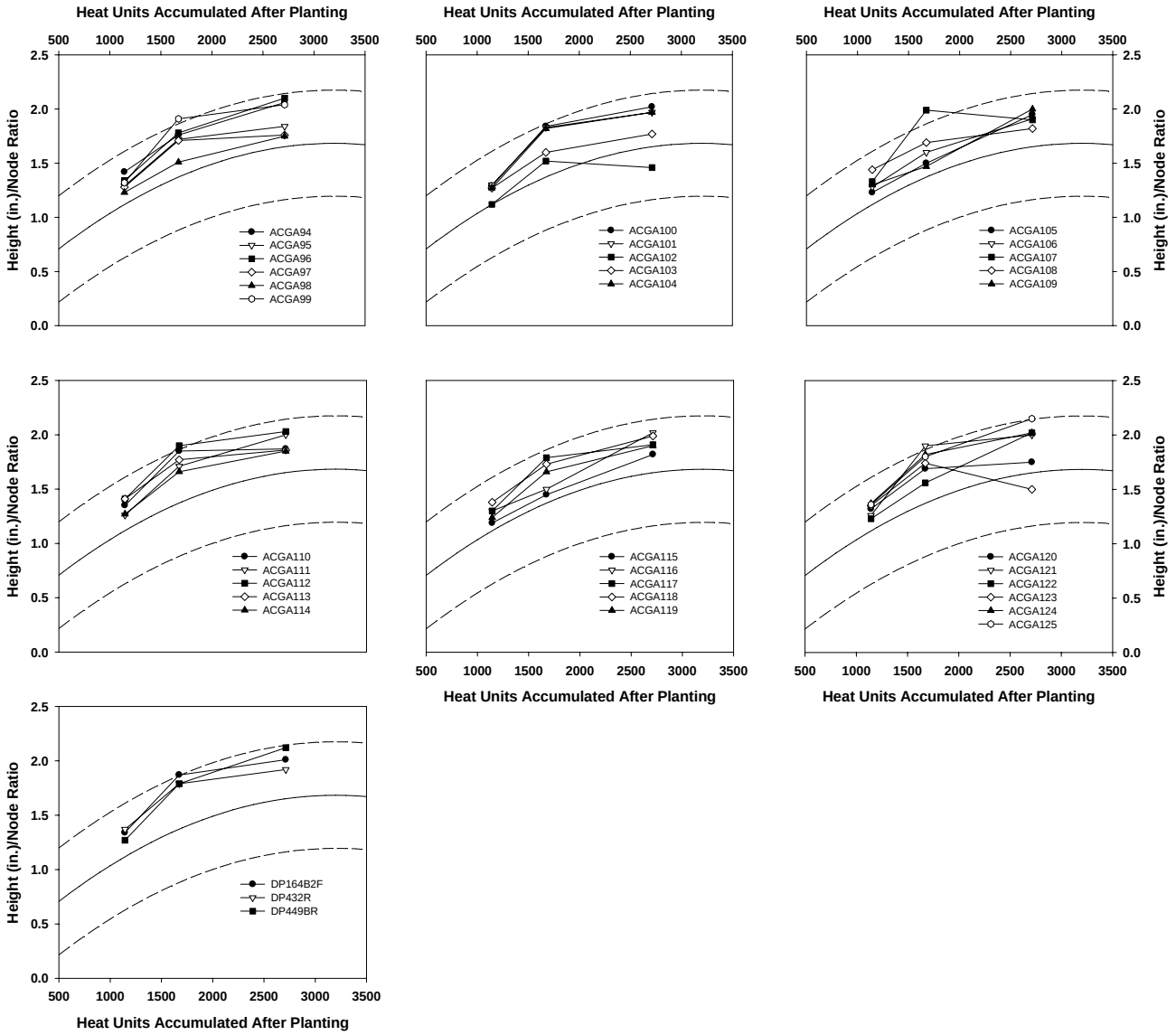

Figure 6. Height (in) to node ratio trends as a function of heat units accumulated after planting (HUAP) for each of the advanced strain lines entered at Yuma, AZ, 2006. Control varieties are plotted in the lower left graph.

Table 3. Lint yield and fiber quality results for the ACGA breeding program preliminary and advanced strain trial conducted in Maricopa, AZ, 2006.

Strain		Lint Yield	Means Separation*	Percent	HVI	Staple	Strength	Uniformity	Micronaire	Leaf Grade	Cotton wt.	Premium	Value
		lbs/acre		Lint	Color	32nds	g/tex	g/tex			g/boll	cent/lb	$/acre
0122-2033-303	ACGA115	2118.3	a	40.8	21	36.0	32.2	82.4	4.55	3	5.44	606.25	1229.67
0144-2036-304	ACGA121	2104.3	a	36.3	21	38.5	34.3	83.3	4.78	3	5.10	670.00	1235.58
DP449BR	DP449BR	2097.6	a	38.8	21	36.8	33.3	82.4	4.50	3	4.84	663.75	1230.08
0101-2165-303	ACGA98	2053.4	a b	38.7	31	37.3	31.4	81.1	3.70	3	4.22	630.00	1197.31
0122-2033-307	ACGA116	2044.4	a b c	40.0	21	36.5	31.6	82.6	4.63	3	5.39	670.00	1200.02
0116-2B-326	ACGA112	2023.0	a b c d	41.0	21	36.3	34.4	83.3	4.60	3	4.52	657.50	1184.89
0116-2016-301	ACGA125	1989.8	a b c d e	38.1	31	37.5	33.7	82.9	4.80	3	5.43	560.00	1146.47
0116-2011-308	ACGA107	1969.2	a b c d e f	35.5	31	39.8	32.6	83.0	4.20	3	5.07	636.25	1149.40
0157-303-B	ACGA124	1955.0	a b c d e f g	40.1	31	37.0	31.3	83.1	4.43	3	4.64	646.25	1143.00
DP164B2F	DP164B2F	1937.5	a b c d e f g h	39.1	21	37.3	30.5	81.4	4.10	3	4.31	638.75	1131.17
0106-3004-B	ACGA100	1876.4	b c d e f g h i	40.2	31	36.8	31.8	81.3	4.25	3	4.50	615.00	1090.69
0101-2100-307	ACGA96	1859.6	c d e f g h i j	38.6	21	37.0	28.8	80.6	4.35	3	4.81	606.25	1079.57
0122-2039-303	ACGA117	1853.9	c d e f g h i j k	38.0	21	36.8	32.9	83.3	4.38	3	5.42	668.75	1088.08
0122-2004-303	ACGA113	1850.2	d e f g h i j k	38.6	21	36.3	31.7	81.7	4.53	3	4.70	671.25	1086.42
0116-2B-308	ACGA111	1846.6	d e f g h i j k	37.3	21	37.0	31.9	82.0	4.50	3	5.83	652.50	1080.77
0106-2022-2B	ACGA99	1803.7	e f g h i j k l	38.6	31	38.3	31.9	81.6	4.05	3	4.21	645.00	1054.63
0144-2086-4B	ACGA122	1803.1	e f g h i j k l	39.1	31	36.3	33.4	82.6	4.68	3	4.54	628.75	1051.09
0116-2B-301	ACGA110	1801.7	e f g h i j k l	37.7	21	38.3	33.0	82.8	4.35	3	5.27	672.50	1057.62
0145-2008-301	ACGA123	1800.0	e f g h i j k l	39.9	21	36.3	33.1	82.0	4.53	3	4.59	625.00	1047.70
0115-2B-304	ACGA106	1787.2	f g h i j k l m	39.6	21	37.0	30.2	82.0	4.20	3	4.31	636.25	1043.09
0122-2053-308	ACGA118	1778.8	f g h i j k l m	40.1	21	37.0	31.4	82.5	4.53	3	4.79	668.75	1043.81
DP432R	DP432R	1773.1	g h i j k l m	40.7	31	36.5	31.0	83.1	4.68	3	4.79	568.75	1022.68
0144-2036-303	ACGA120	1768.4	g h i j k l m	38.9	31	36.8	33.2	82.7	4.68	3	4.50	636.25	1032.22
0122-2014-305	ACGA114	1751.5	h i j k l m n	36.3	21	37.8	32.4	82.6	4.43	3	4.57	663.75	1027.06
0112-2067-302	ACGA103	1737.1	i j k l m n	38.8	21	35.5	31.5	80.8	4.38	3	4.88	562.50	1000.89
0112-2016-303	ACGA101	1735.7	i j k l m n o	35.9	21	36.5	32.0	81.2	4.08	3	4.47	688.75	1022.17
0101-2100-302	ACGA95	1730.6	i j k l m n o	36.9	21	37.5	28.1	79.1	4.05	3	4.80	560.00	996.64
0112-2033-309	ACGA102	1684.7	j k l m n o	35.4	21	36.3	32.2	81.5	4.28	3	3.86	620.00	980.10
0139-2001-302	ACGA119	1676.1	j k l m n o	38.3	21	36.0	33.0	82.3	4.33	3	5.29	618.75	975.39
0116-2012-307	ACGA108	1664.1	k l m n o	40.2	21	35.5	31.9	81.7	5.00	3	5.42	322.50	916.80
0101-2100-301	ACGA94	1641.3	l m n o	36.3	21	36.3	29.8	80.0	4.18	3	4.91	562.50	945.37
0112-2086-303	ACGA105	1596.0	m n o p	36.7	21	36.0	30.7	81.3	4.38	3	4.48	610.00	927.38
0116-2018-307	ACGA109	1569.8	n o p	38.4	31	36.3	32.7	82.0	4.78	3	5.42	540.00	901.61
0101-2141-301	ACGA97	1544.9	o p	37.4	21	37.0	30.2	80.8	4.05	3	5.13	615.00	897.92
0112-2086-302	ACGA104	1440.6	p	34.5	21	36.3	30.4	80.6	4.30	3	4.43	555.00	829.29
LSD§		191.4		1.4	---	1.2	1.7	1.2	0.2	NS	0.6	109.4	111.2
OSL†		<.0001		<.0001	---	<.0001	<.0001	<.0001	<.0001	0.4265	<.0001	<.0001	<.0001
CV‡		7.5		3.3	---	2.3	3.7	1.0	3.8	4.0	8.6	12.6	7.5

*Means followed by the same letter are not statistically different according to a Fisher's least significant difference means separation test.

§ Least Significant Difference

† Observed Significance Level

‡ Coefficient of Variation

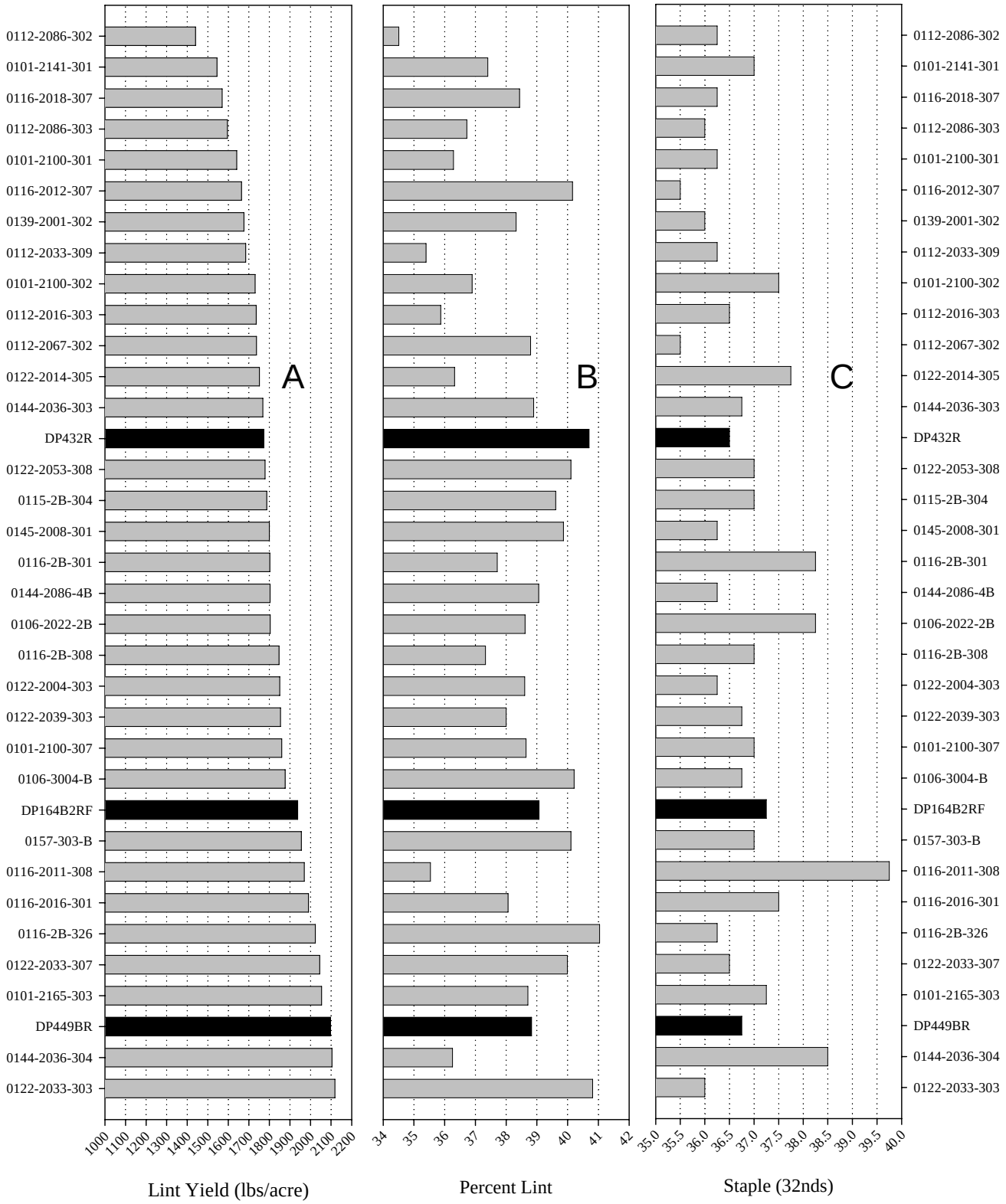

Figure 7. Lint yield (a), lint turnout (b), and fiber staple (c), for each of the advanced strain lines entered at Maricopa, AZ, 2006. Black bars represent control varieties.