UNIVERSITY OF DELAWARE

LIMA BEAN

VARIETY

TRIAL

RESULTS

2011

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2011 University of Delaware Green Baby Lima Bean and Fordhook Lima Bean Variety Trials

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Green Baby Lima Bean Variety Trial at Georgetown

The 2011 Lima Bean Variety Trial included a total of 23 lines. Ten of the lines were entered by the two participating seed companies: ADM Seedwest and Ben Fish & Son. Nine lines were from the University of Delaware lima bean breeding program. The remaining four lines were standard varieties planted as checks. The purpose of this trial is to evaluate new processing green baby lima bean varieties for yield, maturity, and quality under Delaware growing conditions.

Varieties Entered in the 2010 Delaware Green Baby Lima Bean Variety Trial

Variety Name	Company
GBL 21-04-DA	Ben Fish
GBL 24-04-DA	Ben Fish
GBL 26-04-DA	Ben Fish
C-elite Select	check (Ben Fish)
184-85	check (Ben Fish)
M 15	ADM Seedwest
Maestro	ADM Seedwest
G700805	ADM Seedwest
G200381	ADM Seedwest
G200382	ADM Seedwest
G200410	ADM Seedwest
G9002033	ADM Seedwest
Cypress	check (ADM)
8-78	check
DE0501801A	University of Delaware
DE0501805A	University of Delaware
DE0402701	University of Delaware
DE0407903	University of Delaware
DE0407905	University of Delaware
DE0407906	University of Delaware
DE0407907	University of Delaware
DE0505002A	University of Delaware
DE0505002B	University of Delaware

Location:
Field 2C at the University of Delaware Research and Education Center Farm, Georgetown, DE

Cultural Practices:
The trial was planted on June 7, 2011 with a Monosem planter. Some of the seed was treated, and some was not, as indicated in the results section. Varieties were planted in one-row plots with 30 inch between row spacing and 3 inch in-row spacing. Plots were 25 feet in length. The variety "Cypress" was planted in every other row as a border between experimental plots. Plots were arranged in a randomized complete block design with four replications. The field was fertilized according to soil test results. Pre-emergence herbicides (0.6 oz/A Sandea + 1.0 pint/A Dual II Magnum) were applied on June 9, 2011 as well as 50 lbs/A nitrogen in the form of 30% UAN. Plots were cultivated on July 27, 2011 and sidressed with 20 lbs/A nitrogen in the form of ammonium nitrate. Additional hand weeding was done in early August. Weed control in the trial was excellent. Plots were irrigated, when necessary, with a traveling, linear system. Warrior II at 1.9 oz/A was applied for insect control on August 16. No applications were made for disease control.

Harvest:
Harvest decisions were made based on visual evaluation of the individual plot. Plots were harvested to maximize the number of full (as opposed to dry or flat) pods. Not all replications for a variety were harvested on the same day. There were no significant differences between the varieties in percent dry pods at harvest (Table 1). Harvest began on August 23 (77 DAP) and ended on September 16 (101 DAP).

A 15-foot section from each plot was harvested. The plants were cut off at soil level and weighed. To determine maturity at harvest, pods were stripped from five harvested plants from each plot and counted as full, flat or dry. The plants and pulled pods were fed into a stationary FMC viner. Trash was removed from the shelled beans with a fan and a screen, and the cleaned beans were weighed to determine yield.

Downy Mildew Resistance Testing
The nine lines from the University of Delaware Lima Bean Breeding Program were screened for resistance to lima bean downy mildew, an important disease of lima beans in Delaware which is caused by *Phytophthora phaseoli*. Screening took place in field plots. Plants were screened for resistance to race F at the University of Delaware research farm at Georgetown and for resistance to race E at the University of Delaware research farm at Newark. Approximately 50 seeds of each line were planted in single-row plots in each location. The Newark location was planted on July 6, 2011 and the Georgetown location on July 5. Plants were inoculated twice during flowering. To encourage infection susceptible check varieties were planted in every fifth row within the plot and additional moisture was applied via misters timed to come on for four 15 minute intervals during the night. Plants were evaluated several times in September 2011 for disease reaction.

Results and Discussion
Yields differed significantly among the varieties in the trial this year, and overall, yields for the check varieties were higher than average when compared to the past seven year's trials. Weather

conditions were hotter than average this season, with 2011 being the second hottest summer on record for Delaware (second only to 2010). This resulted in a similar situation to what we saw last year. The plants began flowering at the end of July, which is typical for this trial. However, no pods set for approximately two weeks after flowering initiated because of sustained high temperatures. This resulted in an overall longer season and an extremely compressed harvest period for the varieties. A comparison days to harvest for three of the standard varieties for this year versus the historical average is as follows:

Variety	Average DTH for 2006, 2007, 2008 & 2009 Trials	DTH for 2010 Trial	DTH for 2011 Trial
Cypress	77	91	97
C-elite Select	84	96	98
184-85	86	95	99

Cypress was 20 days later than average, C-elite Select was 14 days later, and 184-85 was 13 days later. The 2010 and 2011 trials were both planted on June 6. Harvest was even further delayed in the 2011 trial. This may have been due to a period of cool weather and rain associated with Hurricane Irene that occurred at the end of August. Despite obvious effects of heat on pod set, we did not see any split sets. One replication of DE0501805A set pods earlier and was harvested on August 23 (77 DAP). This plot was located in a small low spot in the field. No other plots were harvested until September 8 (93 DAP).

There were significant differences in yield among the 23 varieties in the trial. The highest yielding standard variety in the trial was C-elite Select, which had a significantly higher yield than the standard variety M-15, but did not have a significantly different yield than Cypress or 184-85. The highest yielding experimental varieties in the trial were DE0505002A, G200382, DE0501801A, G9002033, G200381, DE0402701, and DE0402705; however none differed significantly in yield from C-elite Select. Only DE0505002A had a significantly higher yield than 184-85 and Cypress. DE0505002A was also the highest yielding variety in the 2010 and 2009 trials.

Acknowledgements
The authors gratefully acknowledge:

seasonal Extension Vegetable Program employees Brooke Drury, Heather Baker, Tyler Warfel, Kat'Rina Veney, and Carl VanGessel who helped to plant, maintain and harvest the plots.

James Adkins, who maintains the viner.

Brian Hearn and the REC Farm Crew for help with field operations.

Dr. Tom Evans and Nancy Gregory for assistance with downy mildew disease screening.

Table 1. Yield, Days to Harvest, Maturity at Harvest, Number of Pods per Plant, Plant Weight, Stand Count at Harvest, and Downy Mildew Disease Reactions for Entries in the 2011 Green Baby Lima Bean Variety Trial

Variety	Days to Harvest	Yield (Lbs/A)	% Full	% Flat	% Dry	# Pods/Plant	Plant Weight (Lbs/15 ft)	# Plants/15 ft[1]	Downy Mildew Resistance[2]	
									Race E	Race F
DE0505002A	99 a	3918 a	92 abcd	2 a	6 a	23 a	21.8 a	52 abc	R	S
G200382	98 a	3726 ab	92 abcd	3 a	5 a	27 a	20.1 a	53 a	?	?
DE0501801A	99 a	3577 abc	95 abcd	1 a	5 a	27 a	19.0 a	51 abcd	S	S
G9002033	98 a	3541 abc	91 abcd	1 a	7 a	23 a	17.1 a	49 abcdef	?	?
G200381	99 a	3439 abcd	93 abcd	2 a	6 a	24 a	25.3 a	52 abc	?	?
C-elite Select	98 a	3420 abcde	87 d	3 a	10 a	30 a	19.6 a	44 efgh	S	R
DE0402701	99 a	3338 abcdef	92 abcd	3 a	6 a	24 a	19.7 a	52 ab	S	S
DE0407905	98 a	3323 abcdef	96 ab	1 a	4 a	24 a	19.1 a	53 a	S	S
DE0407907	99 a	3250 bcdef	97 a	1 a	2 a	25 a	18.9 a	46 bcdefg	S	R
184-85	99 a	3170 bcdef	89 bcd	2 a	9 a	28 a	18.5 a	45 defgh	S	R
Cypress	97 a	3126 bcdef	91 abcd	3 a	7 a	20 a	18.3 a	50 abcde	R	S
Maestro	97 a	3095 bcdef	94 abcd	1 a	5 a	31 a	17.2 a	42 gh	?	?
GBL 21-04-DA	97 a	3094 bcdef	92 abcd	2 a	6 a	29 a	16.6 a	46 cdefg	?	?
DE0407903	98 a	3065 cdef	91 abcd	2 a	8 a	25 a	14.3 a	48 abcdefg	S	R
G700805	97 a	3026 cdef	92 abcd	6 a	3 a	26 a	18.6 a	49 abcdef	?	?
8-78	99 a	2940 cdef	91 abcd	3 a	7 a	22 a	16.9 a	53 a	S	R
DE0505002B	98 a	2827 defg	93 abcd	2 a	6 a	21 a	15.5 a	50 abcde	S	S
GBL 26-04-DA	97 a	2816 defg	88 cd	3 a	10 a	22 a	16.2 a	47 abcdefg	?	?
DE0407906	99 a	2784 fg	93 abcd	5 a	3 a	25 a	18.2 a	43 fgh	R	S
G200410	97 a	2739 fg	91 abcd	2 a	6 a	26 a	16.4 a	45 defg	?	?
GBL 24-04-DA	97 a	2717 fg	95 abc	2 a	4 a	29 a	17.3 a	42 gh	?	?
M 15	96 a	2292 gh	93 abcd	2 a	6 a	23 a	15.4 a	39 h	S	R
DE0501805A	92 b	1968 h	75 e	16 a	10 a	23 a	16.0 a	50 abcde	R	S
p-value	***0.0287***	***<0.0001***	***0.0025***	***0.1223***	***0.1441***	***0.1333***	***0.0658***	***<0.0001***		
LSD	**3.39**	**640.9**	**7.75**	**NA**	**NA**	**NA**	**NA**	**6.22**		

[1] Stand counts are highlighted for varieties for which treated seed was planted. Seeding rate was 4 seeds/ft

[2] Resistance to lima bean downy mildew (*Phytophthora phaseoli*) R=resistant, S=susceptible, ?=disease reaction unknown

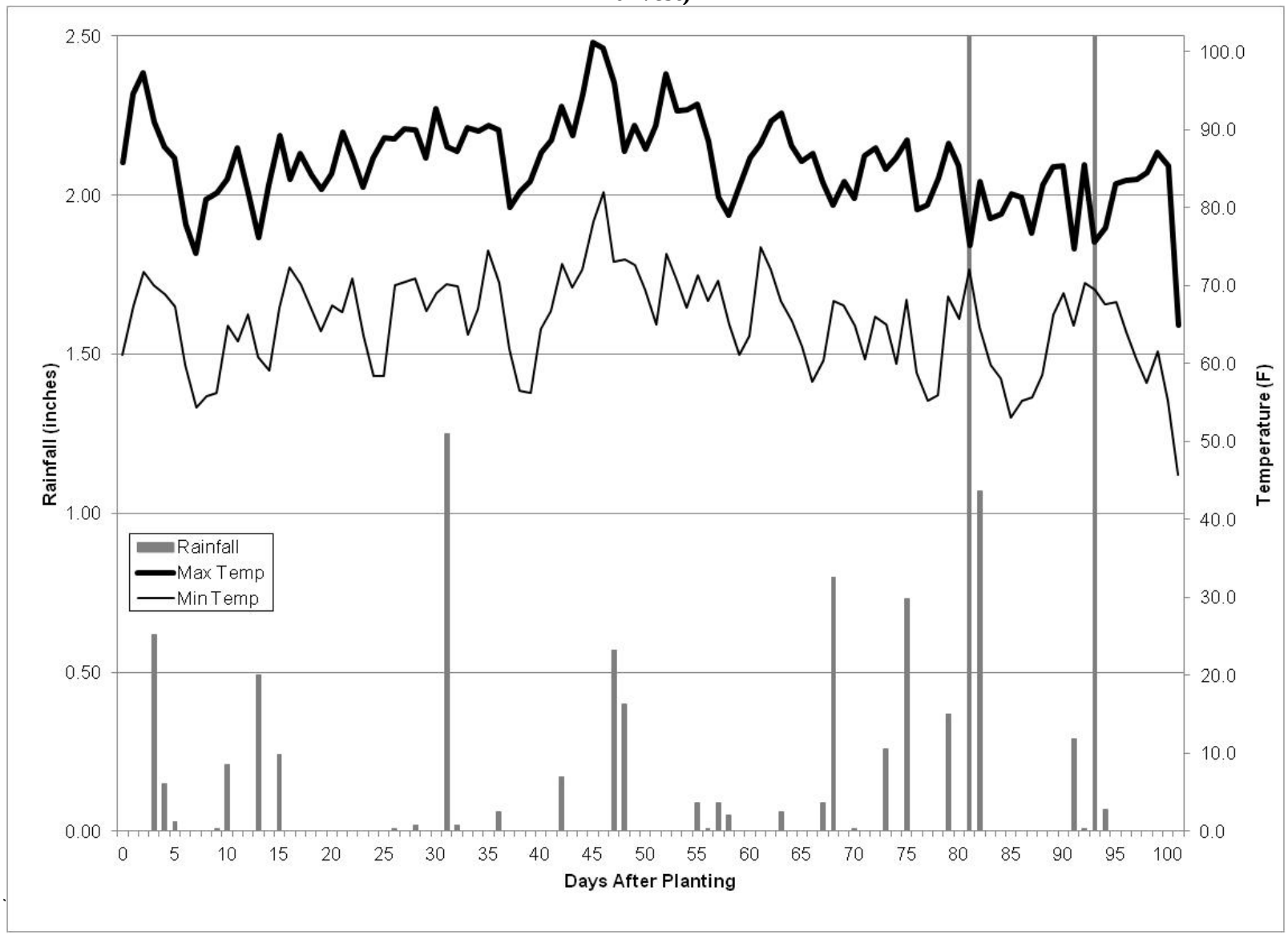
Appendix A: Weather Data for 2011 Green Baby Lima Variety Trial
June 7th (planting) to September 16th (final harvest)

Data from DEOS weather station @ Georgetown, DE-REC: www.deos.udel.edu

DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
0	**7-Jun**	85.8	61.1	0
1	**8-Jun**	94.5	67.5	0
2	**9-Jun**	97.3	71.8	0
3	**10-Jun**	91	70	0.62
4	**11-Jun**	87.8	68.9	0.15
5	**12-Jun**	86.4	67.3	0.03
6	**13-Jun**	77.9	59.8	0
7	**14-Jun**	74.2	54.4	0
8	**15-Jun**	81	55.8	0
9	**16-Jun**	81.9	56.3	0.01
10	**17-Jun**	83.6	64.8	0.21
11	**18-Jun**	87.7	62.9	0
12	**19-Jun**	81.8	66.3	0
13	**20-Jun**	76.2	60.8	0.49
14	**21-Jun**	82.9	59.1	0
15	**22-Jun**	89.2	67.1	0.24
16	**23-Jun**	83.7	72.4	0
17	**24-Jun**	87	70.2	0
18	**25-Jun**	84.2	67.1	0
19	**26-Jun**	82.3	64.1	0
20	**27-Jun**	84.3	67.5	0
21	**28-Jun**	89.7	66.6	0
22	**29-Jun**	86.4	70.9	0
23	**30-Jun**	82.7	63.6	0
24	**1-Jul**	86.4	58.4	0
25	**2-Jul**	88.9	58.4	0
26	**3-Jul**	88.8	70.1	0.01
27	**4-Jul**	90.1	70.5	0
28	**5-Jul**	89.9	70.9	0.02
29	**6-Jul**	86.4	66.8	0
30	**7-Jul**	92.7	69	0
31	**8-Jul**	87.8	70.2	1.25
32	**9-Jul**	87.2	69.9	0.02
33	**10-Jul**	90.2	63.7	0
34	**11-Jul**	89.8	67	0
35	**12-Jul**	90.5	74.5	0
36	**13-Jul**	90	70.4	0.06
37	**14-Jul**	80	61.8	0
38	**15-Jul**	82.1	56.5	0
39	**16-Jul**	83.4	56.3	0
40	**17-Jul**	87.1	64.4	0
41	**18-Jul**	88.7	66.7	0
42	**19-Jul**	93	72.8	0.17
43	**20-Jul**	89.2	69.8	0
44	**21-Jul**	94.6	72.1	0
45	**22-Jul**	101.2	78.2	0
46	**23-Jul**	100.5	82	0
47	**24-Jul**	96	73.1	0.57
48	**25-Jul**	87.3	73.4	0.4
49	**26-Jul**	90.6	72.6	0
50	**27-Jul**	87.5	69.5	0
51	**28-Jul**	90.5	65	0

DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
52	**29-Jul**	97.2	74	0
53	**30-Jul**	92.4	70.7	0
54	**31-Jul**	92.5	67.2	0
55	**1-Aug**	93.3	71.4	0.09
56	**2-Aug**	88.5	68.1	0.01
57	**3-Aug**	81.4	70.6	0.09
58	**4-Aug**	79.1	65	0.05
59	**5-Aug**	82.9	61.1	0
60	**6-Aug**	86.3	63.6	0
61	**7-Aug**	88.1	75	0
62	**8-Aug**	91.1	72	0
63	**9-Aug**	92.1	68	0.06
64	**10-Aug**	87.9	65.4	0
65	**11-Aug**	86	62.2	0
66	**12-Aug**	86.9	57.7	0
67	**13-Aug**	83.2	60.4	0.09
68	**14-Aug**	80.3	68.1	0.8
69	**15-Aug**	83.4	67.5	0
70	**16-Aug**	81.2	64.9	0.01
71	**17-Aug**	86.6	60.5	0
72	**18-Aug**	87.7	66	0
73	**19-Aug**	84.9	65	0.26
74	**20-Aug**	86.4	60	0
75	**21-Aug**	88.7	68.2	0.73
76	**22-Aug**	79.7	58.8	0
77	**23-Aug**	80.4	55.3	0
78	**24-Aug**	83.8	56	0
79	**25-Aug**	88.2	68.6	0.37
80	**26-Aug**	85.4	65.7	0
81	**27-Aug**	75.1	72	5.98
82	**28-Aug**	83.4	64.7	1.07
83	**29-Aug**	78.6	59.8	0
84	**30-Aug**	79.2	58.1	0
85	**31-Aug**	81.7	53	0
86	**1-Sep**	81.4	55.2	0
87	**2-Sep**	76.7	55.6	0
88	**3-Sep**	82.9	58.5	0
89	**4-Sep**	85.2	66.3	0
90	**5-Sep**	85.4	69	0
91	**6-Sep**	74.7	64.8	0.29
92	**7-Sep**	85.5	70.3	0.01
93	**8-Sep**	75.6	69.5	2.6
94	**9-Sep**	77.4	67.6	0.07
95	**10-Sep**	83.1	67.9	0
96	**11-Sep**	83.5	64	0
97	**12-Sep**	83.7	60.5	0
98	**13-Sep**	84.5	57.5	0
99	**14-Sep**	87.1	61.5	0
100	**15-Sep**	85.4	55.3	0
101	**16-Sep**	65	45.7	0

Appendix B: Weather Conditions During 2011 Green Baby Lima Variety Trial June 7th (planting) to September 16th (final harvest)



Green Baby Lima Bean Variety Trials in Grower Fields

In 2011 some experimental baby lima varieties from the University of Delaware lima bean breeding program were tested in two different small plot trials in grower fields. The lines and check varieties included in the two trials are listed below. The purpose of these trials was to evaluate the experimental lima bean varieties for yield, maturity, and quality at different planting dates and under grower field conditions.

Varieties Evaluated in 2011 Grower Field Trials

Variety Name	Early Trial May 25 Planting Dryland	Late Trial June 23 Planting Irrigated
C-elite Select (check)		X
184-85 (check)	X	
Cypress (check)	X	X
DE0501801A	X	X
DE0501805A	X	X
DE0402701		X
DE0407903	X	X
DE0407905	X	X
DE0407906	X	X
DE0407907	X	X
DE0505002A	X	X

Locations:

Trials were located in two different grower fields near Felton, DE. The Early Trial was not irrigated. The Late Trial was in a field irrigated by a center pivot irrigation system.

Cultural Practices:

The Early Trial was planted on May 25, 2011 and the late trial was planted on June 23, 2011. Both trials were planted by hand into rows marked by the grower as the field was being planted. Only the seed of the check varieties was treated. Varieties were planted in one-row plots with 30 inch between row spacing and 3 inch in-row spacing. Plots were 25 feet in length. Plots were arranged in a randomized complete block design with four replications. Fertility, applications for pest and disease problems, and irrigation, in the case of the Late Trial, were managed by the cooperating growers. Additional hand weeding was done in both plots. Weed control in the trials was excellent.

Harvest:

Harvest procedures were identical to those described for the Green Baby Lima Trial at Georgetown. Harvest of the Early Trial began on July 29 and was completed on September 9. Harvest of the Late Trial Began on September 26 and was completed on October 6.

Results and Discussion

Early Trial

Emergence and early stands were excellent in the Early Trial. However, this trial was not irrigated and yields were severely affected by drought. The nearest DEOS weather station in

Viola, DE received 8.18 inches of rain between May 25 (planting) and July 29 (first harvest). Another nearby weather station at Kitts Hummock, DE received 4.41 inches of rain in the same time period. Actual rainfall at the plot was probably somewhere between these two values and either is well below the approximately 18 inches of water needed to produce a good lima crop. Three of the nine varieties were harvested during the expected harvest window for this trial – late July/early August. These varieties were DE0501805A, Cypress, and DE0407903 and were harvested between 65 and 70 DAP (Table 2). The highest yielding of these three varieties, DE0501805A, produced a concentrated set and was harvested at 80% full pods. Cypress and DE0407903 had split sets, which resulted in a sizable percentage of dry pods at harvest.

The remaining six varieties were harvested at the end of August and beginning of September, over 100 DAP. The six late harvested varieties had not set any pods by the expected time of harvest and only produced a yield after the plot received significant rainfall and cooler temperatures in mid August. The later harvested varieties all produced split sets with between 16 and 29% flat pods at harvest.

DE0505002A was also the highest yielding variety in this trial, although there were no statistically significant differences in yield.

Late Trial

Uneven field moisture at planting resulted in variable emergence and stands in the plot. These initial variable field conditions resulted in a high level of variability in the yield data and made it impossible to detect statistically significant varietal differences in yield (Table 3). All of the varieties in the trial produced a concentrated set, and similar percentages of full, flat and dry pods – there were no statistically significant differences in these three variables.

DE0505002A was the highest yielding variety in this trial.

Acknowledgements

The authors gratefully acknowledge:

seasonal Extension Vegetable Program employees Brooke Drury, Heather Baker, Tyler Warfel, Kat'Rina Veney, and Carl VanGessel who helped to plant, maintain and harvest the plots.

James Adkins, who maintains the viner.

Cooperating growers Kyle Webb and Stanley West, as well as Tom Godfrey of Seabrook Brothers and Sons and Kenny Gauen of The Pictsweet Company.

Table 2. Yield, Days to Harvest, Maturity at Harvest, Number of Pods per Plant, Plant Weight, and Stand Count at Harvest for the 2011 Early Green Baby Lima Grower Field Trial – Planted May 25, Unirrigated

Variety	Days to Harvest	Yield (Lbs/A)	% Full	% Flat	% Dry	# Pods/Plant	Plant Weight (Lbs/15 ft)	# Plants/15 ft[1]
DE0505002A	106 a	1389 a	69 ab	25 a	7 c	11 abc	20.3 a	50 bcd
DE0407907	105 a	1277 a	71 ab	21 ab	8 c	10 bcd	18.3 a	43 ef
DE0407905	104 a	1235 a	70 ab	16 abc	14 c	12 abc	19.6 a	48 cde
DE0407906	106 a	1191 a	59 bc	29 a	12 c	11 abc	20.8 a	41 f
DE0501801A	101 b	1184 a	71 ab	27 a	3 c	7 de	19.9 a	54 abc
184-85	106 a	1040 a	59 bc	28 a	14 c	15 a	18.9 a	41 f
DE0501805A	65 d	896 a	80 a	7 bc	13 c	13 ab	11.5 b	46 def
DE0407903	70 c	793 a	46 c	1 c	53 a	5 e	10.9 b	56 ab
Cypress	69 c	658 a	60 bc	4 c	37 b	9 cd	11.8 b	58 a
p-value	***<0.0001***	***0.1156***	***0.0029***	***0.0049***	***<0.0001***	***0.0009***	***<0.0001***	***<0.0001***
LSD	**2.35**	**NA**	**14.325**	**16.191**	**12.895**	**3.9396**	**2.9664**	**6.2274**

[1] Stand counts are highlighted for varieties for which treated seed was planted. Seeding rate was 4 seeds/ft

Table 3. Yield, Days to Harvest, Maturity at Harvest, Number of Pods per Plant, Plant Weight, and Stand Count at Harvest for the 2011 Late Green Baby Lima Grower Field Trial – Planted June 23, Irrigated

Variety	Days to Harvest	Yield (Lbs/A)	% Full	% Flat	% Dry	# Pods/Plant	Plant Weight (Lbs/15 ft)	# Plants/15 ft[1]
DE0505002A	103 ab	3646 a	91 a	3 a	7 a	23 a	21.7 a	50 abc
DE0501801A	104 a	3191 a	80 a	10 a	10 a	24 a	19.8 ab	48 bc
DE0407903	96 c	2893 a	74 a	16 a	11 a	19 a	17.4 abcd	50 ab
DE0407907[2]	100	2590	87	11	2	22	18.5	38
DE0407906	104 a	2555 a	82 a	14 a	5 a	27 a	18.5 abcd	36 de
DE0402701	103 ab	2421 a	73 a	17 a	11 a	20 a	21.2 a	55 a
DE0407905	104 a	2376 a	83 a	13 a	4 a	26 a	16.3 bcd	34 e
C-elite Select	100 b	2310 a	75 a	20 a	5 a	26 a	18.9 abc	34 e
Cypress	96 c	2183 a	82 a	13 a	5 a	18 a	14.7 cd	42 cd
DE0501805A	103 ab	2051 a	87 a	3 a	11 a	26 a	13.9 d	34 e
p-value	***<0.0001***	***0.0986***	***0.1951***	***0.2083***	***0.373***	***0.1257***	***0.0180***	***<0.0001***
LSD	**3.43**	**NA**	**NA**	**NA**	**NA**	**NA**	**4.579**	**7.3408**

[1] Stand counts are highlighted for varieties for which treated seed was planted. Seeding rate was 4 seeds/ft

[2] Only two replications planted due to insufficient seed.

Appendix C: Weather Data for 2011 Green Baby Lima Trials in Grower Fields:
Early Trial May 25-Sep 9 **Late Trial** June 23-Oct 6
Data from DEOS weather station @ Viola, DE: www.deos.udel.edu

Early Trial DAP	Late Trial DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
0		**25-May**	85.8	65.9	0
1		**26-May**	92.9	65.7	0
2		**27-May**	88.2	68.9	0
3		**28-May**	86.2	63.5	0.05
4		**29-May**	88.2	66.4	0
5		**30-May**	93.4	69.6	0
6		**31-May**	96.1	68.8	0
7		**1-Jun**	96	69.5	0
8		**2-Jun**	85.2	58.1	0
9		**3-Jun**	77.6	48.2	0
10		**4-Jun**	81.3	47.3	0
11		**5-Jun**	79	60.7	0.06
12		**6-Jun**	85	55.8	0.01
13		**7-Jun**	88.6	62.2	0
14		**8-Jun**	95	68.2	0
15		**9-Jun**	99.2	72	0
16		**10-Jun**	91.5	68.4	0.14
17		**11-Jun**	88	68.4	0.31
18		**12-Jun**	88.2	64.9	0.14
19		**13-Jun**	76.8	57.4	0.01
20		**14-Jun**	74.9	55.5	0
21		**15-Jun**	81.6	54	0
22		**16-Jun**	83.5	57.3	0.1
23		**17-Jun**	86.2	66.8	0.29
24		**18-Jun**	87.7	65.3	0.01
25		**19-Jun**	85.6	66.5	0
26		**20-Jun**	76.4	59.7	0.17
27		**21-Jun**	87	59.6	0
28		**22-Jun**	93.5	65.6	0.09
29	**0**	**23-Jun**	88	72	0
30	**1**	**24-Jun**	91.3	66.3	0
31	**2**	**25-Jun**	87.3	62	0
32	**3**	**26-Jun**	83.7	58.7	0
33	**4**	**27-Jun**	86.6	66.8	0
34	**5**	**28-Jun**	88	65	0.09
35	**6**	**29-Jun**	86.8	64.9	0
36	**7**	**30-Jun**	84	57.8	0
37	**8**	**1-Jul**	87.1	56.5	0
38	**9**	**2-Jul**	90.8	57.5	0
39	**10**	**3-Jul**	91.5	70.3	0
40	**11**	**4-Jul**	90.6	69	0
41	**12**	**5-Jul**	91.8	68.8	0.79
42	**13**	**6-Jul**	89.6	68.9	0.03
43	**14**	**7-Jul**	96.2	68.6	0
44	**15**	**8-Jul**	91	70.5	1.55
45	**16**	**9-Jul**	87.9	67	0
46	**17**	**10-Jul**	92.7	62.7	0
47	**18**	**11-Jul**	92.8	67.5	0
48	**19**	**12-Jul**	91.9	73.8	0
49	**20**	**13-Jul**	91.7	69.3	0.05
50	**21**	**14-Jul**	85.2	61.6	0

Early Trial DAP	Late Trial DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
51	**22**	**15-Jul**	86.4	56.7	0
52	**23**	**16-Jul**	87.9	57.8	0
53	**24**	**17-Jul**	90.5	64.8	0
54	**25**	**18-Jul**	94.4	67.1	0
55	**26**	**19-Jul**	94.5	70.4	4.1
56	**27**	**20-Jul**	93.1	68.9	0.01
57	**28**	**21-Jul**	98.1	73.4	0
58	**29**	**22-Jul**	102.3	78.7	0
59	**30**	**23-Jul**	98.8	79.2	0
60	**31**	**24-Jul**	94.4	74.5	0.04
61	**32**	**25-Jul**	89.8	71.7	0.13
62	**33**	**26-Jul**	92.4	72.6	0
63	**34**	**27-Jul**	88	67.4	0
64	**35**	**28-Jul**	92.7	64.9	0.01
65	**36**	**29-Jul**	98.7	74	0
66	**37**	**30-Jul**	90.6	68	0
67	**38**	**31-Jul**	94.9	63.5	0.14
68	**39**	**1-Aug**	96.2	68.6	0.17
69	**40**	**2-Aug**	87.3	68.2	0
70	**41**	**3-Aug**	81.6	68.5	0.09
71	**42**	**4-Aug**	77.9	64.9	0.04
72	**43**	**5-Aug**	86.8	60.7	0
73	**44**	**6-Aug**	91	64.3	0
74	**45**	**7-Aug**	92.9	75.6	0
75	**46**	**8-Aug**	90.1	70.7	0
76	**47**	**9-Aug**	92.8	67.4	0
77	**48**	**10-Aug**	88.7	64.4	0
78	**49**	**11-Aug**	85.4	59.3	0
79	**50**	**12-Aug**	89.1	55.5	0
80	**51**	**13-Aug**	86.1	57	0.05
81	**52**	**14-Aug**	80.9	67.8	2.49
82	**53**	**15-Aug**	83.4	66.6	0.7
83	**54**	**16-Aug**	81.4	63.7	0
84	**55**	**17-Aug**	91.1	62.8	0
85	**56**	**18-Aug**	90.3	68.2	0.01
86	**57**	**19-Aug**	88.9	63.6	1.3
87	**58**	**20-Aug**	88.2	58.8	0
88	**59**	**21-Aug**	89.1	67.7	0.3
89	**60**	**22-Aug**	79.2	56.8	0
90	**61**	**23-Aug**	81	53	0.01
91	**62**	**24-Aug**	86.5	55.7	0
92	**63**	**25-Aug**	84.7	68.8	0.21
93	**64**	**26-Aug**	89	65.3	0.98
94	**65**	**27-Aug**	75.1	72.2	7.64
95	**66**	**28-Aug**	82.5	61.4	2.1
96	**67**	**29-Aug**	77.2	56.7	0
97	**68**	**30-Aug**	85.1	55.3	0
98	**69**	**31-Aug**	86.7	54.1	0
99	**70**	**1-Sep**	84.2	56.6	0
100	**71**	**2-Sep**	76.7	57.5	0
101	**72**	**3-Sep**	86	60.9	0
102	**73**	**4-Sep**	88.2	66.7	0
103	**74**	**5-Sep**	85.1	69.2	0
104	**75**	**6-Sep**	74.4	62.5	0.77
105	**76**	7-Sep	87.6	69.8	0

Early Trial DAP	Late Trial DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
106	**77**	**8-Sep**	77.5	70.5	1.28
107	**78**	**9-Sep**	79.4	68.2	0.01
	79	**10-Sep**	86.5	67	0
	80	**11-Sep**	84.1	65.9	0.02
	81	**12-Sep**	84.6	60.4	0.21
	82	**13-Sep**	86.5	61	0
	83	**14-Sep**	91.2	65.9	0
	84	**15-Sep**	82.3	52.1	0.02
	85	**16-Sep**	68.7	45.6	0
	86	**17-Sep**	65.2	48.8	0.01
	87	**18-Sep**	71.2	54.6	0.01
	88	**19-Sep**	73.5	49.2	0
	89	**20-Sep**	72.4	57.5	0.09
	90	**21-Sep**	80.5	57.4	0.01
	91	**22-Sep**	83.8	68.9	0
	92	**23-Sep**	77	69.2	1.17
	93	**24-Sep**	75.4	66.1	0
	94	**25-Sep**	82.1	65.7	0.01
	95	**26-Sep**	83.6	66.6	0.01
	96	**27-Sep**	85	68.2	0.43
	97	**28-Sep**	82.5	67.6	0.22
	98	**29-Sep**	80.2	57.6	0
	99	**30-Sep**	82.4	55.2	0.44
	100	**1-Oct**	65.6	50.9	0.01
	101	**2-Oct**	51.1	46.5	0.09
	102	**3-Oct**	54.5	40.1	0.11
	103	**4-Oct**	65.8	41.6	0
	104	**5-Oct**	73.5	51.2	0
	105	**6-Oct**	70	43.1	0

Fordhook Lima Bean Variety Trial

The 2011 Lima Bean Variety Trial included a total of 32 lines. Twenty-eight of the lines were from the University of Delaware lima bean breeding program. Two varieties were entered by Ben Fish. Concentrated Fordhook and Fordhook 242 were included in the trial as check varieties. The purpose of this trial is to evaluate advanced Fordhook breeding lines for yield, maturity, and quality under Delaware growing conditions.

Varieties Entered in the 2011 Delaware Fordhook Lima Bean Variety Trial

Variety Name	Company
DE0501103A	University of Delaware
DE0501201A	University of Delaware
DE0504101D	University of Delaware
DE0504103C	University of Delaware
DE0600101A	University of Delaware
DE0600101D	University of Delaware
DE0600102B	University of Delaware
DE0600104A	University of Delaware
DE0600601D	University of Delaware
DE0600602B	University of Delaware
DE0600602C	University of Delaware
DE0600605A	University of Delaware
DE0600605C	University of Delaware
DE0601001B	University of Delaware
DE0601001D	University of Delaware
DE0700801A	University of Delaware
DE0700904	University of Delaware
DE0701001B	University of Delaware
DE0701101	University of Delaware
DE0701301A	University of Delaware
DE0701301B	University of Delaware
DE0701303B	University of Delaware
DE0701306A	University of Delaware
DE0701306B	University of Delaware
DE0701502A	University of Delaware
DE0701502B	University of Delaware
DE0701502C	University of Delaware
DE0701506B	University of Delaware
FH 242	check
Concentrated FH (CFH)	check
GSFH 1-10-DA	Ben Fish
GSFH 2-10-DA	Ben Fish

Location:
Field 2B at the University of Delaware Research and Education Center Farm, Georgetown, DE

Cultural Practices:
The trial was hand planted on June 28, 2011 into rows run with a Monosem planter. Only the Concentrated Fordhook and Fordhook 242 seed was treated. Varieties were planted in one-row plots with 30 inch between row spacing and 6 inch in-row spacing. Plots were 10 feet in length. Plots were arranged in a randomized complete block design with three replications. Six of the varieties were not replicated because insufficient seed was available (DE0600101D, DE0600602C, DE0601001B, DE0601001D, DE0701001B and DE0701101). The field was fertilized according to soil test results. Pre-emergence herbicides (0.6 oz/A Sandea + 1.5 pint/A Dual II Magnum) were applied on June 29, 2011 as well as 50 lbs/A nitrogen in the form of 30% UAN. Plots were cultivated on August 4, 2011 and sidressed with 33 lbs/A nitrogen in the form of 30% UAN. Additional hand weeding was done in early August. Weed control in the trial was excellent. Plots were irrigated, when necessary, with a traveling, linear system. Warrior II at 1.9 oz/A was applied for insect control on August 16. No applications were made for disease control.

Harvest:
As harvest approached, plants were visually evaluated for maturity and plots were harvested when the majority of the pods were filled. Not all replications for a variety were harvested on the same day. There were no significant differences between the varieties in percent dry pods at harvest, however there were significant differences between the percent full pods and the percent flat pods (Table 4). Harvest began on September 27 (91 DAP) and ended on October 10 (104 DAP).

An 8 foot section from each plot was harvested. The plants were cut off at soil level and weighed. Pods were stripped from the harvested plants from each plot and counted as full, flat or dry. The pulled pods were shelled in a Model 520 "TaMaCo" huller from Taylor Manufacturing Co., Inc., Moultrie, GA. Any remaining trash was removed from the shelled beans by hand and the cleaned beans were weighed to determine yield.

Results and Discussion
Seedling emergence in this trial was excellent for most varieties (Table 4). The exceptions to this were GSFH 1-10-DA and GSFH 2-10-DA, which had 56% stand at harvest. Concentrated Fordhook also had low stand at harvest (68%).

There were significant differences in yield among the varieties in the trial (Table 4). The standard variety, Concentrated Fordhook (CFH), produced exceptionally low yields this year (838 lbs/A). In the 2008-2010 trials CFH averaged 2908 lbs/A with yields ranging from 1234 to 3863 lbs/A. The highest yielding replicated varieties in the trial this year were DE0600102B, DE0600605C and DE0600602B. DE0600605C and DE0600102B were the highest and third highest yielding varieties (respectively) in the 2009 trial. Most of the varieties in the trial (19) had significantly higher yields than CFH, and the four highest yielding replicated varieties had significantly higher yields than FH 242. FH 242 produced a significantly higher yield than CFH and of the commercially available Fordhook varieties, may be the most suitable for Delaware.

Acknowledgements
The authors gratefully acknowledge:

seasonal Extension Vegetable Program employees Brooke Drury, Heather Baker, Tyler Warfel, Kat'Rina Veney, and Carl VanGessel who helped to plant, maintain and harvest the plots.

Brian Hearn and the REC Farm Crew for help with field operations.

Table 4. Days to Harvest, Yield, Maturity at Harvest, Number of Pods per Plant, Plant Weight, and Stand Count at Harvest, for Entries in the 2011 Fordhook Lima Bean Variety Trial

Variety	Days to Harvest	Yield (Lbs/A)	% Full	% Flat	% Dry	# Pods/Plant	Plant Weight (lbs/8 ft)	# Plants/8 ft[1]
DE0600102B	91 f	3623 a	86 a	5 g	10 a	11.0 a	9.7 bcdefg	14 abc
DE0600605C	91 f	3473 a	73 abcd	24 cdef	3 a	7.5 bcdef	13.2 a	15 ab
DE0600602B	92 ef	3259 ab	75 abc	14 fg	11 a	9.5 abc	11.1 abcde	16 a
DE0701101[2]	91	2641	79	17	5	7.4	10.6	16
DE0701303B	95 cdef	2622 bc	69 abcde	23 def	8 a	11.0 a	9.6 bcdefg	13 bcd
DE0701502A	91 f	2503 cd	76 ab	19 efg	5 a	9.4 abc	11.1 abcde	13 bcd
DE0600101D[2]	91	2478	78	16	5	8.4	11.9	16
DE0700904	95 cdef	2436 cd	58 defgh	29 abcdef	13 a	8.6 abcde	11.3 abcde	14 abc
DE0701301A	92 ef	2425 cd	65 bcdefg	29 abcdef	6 a	9.9 ab	10.5 abcdef	11 cdef
DE0600601D	92 ef	2317 cde	64 bcdefgh	32 abcde	4 a	6.8 bcdefg	12.2 abc	16 a
DE0701301B	94 cdef	2264 cdef	66 bcdefg	24 cdef	10 a	7.2 bcdef	8.8 defg	11 cdef
DE0600605A	96 bcde	2241 cdef	65 bcdefg	27 abcdef	8 a	7.6 bcdef	11.2 abcde	13 bcd
DE0700801A	94 cdef	2189 cdef	64 bcdefg	31 abcde	4 a	9.0 abcd	11.6 abcde	13 bcd
DE0600602C[2]	97	2140	74	24	2	8.4	12.3	13
DE0701306B	93 def	2103 cdef	68 bcdef	19 efg	12 a	8.4 abcde	10.4 abcdef	13 abcd
DE0701306A	98 bcd	1988 cdefg	58 cdefgh	26 bcdef	16 a	8.1 abcde	9.4 cdefg	13 bcd
DE0601001D[2]	97	1959	63	32	6	7.5	13.0	13
DE0601001B[2]	101	1805	41	57	3	4.3	11.6	15
DE0600101A	96 bcde	1796 defgh	62 bcdefgh	27 bcdef	11 a	6.5 cdefg	11.1 abcde	12 bcde
FH 242	92 ef	1793 defgh	52 fghi	37 abcd	12 a	5.7 efgh	12.6 ab	13 abcd
DE0701502C	94 cdef	1698 efghi	55 efghi	38 abcd	7 a	7.0 bcdef	10.1 bcdefg	14 abc
DE0501201A	101 ab	1681 efghi	59 bcdefgh	32 abcde	9 a	7.0 bcdef	11.3 abcde	14 abc
DE0504103C	95 cdef	1642 efghi	64 bcdefgh	31 abcde	5 a	9.5 abc	11.8 abcd	15 ab
GSFH 1-10-DA	98 bcd	1589 fghij	47 hi	44 a	9 a	7.9 abcde	11.1 abcde	9 ef
DE0701001B[2]	94	1421	54	30	17	4.5	6.6	13
DE0701506B	95 cdef	1382 ghijk	59 cdefgh	29 abcdef	12 a	6.0 defgh	7.8 fg	13 bcd
DE0701502B	96 bcde	1312 ghijk	52 efghi	41 ab	7 a	7.6 bcdef	7.3 g	10 def
GSFH 2-10-DA	98 bcd	1284 ghijk	41 i	40 abc	19 a	6.3 defgh	8.6 efg	9 f
DE0501103A	101 ab	1272 hijk	57 defghi	39 abcd	5 a	4.7 fgh	11.8 abcd	13 abcd
DE0600104A	99 abc	1060 ijk	55 efghi	29 abcdef	16 a	3.2 h	10.8 abcdef	14 abc
DE0504101D	103 a	915 jk	57 defghi	27 bcdef	16 a	6.3 defgh	9.8 bcdefg	12 bcde
CFH	95 cdef	838 k	50 ghi	42 ab	8 a	3.7 gh	10.5 abcdef	10 def
p-value	***<0.0001***	***<0.0001***	***0.0014***	***0.0050***	***0.2418***	***0.0002***	***0.0486***	***0.00020***
LSD	**4.85**	**715.8**	**16.85**	**16.72**	**NA**	**3.14**	**3.05**	**3.21**

[1] Seeding rate was 2 seeds/ft; [2] Lines not replicated in the trial due to insufficient seed

Appendix D: Weather Data for 2011 Fordhook Lima Variety Trial
June 28th (planting) to October 10th (final harvest)

DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
0	**28-Jun**	89.7	66.6	0
1	**29-Jun**	86.4	70.9	0
2	**30-Jun**	82.7	63.6	0
3	**1-Jul**	86.4	58.4	0
4	**2-Jul**	88.9	58.4	0
5	**3-Jul**	88.8	70.1	0.01
6	**4-Jul**	90.1	70.5	0
7	**5-Jul**	89.9	70.9	0.02
8	**6-Jul**	86.4	66.8	0
9	**7-Jul**	92.7	69	0
10	**8-Jul**	87.8	70.2	1.25
11	**9-Jul**	87.2	69.9	0.02
12	**10-Jul**	90.2	63.7	0
13	**11-Jul**	89.8	67	0
14	**12-Jul**	90.5	74.5	0
15	**13-Jul**	90	70.4	0.06
16	**14-Jul**	80	61.8	0
17	**15-Jul**	82.1	56.5	0
18	**16-Jul**	83.4	56.3	0
19	**17-Jul**	87.1	64.4	0
20	**18-Jul**	88.7	66.7	0
21	**19-Jul**	93	72.8	0.17
22	**20-Jul**	89.2	69.8	0
23	**21-Jul**	94.6	72.1	0
24	**22-Jul**	101.2	78.2	0
25	**23-Jul**	100.5	82	0
26	**24-Jul**	96	73.1	0.57
27	**25-Jul**	87.3	73.4	0.4
28	**26-Jul**	90.6	72.6	0
29	**27-Jul**	87.5	69.5	0
30	**28-Jul**	90.5	65	0
31	**29-Jul**	97.2	74	0
32	**30-Jul**	92.4	70.7	0
33	**31-Jul**	92.5	67.2	0
34	**1-Aug**	93.3	71.4	0.09
35	**2-Aug**	88.5	68.1	0.01
36	**3-Aug**	81.4	70.6	0.09
37	**4-Aug**	79.1	65	0.05
38	**5-Aug**	82.9	61.1	0
39	**6-Aug**	86.3	63.6	0
40	**7-Aug**	88.1	75	0
41	**8-Aug**	91.1	72	0
42	**9-Aug**	92.1	68	0.06
43	**10-Aug**	87.9	65.4	0
44	**11-Aug**	86	62.2	0
45	**12-Aug**	86.9	57.7	0
46	**13-Aug**	83.2	60.4	0.09
47	**14-Aug**	80.3	68.1	0.8

DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
48	**15-Aug**	83.4	67.5	0
49	**16-Aug**	81.2	64.9	0.01
50	**17-Aug**	86.6	60.5	0
51	**18-Aug**	87.7	66	0
52	**19-Aug**	84.9	65	0.26
53	**20-Aug**	86.4	60	0
54	**21-Aug**	88.7	68.2	0.73
55	**22-Aug**	79.7	58.8	0
56	**23-Aug**	80.4	55.3	0
57	**24-Aug**	83.8	56	0
58	**25-Aug**	88.2	68.6	0.37
59	**26-Aug**	85.4	65.7	0
60	**27-Aug**	75.1	72	5.98
61	**28-Aug**	83.4	64.7	1.07
62	**29-Aug**	78.6	59.8	0
63	**30-Aug**	79.2	58.1	0
64	**31-Aug**	81.7	53	0
65	**1-Sep**	81.4	55.2	0
66	**2-Sep**	76.7	55.6	0
67	**3-Sep**	82.9	58.5	0
68	**4-Sep**	85.2	66.3	0
69	**5-Sep**	85.4	69	0
70	**6-Sep**	74.7	64.8	0.29
71	**7-Sep**	85.5	70.3	0.01
72	**8-Sep**	75.6	69.5	2.6
73	**9-Sep**	77.4	67.6	0.07
74	**10-Sep**	83.1	67.9	0
75	**11-Sep**	83.5	64	0
76	**12-Sep**	83.7	60.5	0
77	**13-Sep**	84.5	57.5	0
78	**14-Sep**	87.1	61.5	0
79	**15-Sep**	85.4	55.3	0
80	**16-Sep**	65	45.7	0
81	**17-Sep**	63.9	49.1	0.24
82	**18-Sep**	65.1	55.3	0.02
83	**19-Sep**	69.3	48.2	0
84	**20-Sep**	73.5	53.7	0
85	**21-Sep**	75.5	52.7	0
86	**22-Sep**	80	59.8	0.01
87	**23-Sep**	76.5	61	0.45
88	**24-Sep**	73	58.8	0.03
89	**25-Sep**	75.5	57.1	0
90	**26-Sep**	79.3	58.4	0
91	**27-Sep**	81.2	58	0
92	**28-Sep**	80.7	60.8	0.1
93	**29-Sep**	81.2	58.2	0.02
94	**30-Sep**	79.7	54	0.62
95	**1-Oct**	62.7	51	0.02
96	**2-Oct**	51.2	44.8	0
97	**3-Oct**	54.8	40.7	0.01
98	**4-Oct**	65.4	43.4	0
99	**5-Oct**	72.2	50.6	0

DAP	Date	Max Temp °F	Min Temp °F	Rainfall (in.)
100	**6-Oct**	68.5	44.3	0
101	**7-Oct**	69.2	38.8	0
102	**8-Oct**	74.3	41.4	0
103	**9-Oct**	81.1	43.3	0
104	**10-Oct**	80.9	46.1	0

Appendix E: Weather Conditions During 2011 Fordhook Variety Trial June 28th (planting) to October 10th (final harvest)