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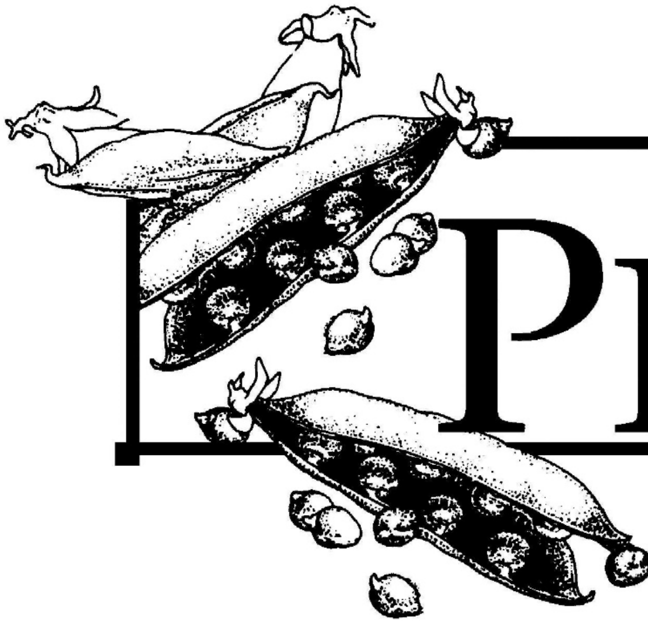

PEA

Variety Trial Results

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2014

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2014 University of Delaware Pea Variety Trial

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Introduction

The 2014 Pea Variety Trials were conducted at the University of Delaware Research and Education Center. The purpose of these trials is to evaluate and identify varieties best adapted for our production region. Yield, quality and maturity are important characteristics that can vary for any one variety between production regions. Similar trials have been conducted on the farm since 1994.

Trials were planted on two dates (mid- March and mid-April) to place the varieties in the planting season appropriate for their maturity classification. This year's trials were planted on March 24 and April 18. The Early Trial was planted later than typical this year because of an unusually cold and snowy spring. Early maturing varieties are generally planted during the first half of the planting season and longer maturing varieties are planted in the second half. Later plantings are exposed to warmer conditions, which generate quicker accumulations of heat units. Thus, longer maturing varieties are used in later plantings.

Materials and Methods

Planting and Crop Management

Twenty-four varieties were planted in the March 24 trial, and 19 varieties in the April 18 trial. The trials were located in Field 31 at the University of Delaware Research Farm in Georgetown, DE. Field was limed and potassium was applied according to soil test results prior to planting. Both were irrigated as needed, and grown under standard commercial management practices. Weed control in both trials was good.

Planting Date: **Early Trial** – March 24, 2014; 24 varieties
Late Trial – April 18, 2014; 19 varieties

Herbicide: Pursuit @ 2 oz/A + Dual II Magnum @ 1 pt/A with 30% UAN at 25 gal/A (80 lbs N/A) applied preemergence

Planting: Trials were planted using an Almaco drill with 9 rows spaced 8 inches apart. Seeding rate was 8 to 9 seeds per foot of row.

Stands: **Early Trial –** stands were excellent
Late Trial - stands were excellent

Plot Design: 6 x 30 foot plots arranged in a randomized complete block design with 3 replications

Varieties in the 2014 Early Pea Trial

Variety	Company
BSC2014	Brotherton Seed Co. Inc.
BSC5051	Brotherton Seed Co. Inc.
Gusty*	Brotherton Seed Co. Inc.
Exp-16505	Crites Seed, Inc.
CS-430AF*	Crites Seed, Inc.
Exp-12805*	Crites Seed, Inc.
CS-424F	Crites Seed, Inc.
GV 437	Gallatin Valley
GV 490	Gallatin Valley
PLS M-14	Pure Line Seeds
PLS 226*	Pure Line Seeds
PLS 228*	Pure Line Seeds
PLS 595*	Pure Line Seeds
Pizarro*	Seminis/Monsanto
SV0956QH	Seminis/Monsanto
SV0955QH	Seminis/Monsanto
SV0935QF*	Seminis/Monsanto
SV0969QH	Seminis/Monsanto
Nitro	Seminis/Monsanto
Jumpstart	check variety
Strike	check variety
Marias	check variety
June	check variety
Cabree	check variety

*** Afila Variety**

Varieties in the 2014 Late Pea Trial

Variety	Company
Destiny	Brotherton Seed Co. Inc
BSC4241A	Brotherton Seed Co. Inc
BSC3661	Brotherton Seed Co. Inc
CS-437F	Crites Seed, Inc.
CS-433AF*	Crites Seed, Inc.
Exp-32963	Crites Seed, Inc.
Exp-32965	Crites Seed, Inc.
Welland*	Crites Seed, Inc.
GV 513	Gallatin Valley
Reliance*	Seminis/Monsanto
SV8112QF*	Seminis/Monsanto
SV1058QH*	Seminis/Monsanto
SV7688QF*	Seminis/Monsanto
Ambiance*	Seminis/Monsanto
SV1036QF*	Seminis/Monsanto
SV0893QF	Seminis/Monsanto
Maurice*	Seminis/Monsanto
Bolero	check variety
Grundy	check variety

*** Afila Variety**

Pre Harvest Data

Stand counts of emerged plants were completed on April 21, 2014 for the Early Trial (28 DAP) and on May 12, 2014 (24 DAP) for the Late Trial. The number of emerged plants was counted for a three foot long section of row in three randomly selected locations in each plot. The date of first flower and peak flowering was noted for each plot.

Harvest Procedure

Each variety was harvested as near to a tenderometer reading of 100 as possible. Pre-harvest samples were taken two to three days prior to reaching this maturity level whenever possible. All three replications for each variety were harvested on the same day.

Plants were pulled from a 6 x 25 foot section of the plot (150 ft^2). The vines were weighed and fed into a stationary FMC viner. Shelled peas were collected and cleaned (removing leaves, stones, and other trash). The clean, shelled peas were weighed. A 700 g sub-sample was put through a size separator that segregated peas into the following sizes according to their diameter: 12/32 inch or greater (#4 sieve size); between 11/32 and 12/32 inch (#3 sieve size); between 9/32 and 11/32 inch (#1 and #2 sieve size); and peas smaller than 9/32 inch (trash). After each size was weighed, peas with sieve sizes 1 through 4 were recombined into a bulk sample with the smallest (trash) peas removed. Three tenderometer readings were taken from this bulked sample. The average is reported.

Ten plants were taken from each variety and the following measurements were taken: vine length; number of nodes setting usable pods; number of pods per plant; pod length; and peas per pod. Statistics for pod length and number of peas per pod were calculated based on ten pods that were randomly selected from the ten sampled plants.

Discussion of Trial Results

The results for the two trials are reported in separate sections. Each section consists of twelve tables of results and one chart. In most tables the variety means are listed in descending order. Means followed by the same letter are not significantly different as determined by Fischer's protected LSD with 5% error (α=0.05). The LSD value and p-value for the effect of the independent variable are included at the bottom of each table.

Rainfall levels were average during the time the trials were conducted and irrigation was applied as necessary via an overhead linear irrigation system. Spring weather this year was colder than typical and planting of the Early Trial, which is usually planted around March 15 was delayed until March 24 by bad weather and snow on the ground. The soil was frozen the morning of the day the Early Trial was planted and the next day it snowed several inches! The Late Trial was planted close to the standard mid-April date on April 18. Temperatures in April were average, but cooler than some recent years. May temperatures were slightly cooler than average and June temperatures were average or higher than average with the exception of the June 11 through 13 which was a period of cool, foggy wet weather which may have favored the botrytis which resulted in yield loss in some of the varieties in the Late Trial. Harvest of the Early Trial began on May 30, which is about five days later than the typical first harvest date for this trial, but not surprising since it was planted later than is usual. The harvest of the Late Trial began on June 16 which is typical for this trial. Complete weather data and heat unit accumulation for the trials is included in Appendices A & B.

Tables 2E and 2L report the average stand counts, percent stand and seed treatment components for each variety in the trial. Because of cool weather, the Early Trial emerged slowly, but we did not see damage from seed corn maggot in either the Early or Late trials this year and stands were excellent in both trials. Seed corn maggot damage is not uncommon in early planted peas in Delaware and is sometimes observed in our trials. In the Early Trial we did see some bleaching of plants that may have been related to herbicide injury. An estimation of percent of plants injured in each plot was made and the average of the three plots (replications) for each variety is reported in the table below.

Average Percent Bleaching Injury for Varieties in the Early Trial

Variety	% Injury
Jumpstart	8.67
PLS 228	8.33
June	5.00
Gusty	3.67
BSC2014	3.33
Nitro	3.33
GV 437	2.00
PLS M-14	2.00
Marias	2.00
GV 490	2.00
Exp-12805	1.67
SV0955QH	1.67

Variety	% Injury
SV0969QH	1.67
Exp-16505	0.67
BSC5051	0.67
Pizarro	0.33
Cabree	0.33
PLS 226	0.33
SV0935QF	0.33
PLS 595	0.33
Strike	0.00
CS-430AF	0.00
SV0956QH	0.00
CS-424F	0.00

Jumpstart and PLS 228 were especially affected and one replication of PLS 228 was not harvested as a result of severe injury. Because of this, PLS 228 could not be included in the statistical analysis, instead the two replication average is reported for this variety in the following yield tables. A less affected border plot of Jumpstart was harvested instead of the severely injured experimental plot for that variety. Injury was most severe in one corner of replication three. For other plots with injury, we selected the harvest section to avoid injured plants, which were in most cases only 1-5% of the plot.

Plot Map for Early Pea Variety Trial Showing Distribution of Bleaching Injury

Border (Jumpstart)	**Border (Jumpstart)**	**Border (Jumpstart)**
20 - Marias	20 - Marias	5 - PLS M-14
21 - June	12 - Pizarro	19 - Strike
6 - PLS 226	14 - SV0955QH	11 - Gusty
3 - Exp-12805	19 - Strike	15 - SV0935QF
14 - SV0955QH	21 - June	8 - PLS 595
5 - PLS M-14	11 - Gusty	6 - PLS 226
9 - BSC2014	17 - Nitro	24 - GV 490
1 - Exp-16505	5 - PLS M-14	16 - SV0969QH
12 - Pizarro	8 - PLS 595	1 - Exp-16505
24 - GV 490	1 - Exp-16505	21 - June
16 - SV0969QH	6 - PLS 226	2 - CS-430AF
8 - PLS 595	16 - SV0969QH	10 - BSC5051
10 - BSC5051	7 - PLS 228	23 - GV 437
2 - CS-430AF	15 - SV0935QF	20 - Marias
13 - SV0956QH	9 - BSC2014	4 - CS-424F
22 - Cabree	23 - GV 437	14 - SV0955QH
19 - Strike	18 - Jumpstart	9 - BSC2014
4 - CS-424F	22 - Cabree	17 - Nitro
23 - GV 437	10 - BSC5051	3 - Exp-12805
11 - Gusty	2 - CS-430AF	22 - Cabree
18 - Jumpstart	24 - GV 490	13 - SV0956QH
17 - Nitro	3 - Exp-12805	12 - Pizarro
7 - PLS 228	13 - SV0956QH	18 - Jumpstart
15 - SV0935QF	4 - CS-424F	7 - PLS 228
Border (Jumpstart)	**Border (Jumpstart)**	**Border (Jumpstart)**

Percent Injury
20
15
5
1

Tables 3E and 3L report the net and gross yields adjusted to a tenderometer reading of 100. The adjustment calculation procedure is based on the method described by Pumphrey *et al.* (see Appendix C: Adjusting Pea Yields to a T-Reading of 100). Briefly, the adjustment factor (Y) is the percent of yield at a T-reading of 100 for the T-reading at harvest (X).

$$Y = -1059.1 - 8.405X + 200X^{1/2}$$

and

$$\text{Yield adjusted to a T-reading of 100} = \frac{\text{Yield at T-reading } X}{(Y/100)}$$

The net yield is calculated by subtracting the percent of peas smaller than 9/32 inch, trash, (as determined by sizing of a 700 g sub-sample) from the gross yield.

Yields in the Early Trial were average for what we typically see in the trial. The highest yielding variety in the early trial was BSC5051, which was also one of the latest varieties in the trial. CS-424F and Marias were not significantly different than BSC5051 in terms of yield and matured slightly earlier. BSC5051, CS-424F, PLS 228, Marias, GV 437, Exp-12805, CS-430AF, Exp-16505, Pizarro and the check varieties, Strike and Jumpstart produced high yields in comparison to other varieties that matured at the same time (Chart 1E). CS-424 F was the highest yielding variety in the 2012 and 2010 Early Pea Trials and performed well again this year. Nitro had the lowest yields in the early trial, but it is a very small sieve variety.

Yields in the Late Trial were slightly below average compared to what we have seen in past years for this trial. The highest yielding variety in the late trial was GV 513. SV0893QF, SV788QF, Maurice and SV1036QF were not significantly different than GV 513 in terms of yield. The aforementioned varieties all had significantly higher yields than the trial check variety, Grundy, but only GV 513 had a significantly higher yield than the other check variety, Bolero. Maurice was the latest maturing variety in the trial, and was harvested at T-reading of 86 three days after Bolero. Some of the varieties in the trials suffered yield loss as a result of botrytis which caused abortion of flowers and pods. The disease was first noted on June 12, following a period of very wet weather and was confirmed by the University of Delaware Plant Diagnostician. CS-437F, Reliance Grundy, Destiny, BSC4241A, BSC3661, and Exp-32965 appeared to suffer yield loss as a result of botrytis.

Early Trial Pre-Harvest Data

Table 1E: Flowering Data

Variety	First Flower		Full Flower	
	DAP	Heat Units	DAP	Heat Units
Exp-16505	44	558	49	698
Pizarro	45	586	49	698
Jumpstart	45	586	49	698
Strike	45	586	49	698
CS-430AF	46	610	49	698
Cabree	46	610	49	698
Exp-12805	47	640	50	727
June	47	640	51	746
GV 437	48	667	50	727
PLS M-14	48	667	50	727
Marias	48	667	51	746
SV0956QH	48	667	52	776
SV0955QH	49	698	51	746
PLS 226	49	698	53	800
BSC2014	49	698	53	800
Gusty	49	698	57	874
CS-424F	50	727	56	853
GV 490	50	727	56	853
PLS 228	50	727	56	853
SV0969QH	51	746	58	902
SV0935QF	51	746	56	853
Nitro	53	800	58	902
BSC5051	55	836	58	902
PLS 595	56	853	60	960

Table 2E: Stand Counts (Plants/Yard), Percent Stand, and Seed Treatment

Variety	Plants/Yd	% Stand (at 8 seeds/ft)	Seed Treatment						
			Captan	Allegiance	Maxim	Apron	Cruiser	Lorsban	Molybdenum
Exp-12805	29.8 a	124			x	x	x		x
BSC2014	28.9 a	120	x			x	x		
GV 490	27.6 a	115			x	x	x		
CS-430AF	26.7 a	111			x	x	x		x
GV 437	26.6 a	111			x	x	x		
PLS 228	26.2 a	109	x	x			x		
SV0955QH	26.0 a	108	x	x			x		
Gusty	25.7 a	107	x			x	x		
SV0935QF	25.7 a	107	x	x			x		
CS-424F	25.6 a	106			x	x	x		x
PLS M-14	25.6 a	106	x	x			x		
BSC5051	25.4 a	106	x			x	x		
Exp-16505	25.3 a	106			x	x	x		x
SV0969QH	24.9 a	104	x	x			x		
Cabree	24.7 a	103			x	x		x	
PLS 226	24.6 a	102	x	x			x		
Jumpstart	24.4 a	102			x	x		x	
PLS 595	24.3 a	101	x	x			x		
SV0956QH	23.9 a	100	x	x			x		
Strike	23.4 a	98			x	x		x	
Nitro	22.4 a	94	x	x			x		
Marias	21.9 a	91			x	x		x	
June	21.7 a	90			x	x		x	
Pizarro	21.4 a	89	x	x			x		
p-value	0.7102								
LSD	NA								

Early Trial Harvest Data

Table 3E: Weight of Vines from 150 ft^2 Harvest Area (lbs.)

Variety	Vine Weight (lbs.)	
GV 490	106	a
BSC5051	91	ab
PLS 228	90	*
Gusty	89	abc
SV0935QF	88	bcd
CS-424F	87	bcde
SV0969QH	85	bcdef
PLS 595	81	bcdefg
PLS M-14	81	bcdefg
Exp-12805	79	bcdefg
SV0955QH	76	bcdefgh
PLS 226	75	bcdefghi
Nitro	73	cdefghi
GV 437	71	defghijk
Marias	70	efghijk
BSC2014	69	fghijk
Jumpstart	68	fghijk
CS-430AF	68	fghijk
Pizarro	63	ghijk
SV0956QH	61	hijk
June	58	hijk
Strike	58	ijk
Cabree	57	jk
Exp-16505	55	k
p-value	<0.0001	
LSD	17.778	

Table 4E: Net Yields (% Trash Subtracted) and Gross Yields Adjusted to a Tenderometer Reading of 100 (lbs/A)

Variety	Adj. Net Yield (lbs/A)		Adj. Gross Yield (lbs/A)	
BSC5051	6428	a	6601	a
CS-424F	5615	ab	5649	ab
PLS 228	5399	*	5705	*
Marias	4996	abc	5125	abc
GV 437	4255	bcd	4443	bcd
SV0935QF	4216	bcd	4257	bcde
Exp-12805	3956	bcde	4208	bcdef
PLS 595	3922	bcde	4164	bcdef
GV 490	3584	cdef	3659	cdefg
PLS M-14	3314	cdef	3374	cdefg
CS-430AF	3143	def	3251	defg
SV0956QH	3065	def	3405	cdefg
Jumpstart	3005	def	3231	defg
SV0969QH	2936	defg	3011	defg
Gusty	2831	defg	3039	defg
Strike	2794	defg	2860	defg
Exp-16505	2723	defg	2770	defg
Pizarro	2637	defg	2669	defg
SV0955QH	2556	defg	2755	defg
June	2451	efg	2586	efg
Cabree	2277	efg	2390	fg
PLS 226	2145	fg	2192	g
BSC2014	1909	fg	2055	g
Nitro	1290	g	2048	g
p-value	<0.0001		0.0003	
LSD	1714.9		1819.2	

Table 5E: Pea Size (% peas by weight in each class) and Tenderometer Reading at Harvest

Variety	% #4	% #3	% #1 & #2	% Trash	T-reading at Harvest
Exp-16505	71.5 a	20.9 kl	5.8 i	1.7 bc	122 b
Pizarro	70.7 a	21.4 jkl	6.7 hi	1.2 c	111 cde
GV 490	64.7 ab	22.5 ijkl	10.0 ghi	2.9 bc	106 fgh
CS-424F	60.7 abc	29.7 ghij	9.1 ghi	0.6 c	105 fgh
PLS M-14	56.5 bcd	30.6 ghi	10.6 ghi	2.3 bc	111 cd
PLS 226	54.7 bcde	31.6 gh	11.6 fghi	2.2 bc	108 def
Strike	49.2 cdef	34.1 fgh	14.1 efg	2.6 bc	111 cde
June	46.7 defg	34.5 efgh	13.5 efgh	5.3 bc	122 b
SV0935QF	46.3 defg	42.8 abcde	9.8 ghi	1.0 c	144 a
Gusty	45.8 defg	30.0 ghi	18.8 de	5.4 bc	96 kl
SV0955QH	43.4 efgh	28.2 hijk	21.2 cd	7.2 bc	99 ijkl
GV 437	43.1 efgh	34.6 defgh	17.9 def	4.3 bc	103 fghi
Marias	38.5 fghi	44.9 ab	14.0 efg	2.6 bc	98 jkl
BSC5051	37.4 fghij	42.0 abcdef	18.1 def	2.5 bc	94 l
SV0969QH	35.6 ghij	43.5 abc	18.3 def	2.7 bc	115 c
PLS 228	34.2 *	37.4 *	23.0 *	10.8 *	105 *
CS-430AF	33.3 hij	44.1 abc	19.1 de	3.5 bc	106 efg
Cabree	33.1 hij	43.1 abcd	19.1 de	4.6 bc	106 fgh
PLS 595	30.2 ij	36.0 cdefgh	28.0 bc	5.7 bc	82 m
Exp-12805	29.9 ij	40.4 abcdef	23.7 cd	6.0 bc	102 ghij
BSC2014	28.1 ij	37.1 bcdefg	27.6 bc	7.2 bc	101 hijk
SV0956QH	25.6 j	33.5 fgh	30.9 b	9.9 b	97 jkl
Jumpstart	13.2 k	46.9 a	32.7 b	7.1 bc	107 def
Nitro	3.4 k	18.2 l	52.0 a	26.4 a	106 efg
p-value	<0.0001	<0.0001	<0.0001	0.0005	<0.0001
LSD	12.39	8.56	7.03	8.32	4.9

Table 6E: Tenderometer Reading at Harvest

Variety	Tenderometer Reading		Standard Deviation of T-Reading
PLS 595	82	m	2.6
BSC5051	94	l	6.3
Gusty	96	kl	3.9
SV0956QH	97	jkl	3.8
Marias	98	jkl	6.0
SV0955QH	99	ijkl	3.0
BSC2014	101	hijk	9.6
Exp-12805	102	ghij	1.6
GV 437	103	fghi	3.7
PLS 228	105	*	4.1
CS-424F	105	fgh	4.6
Cabree	106	fgh	3.8
GV 490	106	fgh	1.8
Nitro	106	efg	5.6
CS-430AF	106	efg	4.9
Jumpstart	107	def	2.5
PLS 226	108	def	7.0
Strike	111	cde	5.3
Pizarro	111	cde	3.7
PLS M-14	111	cd	5.8
SV0969QH	115	c	2.4
Exp-16505	122	b	1.9
June	122	b	5.2
SV0935QF	144	a	13.0
p-value	<0.0001		
LSD	4.90		

Plant Characteristics for Early Trial Varieties Based on a 10-Plant Sample

Table 7E: Vine Length in Centimeters

Variety	Vine Length (cm)	
Nitro	60.2	a
Exp-16505	54.5	b
Gusty	53.3	bc
PLS 226	53.3	bc
BSC5051	48.1	cd
GV 490	47.1	de
SV0935QF	46.3	de
SV0969QH	45.2	def
CS-424F	44.4	def
Exp-12805	42.1	efg
BSC2014	41.8	efgh
Strike	41.7	efghi
Marias	40.1	fghij
Pizarro	39.8	fghij
PLS M-14	38.7	ghij
Jumpstart	38.6	ghij
PLS 595	36.6	ghijk
CS-430AF	36.3	hijk
GV 437	36.2	ijk
SV0955QH	35.8	jk
June	35.4	jkl
Cabree	31.2	kl
SV0956QH	30.2	l
p-value	<0.0001	
LSD	5.54	

Table 8E: Number of Pods per Plant

Variety	Pods/Plant	
Exp-16505	5.5	a
Nitro	4.7	ab
Exp-12805	4.2	bc
SV0935QF	3.8	bcd
Strike	3.5	cde
June	3.3	cdef
CS-424F	3.2	def
SV0969QH	3.1	def
Gusty	3.0	def
PLS M-14	2.9	defg
BSC5051	2.9	defg
BSC2014	2.8	efgh
SV0955QH	2.8	efgh
GV 437	2.7	efgh
SV0956QH	2.6	efgh
Jumpstart	2.6	efgh
Marias	2.6	efgh
CS-430AF	2.5	fgh
PLS 226	2.0	gh
Pizarro	2.0	gh
PLS 595	1.9	h
Cabree	1.9	h
GV 490	1.9	h
p-value	<0.0001	
LSD	0.99	

Table 9E: Number of Pod-Bearing Nodes per Plant

Variety	Nodes w/ Pods/Plant	
Exp-16505	4.4	a
Strike	3.2	b
June	3.2	b
Exp-12805	2.7	bc
Nitro	2.7	bc
SV0955QH	2.5	cd
GV 437	2.3	cde
CS-424F	2.2	cdef
BSC2014	2.2	cdef
PLS M-14	2.1	cdefg
Jumpstart	2.1	cdefg
SV0956QH	2.0	defgh
SV0935QF	2.0	defgh
BSC5051	1.9	defgh
Gusty	1.9	defgh
CS-430AF	1.8	efgh
Pizarro	1.8	efgh
Marias	1.8	efgh
PLS 595	1.6	fgh
SV0969QH	1.6	fgh
GV 490	1.5	gh
PLS 226	1.4	h
Cabree	1.4	h
p-value	<0.0001	
LSD	0.61	

Table 10E: Average Number of Peas/Pod

Variety	Peas/Pod	
PLS 595	9.5	a
GV 490	8.7	b
Exp-16505	7.4	c
PLS 226	7.1	cd
BSC5051	7.0	cde
Gusty	7.0	cde
Marias	6.8	cdef
SV0935QF	6.7	defg
CS-430AF	6.7	defgh
Jumpstart	6.7	defgh
GV 437	6.7	defgh
PLS M-14	6.6	defgh
June	6.6	defgh
BSC2014	6.5	defgh
Pizarro	6.5	defgh
SV0955QH	6.5	defgh
Exp-12805	6.4	efgh
CS-424F	6.4	efgh
SV0969QH	6.3	fgh
Strike	6.3	fgh
Nitro	6.1	ghi
SV0956QH	6.1	hi
Cabree	5.6	i
p-value	<0.0001	
LSD	0.64	

Table 11E: Average Pod Length (cm)

Variety	Pod Length (cm)	
Nitro	7.3	a
Exp-16505	6.2	ab
SV0935QF	6.1	abc
CS-430AF	5.8	bcd
PLS 595	5.8	bcd
BSC5051	5.8	bcd
SV0956QH	5.7	bcde
SV0955QH	5.5	bcde
SV0969QH	5.5	bcde
GV 490	5.4	bcdef
GV 437	5.3	bcdefg
PLS 226	5.1	bcdefg
Gusty	5.1	bcdefg
BSC2014	5.0	bcdefg
Strike	5.0	bcdefg
June	5.0	bcdefg
CS-424F	4.9	bcdefg
Exp-12805	4.8	cdefg
PLS M-14	4.8	cdefg
Jumpstart	4.5	defg
Pizarro	4.4	efg
Marias	4.1	fg
Cabree	4.0	g
p-value	<0.0001	
LSD	1.37	

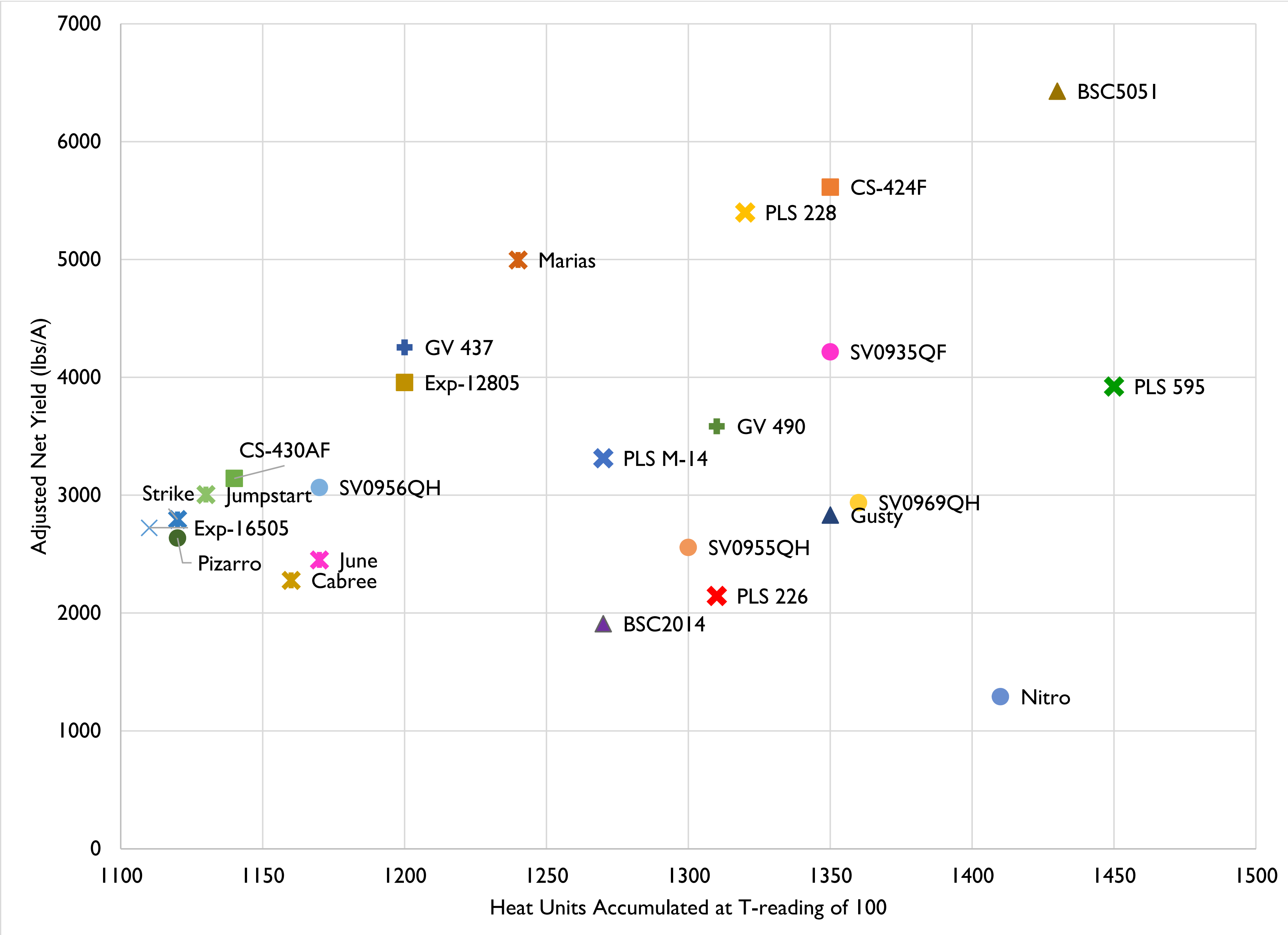
Early Trial Maturity Data

Table 12E: Tenderometer Readings Leading Up To and Including Harvest

Variety	**Reported Heat Units**	**T-Readings Up to and Including Harvest by Date and Accumulated Heat Units**													
		27 May	28 May	29 May	30 May	31 May	1 Jun	2 Jun	3 Jun	4 Jun	5 Jun	6 Jun	7 Jun	8 Jun	9 Jun
		1078	1105	1119	1140	1164	1184	1205	1236	1272	1301	1328	1356	1386	1421
Exp-16505	1140	85	89		**122***										
Pizarro	1170	89	98	103	**111**										
Strike	1140	97	91		**111**										
Jumpstart	1110	91	94	92	**107**										
CS-430AF	1160	79			**106**										
Cabree	1170	78			95	**106**									
SV0956QH	1205		79		97	**97**									
June	1160				91			**122**							
GV 437	1230							**103**							
Exp-12805	1220				88			**102**							
Marias	1290				89			92	**98**						
BSC2014	1150							72		**101**					
PLS M-14	1165							88	85		**111**				
SV0955QH	1290				77			87		88	**99**				
PLS 226	1165								87	85	95	**108**			
GV 490	1280							76	80	86	92	**106**			
PLS 228	1190								73		90	**105**			
Gusty	1350									74	94	**96**			
CS-424F	1315									83	90	95	**105**		
SV0935QF	1340										79	87			**144**
SV0969QH	1360									72		84			**115**
Nitro	1370											77			**106**
BSC5051	1300									68		72			**94**
PLS 595	1450											73			**82**

*****Bold numbers indicated the day on which the variety was harvested and are an average of three samples from each of three replications

Chart 1E: Adjusted Net Yield (lbs/A) by Heat Units Accumulated at T-Reading of 100



Late Trial Pre-Harvest Data

Table 1L: Flowering Data

Variety	First Flower		Full Flower	
	DAP	Heat Units	DAP	Heat Units
SV1058QH	42	870	45	934
SV8112QF	42	870	46	965
Exp-32963	43	893	47	1002
Reliance	43	893	47	1002
Destiny	44	914	47	1002
CS-437F	45	934	47	1002
CS-433AF	45	934	47	1002
Welland	45	934	47	1002
BSC4241A	45	934	50	1085
BSC3661	45	934	49	1057
Bolero	45	934	50	1085
Grundy	45	934	51	1115
GV 513	45	934	50	1085
SV1036QF	45	934	48	1030
SV7688QF	46	965	50	1085
Ambiance	46	965	50	1085
Exp-32965	47	1002	52	1150
SV0893QF	47	1002	52	1150
Maurice	51	1115	54	1220

Table 2L: Stand Counts (Plants/Yard), Percent Stand, and Seed Treatment

Variety	Plants/Yd	% Stand (at 8 seeds/ft)	Seed Treatment					
			Captan	Allegiance	Maxim	Apron	Cruiser	Molybdenum
SV7688QF	28.6 a	119	x	x			x	
Welland	28.3 a	118			x	x	x	
Exp-32965	26.1 a	109			x	x	x	
Bolero	25.9 a	108			x	x		x
GV 513	25.9 a	108			x	x	x	
Destiny	24.9 a	104	x			x	x	
SV0893QF	24.8 a	103	x	x			x	
BSC3661	24.4 a	102		x	x		x	
Exp-32963	24.2 a	101			x	x	x	
Reliance	24.1 a	100	x	x			x	
SV1036QF	23.4 a	98	x	x			x	
CS-437F	23.3 a	97			x	x	x	
SV8112QF	23.3 a	97	x	x			x	
BSC4241A	23.1 a	96	x			x	x	
CS-433AF	23.0 a	96			x	x	x	
Maurice	22.8 a	95	x	x			x	
Grundy	22.2 a	93			x	x		x
SV1058QH	21.9 a	91	x	x			x	
Ambiance	21.3 a	89	x	x			x	
p-value	0.2122							
LSD	NA							

Late Trial Harvest Data

Table 3L: Weight of Vines from 150 ft^2 Harvest Area

Variety	Vine Weight (lbs.)
GV 513	115 a
SV1036QF	95 b
Exp-32965	93 bc
Maurice	87 bcd
BSC3661	87 bcd
SV7688QF	86 bcde
CS-433AF	85 bcde
CS-437F	83 cdef
SV8112QF	81 defg
Grundy	78 defg
Bolero	78 defg
Destiny	78 defg
Welland	77 efg
SV0893QF	77 efg
Reliance	74 fg
BSC4241A	74 fg
Exp-32963	73 g
SV1058QH	71 g
Ambiance	58 h
p-value	<0.0001
LSD	10.2

Table 4L: Net Yields (% Trash Subtracted) and Gross Yields Adjusted to a Tenderometer Reading of 100

Variety	Adj. Net Yield (lbs/A)	Adj. Gross Yield (lbs/A)
GV 513	4401 a	4518 a
SV0893QF	4089 ab	4221 ab
SV7688QF	4050 ab	4215 ab
Maurice	3467 abc	3834 abc
SV1036QF	3263 abcd	3317 bcd
Bolero	3213 bcde	3236 bcdef
Welland	3160 bcdef	3280 bcde
SV8112QF	2703 cdefg	2829 cdefg
Exp-32963	2626 cdefg	2718 cdefg
BSC4241A	2507 cdefg	2559 defg
CS-433AF	2248 defgh	2367 defgh
BSC3661	2242 defgh	2281 defgh
SV1058QH	2208 defgh	2252 defgh
Grundy	2080 efgh	2116 fghi
Destiny	2031 fghi	2126 efghi
Reliance	1887 ghi	1952 ghi
CS-437F	1209 hi	1223 hi
Exp-32965	1197 hi	1280 hi
Ambiance	927 i	1059 i
p-value	<0.0001	<0.0001
LSD	1141.4	1160.4

Table 5L: Pea Size (% peas by weight in each class) and Tenderometer Reading at Harvest

Variety	% #4	% #3	% #1 & #2	% Trash	T-reading at Harvest
SV1036QF	62.5 a	28.1 f	7.8 j	1.6 fgh	107 efg
Bolero	49.9 b	39.3 de	10.0 ij	0.8 h	124 b
CS-437F	43.6 bc	43.7 abcde	11.5 hij	1.1 gh	149 a
Grundy	36.2 cd	47.8 abc	14.3 ghi	1.6 fgh	114 cde
Destiny	34.3 cd	37.2 e	23.6 def	5.0 cd	113 de
Exp-32963	33.9 cd	43.1 abcde	19.7 efg	3.4 defg	105 fg
BSC3661	33.3 de	50.5 a	14.5 ghi	1.7 fgh	111 def
BSC4241A	33.2 de	47.3 abcd	17.4 fgh	2.0 fgh	112 def
SV1058QH	28.8 def	47.8 abc	21.4 def	2.0 fgh	121 bc
Exp-32965	27.4 def	41.7 bcde	24.7 de	6.2 c	142 a
GV 513	23.4 efg	49.2 ab	24.9 de	2.5 efgh	101 gh
CS-433AF	22.4 fgh	45.2 abcde	27.2 d	5.2 cd	100 gh
SV0893QF	21.6 fghi	49.6 ab	25.4 de	3.4 defg	94 hi
Reliance	15.9 ghij	47.1 abcd	33.6 c	3.3 defg	124 b
SV8112QF	12.5 hijk	46.7 abcd	36.2 bc	4.6 cde	112 def
SV7688QF	11.9 ijk	50.3 a	33.8 c	3.9 cdef	90 i
Maurice	9.8 jk	39.9 cde	40.7 b	9.7 b	86 j
Welland	9.1 jk	48.0 abc	39.2 bc	3.7 def	102 g
Ambiance	2.7 k	26.4 f	58.3 a	12.7 a	116 cd
p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LSD	9.97	8.11	6.25	2.35	7.5

Table 6L: Tenderometer Reading at Harvest

Variety	Tenderometer Reading	Standard Deviation of T-Reading
Maurice	86 j	3.9
SV7688QF	90 i	6.9
SV0893QF	94 hi	3.8
CS-433AF	100 gh	6.1
GV 513	101 gh	4.7
Welland	102 g	5.7
Exp-32963	105 fg	6.8
SV1036QF	107 efg	3.8
BSC3661	111 def	4.9
SV8112QF	112 def	5.5
BSC4241A	112 def	12.2
Destiny	113 de	6.9
Grundy	114 cde	6.5
Ambiance	116 cd	11.6
SV1058QH	121 bc	10.0
Bolero	124 b	16.4
Reliance	124 b	11.9
Exp-32965	142 a	7.4
CS-437F	149 a	14.3
p-value	<0.0001	
LSD	7.5	

Plant Characteristics for Late Trial Varieties Based on a 10-Plant Sample

Table 7L: Vine Length in Centimeters

Variety	Vine Length (cm)	
SV1036QF	70.8	a
SV7688QF	68.0	ab
BSC3661	63.0	bc
Exp-32965	62.5	bcd
SV0893QF	62.2	bcd
GV 513	61.3	cd
Maurice	60.2	cde
Welland	58.0	cde
Ambiance	57.3	cde
Grundy	56.6	def
Bolero	54.6	ef
CS-433AF	50.7	fg
CS-437F	47.3	gh
SV8112QF	46.8	gh
Destiny	46.1	gh
SV1058QH	46.0	gh
BSC4241A	43.3	hi
Exp-32963	39.3	i
Reliance	38.0	i
p-value	<0.0001	
LSD	6.29	

Table 8L: Number of Pods per Plant

Variety	Pods/Plant	
Ambiance	6.0	a
SV8112QF	4.4	b
Maurice	4.3	bc
SV7688QF	3.9	bcd
SV1058QH	3.2	bcde
Welland	3.0	bcde
SV1036QF	3.0	bcde
SV0893QF	2.8	cdef
Bolero	2.7	def
CS-433AF	2.5	def
GV 513	2.4	def
Destiny	2.2	ef
Exp-32965	2.1	efg
CS-437F	1.9	efg
Grundy	1.9	efg
Exp-32963	1.8	efg
BSC4241A	1.8	efg
Reliance	1.4	fg
BSC3661	0.6	g
p-value	<0.0001	
LSD	1.50	

Table 9L: Number of Pod-Bearing Nodes per Plant

Variety	Nodes w/ Pods/Plant	
Ambiance	4.4	a
SV8112QF	2.8	b
SV7688QF	2.6	b
SV0893QF	2.1	bc
Maurice	2.1	bc
SV1058QH	2.0	bcd
SV1036QF	2.0	bcd
CS-437F	1.6	cd
CS-433AF	1.6	cd
Welland	1.6	cd
GV 513	1.6	cd
Exp-32965	1.5	cd
BSC4241A	1.5	cd
Bolero	1.5	cd
Destiny	1.4	cd
Reliance	1.3	cde
Grundy	1.3	cde
Exp-32963	1.2	de
BSC3661	0.5	e
p-value	<0.0001	
LSD	0.5658	

Table 10L: Average Number of Peas per Pod

Variety	Peas/Pod	
Maurice	7.0	a
Welland	6.9	ab
Ambiance	6.7	ab
CS-433AF	6.3	abc
SV7688QF	6.3	abc
Bolero	6.2	abc
Destiny	6.0	abcd
SV1058QH	6.0	abcd
Exp-32965	5.8	abcde
SV8112QF	5.7	abcdef
SV0893QF	5.2	bcdef
Grundy	4.9	cdefg
BSC4241A	4.7	cdefg
SV1036QF	4.6	cdefg
GV 513	4.3	defg
CS-437F	4.2	efg
Exp-32963	4.0	fg
Reliance	3.3	g
BSC3661	3.2	g
p-value	<0.0001	

Table 11L: Average Pod Length in Centimeters

Variety	Pod Length (cm)	
Grundy	10.4	a
SV1036QF	8.4	b
GV 513	8.3	bc
Maurice	8.0	bcd
Bolero	7.9	bcde
SV0893QF	7.8	bcdef
SV7688QF	7.7	bcdefg
SV1058QH	7.5	cdefgh
CS-433AF	7.3	defgh
Destiny	7.2	efgh
SV8112QF	7.0	fghi
BSC4241A	6.9	ghi
CS-437F	6.8	hij
Exp-32965	6.8	hij
Ambiance	6.8	hij
Exp-32963	6.3	ij
Reliance	6.3	ij
BSC3661	6.2	ij
Welland	6.0	j
p-value	<0.0001	

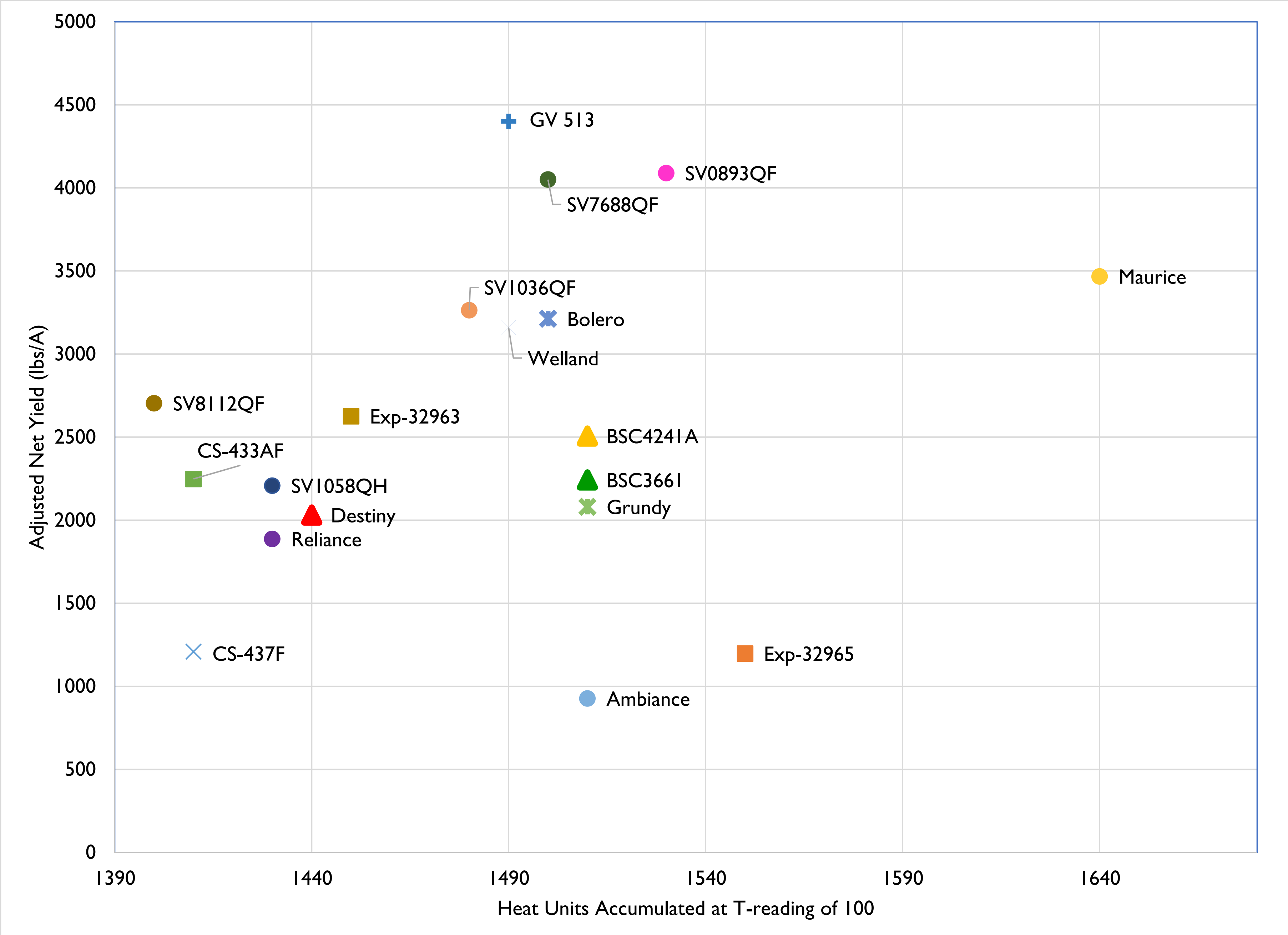
Late Trial Maturity Data

Table 12L: Tenderometer Readings Leading Up To and Including Harvest

Variety	**Reported Heat Units**	**Date and Accumulated Heat Units**							
		16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun
		1374	1415	1459	1496	1527	1557	1588	1617
SV8112QF	1430	90	**112**						
CS-433AF	1405	91	**100**						
CS-437F	1395					**149**			
Reliance	1420		82	**124**					
SV1058QH	1450	86	80	**121**					
Destiny	1400			**113**					
Exp-32963	1405		84	**105**					
SV1036QF	1525			92	**107**				
Welland	1505		75	86	**102**				
GV 513	1450			89	**101**				
SV7688QF	1480		73	87	**90**				
Bolero	1480		78	85	91	**124**			
Ambiance	1480			76		**116**			
Grundy	1595			82	71	**114**			
BSC4241A	1450			80	76	**112**			
BSC3661	1530				76	**111**			
SV0893QF	1525			78	79	**94**			
Exp-32965	1440					75			**142**
Maurice	1650								**86**

*****Bold numbers indicated the day on which the variety was harvested and are an average of three samples from each of three replications

Chart 1L: Adjusted Net Yield (lbs/A) by Heat Units Accumulated at T-Reading of 100



Appendix A: Weather Data for 2014 Early Pea Variety Trial

Date	DAP	High	Low	Daily Heat Units	Accumulated Heat Units	Daily Rainfall	Accumulated Rainfall
24-Mar-14	0	36.3	24.1	0	**0**	0	0
25-Mar-14	1	38.1	22.5	0	**0**	0.03	0.03
26-Mar-14	2	34.3	26	0	**0**	0.13	0.16
27-Mar-14	3	44.2	17.3	0	**0**	0	0.16
28-Mar-14	4	65.7	38.3	12	**12**	0	0.16
29-Mar-14	5	63.6	57.4	20.5	**33**	0.99	1.15
30-Mar-14	6	61.3	37.2	9.25	**42**	0.53	1.68
31-Mar-14	7	57.6	36.8	7.2	**49**	0.02	1.7
1-Apr-14	8	59.3	32.8	6.05	**55**	0	1.7
2-Apr-14	9	65.7	38.9	12.3	**67**	0	1.7
3-Apr-14	10	63.5	46.5	15	**82**	0.01	1.71
4-Apr-14	11	55	45.8	10.4	**93**	0	1.71
5-Apr-14	12	58	42.8	10.4	**103**	0	1.71
6-Apr-14	13	59.1	31.3	5.2	**108**	0	1.71
7-Apr-14	14	59.1	33.1	6.1	**114**	0.36	2.07
8-Apr-14	15	64.6	50.6	17.6	**132**	0.07	2.14
9-Apr-14	16	63.5	37.5	10.5	**143**	0	2.14
10-Apr-14	17	66.3	38.1	12.2	**155**	0	2.14
11-Apr-14	18	76.9	53.9	25.4	**180**	0	2.14
12-Apr-14	19	73.1	49.3	21.2	**201**	0	2.14
13-Apr-14	20	79	49.6	24.3	**226**	0	2.14
14-Apr-14	21	76.2	62	29.1	**255**	0	2.14
15-Apr-14	22	68.3	33.4	10.85	**266**	1.22	3.36
16-Apr-14	23	47.3	31.4	0	**266**	0.13	3.49
17-Apr-14	24	46.7	29.8	0	**266**	0	3.49
18-Apr-14	25	51.5	39.1	5.3	**271**	0	3.49
19-Apr-14	26	63.6	38.7	11.15	**282**	0	3.49
20-Apr-14	27	54.6	38.7	6.65	**289**	0	3.49
21-Apr-14	28	64.1	34.3	9.2	**298**	0	3.49
22-Apr-14	29	76.4	40.5	18.45	**316**	0.01	3.5
23-Apr-14	30	59.7	46.8	13.25	**330**	0	3.5
24-Apr-14	31	60.6	40.2	10.4	**340**	0	3.5
25-Apr-14	32	64.9	34.9	9.9	**350**	0.3	3.8
26-Apr-14	33	71.6	49.8	20.7	**371**	0.07	3.87
27-Apr-14	34	63.9	44.9	14.4	**385**	0	3.87
28-Apr-14	35	59.3	41.1	10.2	**395**	0.33	4.2
29-Apr-14	36	49.7	45.2	7.45	**403**	0.53	4.73
30-Apr-14	37	65.5	49.6	17.55	**420**	0.49	5.22
1-May-14	38	75.9	65.3	30.6	**451**	0.01	5.23
2-May-14	39	67.9	50.8	19.35	**470**	0.03	5.26
3-May-14	40	70.5	45.9	18.2	**488**	0	5.26
4-May-14	41	74.7	45.4	20.05	**508**	0	5.26
5-May-14	42	64.4	46	15.2	**524**	0	5.26
6-May-14	43	70.7	50.1	20.4	**544**	0	5.26
7-May-14	44	63	45.1	14.05	**558**	0.13	5.39
8-May-14	45	81.2	55.3	28.25	**586**	0	5.39
9-May-14	46	71.7	54.8	23.25	**610**	0	5.39
10-May-14	47	78.6	62.1	30.35	**640**	0	5.39
11-May-14	48	78.5	56.6	27.55	**667**	0	5.39
12-May-14	49	85.8	55	30.4	**698**	0.11	5.5
13-May-14	50	84.4	54.5	29.45	**727**	0	5.5
14-May-14	51	62.9	54.9	18.9	**746**	0.02	5.52
15-May-14	52	80.3	59.7	30	**776**	0	5.52

16-May-14	53	70.3	56.4	23.35	**800**	1.51	7.03
17-May-14	54	66.9	50.7	18.8	**818**	0	7.03
18-May-14	55	66.6	49	17.8	**836**	0	7.03
19-May-14	56	70.5	42.6	16.55	**853**	0	7.03
20-May-14	57	74.4	48	21.2	**874**	0	7.03
21-May-14	58	76.2	60.3	28.25	**902**	0.01	7.04
22-May-14	59	81.7	61.4	31.55	**934**	0.06	7.1
23-May-14	60	74	57.9	25.95	**960**	0	7.1
24-May-14	61	73.1	53.9	23.5	**983**	0	7.1
25-May-14	62	79.7	51.3	25.5	**1009**	0	7.1
26-May-14	63	84.7	58.9	31.8	**1040**	0	7.1
27-May-14	64	87.7	67	37.35	**1078**	0.15	7.25
28-May-14	65	78.4	55.7	27.05	**1105**	0	7.25
29-May-14	66	55.9	53.4	14.65	**1119**	0.11	7.36
30-May-14	67	68.7	53.1	20.9	**1140**	0.02	7.38
31-May-14	68	74.4	52.8	23.6	**1164**	0	7.38
1-Jun-14	69	72.6	48.2	20.4	**1184**	0	7.38
2-Jun-14	70	77.5	43.3	20.4	**1205**	0	7.38
3-Jun-14	71	86.1	57	31.55	**1236**	0	7.38
4-Jun-14	72	87.9	64.4	36.15	**1272**	0.06	7.44
5-Jun-14	73	75.1	61.8	28.45	**1301**	0.54	7.98
6-Jun-14	74	76	58.3	27.15	**1328**	0	7.98
7-Jun-14	75	81.3	53.9	27.6	**1356**	0	7.98
8-Jun-14	76	83	56.8	29.9	**1386**	0	7.98
9-Jun-14	77	84.1	67.4	35.75	**1421**	0	7.98

Appendix B: Weather Data for 2014 Late Pea Variety Trial

Date	DAP	High	Low	Daily Heat Units	Accumulated Heat Units	Daily Rainfall/ Irrigation*	Accumulated Rainfall/ Irrigation
18-Apr-14	0	51.5	39.1	0	**0**	0	0
19-Apr-14	1	63.6	38.7	11.15	**11**	0	0
20-Apr-14	2	54.6	38.7	6.65	**18**	0	0
21-Apr-14	3	64.1	34.3	9.2	**27**	0	0
22-Apr-14	4	76.4	40.5	18.45	**45**	0.01	0.01
23-Apr-14	5	59.7	46.8	13.25	**59**	0	0.01
24-Apr-14	6	60.6	40.2	10.4	**69**	0	0.01
25-Apr-14	7	64.9	34.9	9.9	**79**	0.3	0.31
26-Apr-14	8	71.6	49.8	20.7	**100**	0.07	0.38
27-Apr-14	9	63.9	44.9	14.4	**114**	0	0.38
28-Apr-14	10	59.3	41.1	10.2	**124**	0.33	0.71
29-Apr-14	11	49.7	45.2	7.45	**132**	0.53	1.24
30-Apr-14	12	65.5	49.6	17.55	**149**	0.49	1.73
1-May-14	13	75.9	65.3	30.6	**180**	0.01	1.74
2-May-14	14	67.9	50.8	19.35	**199**	0.03	1.77
3-May-14	15	70.5	45.9	18.2	**217**	0	1.77
4-May-14	16	74.7	45.4	20.05	**238**	0	1.77
5-May-14	17	64.4	46	15.2	**253**	0	1.77
6-May-14	18	70.7	50.1	20.4	**273**	0	1.77
7-May-14	19	63	45.1	14.05	**287**	0.13	1.9
8-May-14	20	81.2	55.3	28.25	**315**	0	1.9
9-May-14	21	71.7	54.8	23.25	**339**	0	1.9
10-May-14	22	78.6	62.1	30.35	**369**	0	1.9
11-May-14	23	78.5	56.6	27.55	**397**	0	1.9
12-May-14	24	85.8	55	30.4	**427**	0.11	2.01
13-May-14	25	84.4	54.5	29.45	**456**	0	2.01
14-May-14	26	62.9	54.9	18.9	**475**	0.02	2.03
15-May-14	27	80.3	59.7	30	**505**	0	2.03
16-May-14	28	70.3	56.4	23.35	**529**	1.51	3.54
17-May-14	29	66.9	50.7	18.8	**547**	0	3.54
18-May-14	30	66.6	49	17.8	**565**	0	3.54
19-May-14	31	70.5	42.6	16.55	**582**	0	3.54
20-May-14	32	74.4	48	21.2	**603**	0	3.54
21-May-14	33	76.2	60.3	28.25	**631**	0.01	3.55
22-May-14	34	81.7	61.4	31.55	**663**	0.06	3.61
23-May-14	35	74	57.9	25.95	**689**	0	3.61
24-May-14	36	73.1	53.9	23.5	**712**	0	3.61
25-May-14	37	79.7	51.3	25.5	**738**	0	3.61
26-May-14	38	84.7	58.9	31.8	**770**	0	3.61
27-May-14	39	87.7	67	37.35	**807**	0.15	3.76
28-May-14	40	78.4	55.7	27.05	**834**	0	3.76
29-May-14	41	55.9	53.4	14.65	**849**	0.11	3.87
30-May-14	42	68.7	53.1	20.9	**870**	0.02	3.89
31-May-14	43	74.4	52.8	23.6	**893**	0	3.89
1-Jun-14	44	72.6	48.2	20.4	**914**	0	3.89
2-Jun-14	45	77.5	43.3	20.4	**934**	0	3.89
3-Jun-14	46	86.1	57	31.55	**965**	0	3.89
4-Jun-14	47	87.9	64.4	36.15	**1002**	0.06	3.95
5-Jun-14	48	75.1	61.8	28.45	**1030**	0.54	4.49
6-Jun-14	49	76	58.3	27.15	**1057**	0	4.49
7-Jun-14	50	81.3	53.9	27.6	**1085**	0	4.49
8-Jun-14	51	83	56.8	29.9	**1115**	0	4.49
9-Jun-14	52	84.1	67.4	35.75	**1150**	0	4.49

10-Jun-14	53	84.8	71	37.9	**1188**	0.23	4.72
11-Jun-14	54	76.7	67.4	32.05	**1220**	0.39	5.11
12-Jun-14	55	74.4	66.7	30.55	**1251**	0.04	5.15
13-Jun-14	56	85.5	69.8	37.65	**1289**	0	5.15
14-Jun-14	57	75.2	60.3	27.75	**1316**	0	5.15
15-Jun-14	58	79	53.7	26.35	**1343**	0	5.15
16-Jun-14	59	86.2	57.1	31.65	**1374**	0	5.15
17-Jun-14	60	92.6	68.3	40.45	**1415**	0	5.15
18-Jun-14	61	94.3	74.8	44.55	**1459**	0	5.15
19-Jun-14	62	86.2	66.3	36.25	**1496**	0.05	5.2
20-Jun-14	63	81.1	62.1	31.6	**1527**	0	5.2
21-Jun-14	64	75.5	63.1	29.3	**1557**	0.03	5.23
22-Jun-14	65	79.1	63.1	31.1	**1588**	0	5.23
23-Jun-14	66	80.9	56.9	28.9	**1617**	0	5.23

Appendix C: Adjusting Pea Yields to a T-reading of 100

Pumphery FV, RE Ramig, RR Allmoras. 1975 "Yield tenderness relationships in 'Dark Skinned Perfection' peas. Journal of the American Society of Horticultural Science. 100:507-509.

Yield-Tenderness Relationships in 'Dark Skinned Perfection' Peas[1]

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Abstract. Maturity effects on yield of fresh peas (*Pisum sativum* L.) were identified by yield-tenderometer measurements. A percent yield-tenderometer reading relationship was shown to be a useful means for yield adjustment to a common maturity—100 tenderometer reading. Analysis of random error in the predicted percent yield, as a function of tenderometer reading, indicates the need to plan harvests within the 90 to 110 tenderometer range. Alternatively, the yield-tenderometer reading relationships show the possible magnitude of errors incurred in comparing green pea yields when no adjustment is made for dissimilar tenderometer ratings.

Improved techniques are needed for determining and comparing fresh pea (*Pisum sativum* L.) yields. Expressions of fresh pea yields are generally not precise because of harvest at a growth stage when fresh pea wt is increasing rapidly while tenderness may decrease even more rapidly. Pea yields may increase as much as 900 kg/ha daily when growth conditions are favorable. Such a yield increase often causes yield differences between treatments only because the treatments affected maturity. Examples of such treatments are comparisons involving cultivars, tillage, fertilizer, irrigation, or herbicides.

The need for comparing yields of processing peas at a common tenderometer rating, such as 100, has been suggested repeatedly, but, unfortunately there is little published information. Yield and tenderness are inversely related; i.e., yield increases as tenderness decreases (tenderometer readings increase). However, changes in yield and tenderometer readings are generally not a linear function of time (2, 3, 4, 6). Yield increases per unit of increase in tenderometer readings are generally greater when tenderometer values are below 100-to 120 than at higher tenderometer values. Hagedorn et al. (1) reported an unusual linear relationship between yield and tenderometer reading up through readings of 150.

Adjustments of absolute yield to a common base of 100 tenderometer reading is complicated, because temporal changes in yield and tenderometer reading vary between years, fields, and cultivars. Some of the factors influencing increase of fresh pea wt and associated change in tenderness are temperature, wind, humidity, available soil moisture, and soil fertility. However, temperature and moisture are the dominating factors. Yield differences produced by these factors, along with seasonal and field variations preclude direct adjustments of yield based on tenderness rating, i.e., *x* pounds of peas per unit change in tenderometer reading. Norton et al. (4) presented yield-tenderness relationships indirectly in terms of percent yield at a given tenderometer reading. The method for adjusting fields was developed by H. K. Schultz and M. W. Carstens. They used the yield at 100 tenderometer reading as 100 percent yield. Kramer (2) and Sayre (7) used percent of maximum yield as their expression of the observed yields at various tenderometer readings.

Our objectives were to emphasize the need for comparing yields of fresh peas at a common tenderometer reading, and to present additional data in support of the Norton et al. (4) method for adjusting yields.

Methods and Procedures

Dark Skinned Perfection peas were grown in 17 field experiments from which fresh pea yields and tenderness evaluations were made. The experiments were conducted on or near the Columbia Basin Research Center, Pendleton, Oregon. Seeding rates varied from about 130 to 230 kg/ha, in row spacings varying from 15 to 20 cm. Plant environment varied considerably because the data were collected during 11 years from experiments testing fertilizers, herbicides, and tillage—all 3 factors alone or in various combinations. All experiments were dryland, except 2 which were irrigated. In the dryland experiments, about 61 percent of the evapotranspiration was derived from soil water stored prior to pea planting. Longterm rainfall averages during the growing season for peas are 3.9, 3.7, 3.4, and 3.5 cm, respectively, for March, April, May, and June at the Columbia Basin Research Center. Corresponding average monthly temperatures are 6.1, 10.0, 13.3, and 17.2°C.

Fresh pea harvests were made to provide tenderometer readings below 100 at the earliest harvest, near 100 at the middle harvest, and above 100 at the latest harvest. Usually 3 or more harvests were necessary and the interval between harvests was generally 1 or 2 days in each of the 17 experiments. Harvests in the dryland experiments occurred in late June and only rarely in early June, while those under irrigation occurred about 5 days later.

From the data obtained in each experiment, pea yield at 100 tenderometer reading was interpolated. Then the ratio of measured to interpolated yield at 100 tenderometer reading was used to obtain "percent yield" (when multiplied by 100). All percent yields and corresponding tenderometer readings were plotted to obtain a scattergram of percent yield versus tenderometer reading, from which a least squares fit was made using the model: $Y = a + bX + cX^{n}$, where Y is percent yield, X is tenderometer reading; a, b, and c are parameters to be estimated statistically.

Results and Discussion

Six experiments typify green pea development observed in the 17 experiments. They are presented herein (Figs. 1, 2, and 3) because their greater number of harvests more precisely defined trends. These relationships were typical, also, of those found in the literature.

Yields varied from experiment to experiment, but yields within experiments were usually nonlinear functions of time (Fig. 1). In some experiments rates of yield change (change in slope) were positive throughout all harvests, while in others they became negative soon after the harvest series was initiated.

Tenderometer readings increased as a function of time (Fig. 2), but the tenderometer readings increased more rapidly after tenderometer readings had reached 100. An exponentially increasing tenderness function of time was suggested for both dryland and irrigated peas in Fig. 2.

Pea yields are distinctly nonlinear functions of tenderometer reading (Fig. 3). Field to field variation also caused large separation of curves. These 2 features of the yield-tenderness curves emphasize a critical need for comparing experimental yields within an experiment on a common tenderometer rating basis. We have not found a feasible direct adjustment of yields.

Pea yields expressed as a percent of the yield expected at 100 tenderometer are plotted versus tenderometer reading (Fig. 4), and the estimated equations are shown separately for irrigated and

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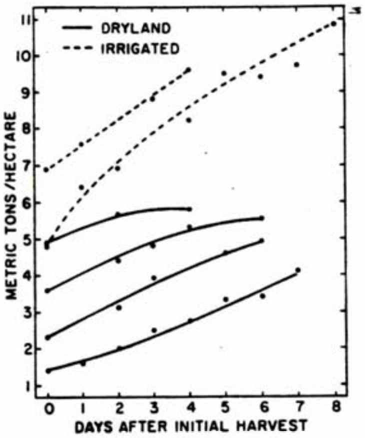

Fig. 1. Yield versus time of harvest for fresh peas in 6 typical experiments.

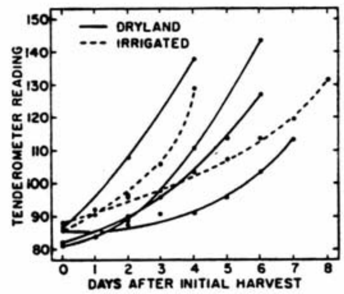

Fig. 2. Tenderometer of fresh peas as affected by time of harvest in 6 typical experiments.

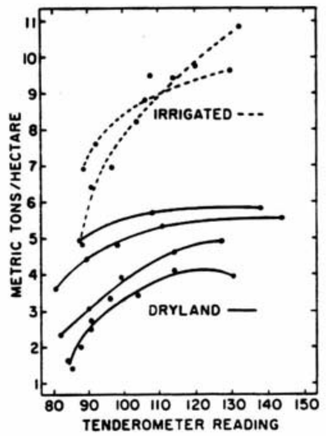

Fig. 3. Yield of fresh peas and associated tenderometer reading in 6 typical experiments.

dryland peas. These equations (Fig. 4) were slightly modified for easy use in adjusting percent yield when tenderometer readings were not 100. The modification involved estimation of Y at 100 tenderometer using equations in Fig. 4. This estimate of Y was then designated as the mean of Y when the mean of X was designated as 100. The equations are shown as follows:

Dryland peas: $(Y-97.21) - -14.134\ (X-100) + 315.14\ (X^{1/2} - 10)$

Irrigated peas: $(Y-100.43) - -8.405\ (X-100) + 200.00\ (X^{1/2} - 10)$

In these equations, Y is percent yield to be calculated, and X is observed tenderometer reading.

The scatter diagram of Fig. 4 (a composite over the 17 experiments) can be used to adjust yields to a common maturity (100 tenderometer). Such a calibration adjusts for maturity differences. However, the increasing scatter in Fig. 4 as the tenderometer reading deviates from 100 suggests strongly that harvests should be planned to achieve tenderometer readings within the 90 to 110 range. Ordinarily in regression, where the variance of the dependent variable is assumed independent of the independent variable, the precision of predicted dependent variable decreases as the dependent variable becomes larger or smaller than the mean (5). The scatter distribution in Fig. 4 shows a variance dependent on tenderometer reading. We have combined this variance estimate with that of regression in Table 1 to emphasize the true variability characteristics of the calibration in Fig. 4, and the need to plan harvests within the 90 to 110 tenderometer range.

The curves and data points for dryland and irrigated peas were

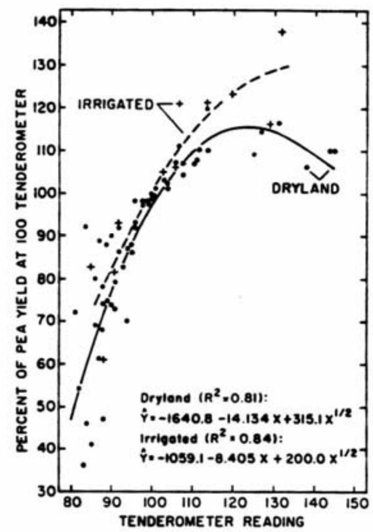

Fig. 4. Percent yield-tenderometer reading relationship for 'Dark Skinned Perfection' pea in irrigated and dryland experiments.

Table 1. Expected random error in estimating a percent-pea-yield at different ranges of tenderometer.[z]

Tenderometer range	$\sigma_{\hat{y}}$	Weighing factor	Estimated true $\sigma_{\hat{y}}$
80-85	8.8[y]	2.1[x]	18.5[w]
85-90	8.7	1.9	16.6
90-95	8.7	0.4	3.5
95-100	8.6	0.4	3.3
100-105	8.6	0.2	1.5
105-110	8.7	0.5	4.5
110-115	8.7	0.5	4.5
115-120	8.8	1.4	12.3

[z] Computations were made using regression composited over irrigated and dryland conditions.

[y] $\sigma_{\hat{y}}$ is the random error expected from multiple regression assuming a variance of y independent of x.

[x] *Weighing factor* is a ratio in which the numerator is the standard error of estimate within the indicated tenderometer range and the denominator is the standard error of estimate for the whole tenderometer range. This ratio approximates the nonuniform variance of percent pea yield at different tenderometer readings.

[w] Estimated true $\sigma_{\hat{y}}$ is the product. (weighing factor) ($\sigma_{\hat{y}}$).

maintained separate in Fig. 4. Above about 110 tenderometer reading the percent yields separate distinctly. This separation of yields indicates a major influence of available soil water on the development of fresh peas in their later stages of growth. We suggest that this factor be carefully evaluated for experiments where irrigation or stored soil water is an experimental variable.

In passing, we note the failure of an appealing normalization procedure involving both yield and tenderometer reading. For each experiment, the maximum and minimum yield or tenderometer readings were noted and the normalized observation computed as $(u-u_{min})/(u_{max}-u_{min})$. The symbol u indicates the variable to be normalized. Nearly the whole range of normalized yield was noted for normalized tenderometer readings <0.5. Furthermore, there was much scatter providing little basis for a calibration.

Norton et al. (4) and Sayre (7) point out that 1 scale is not applicable to all pea cultivars. Norton et al. (4) add that the use of a well-developed scale for 1 cultivar to adjust another cultivar may introduce less error than using a scale developed from only a few points. Information presented in Fig. 4 is consistent with earlier results (1, 2, 4, 7) showing a similar relationship between percent yield and tenderometer readings in the range of 90 to 110. Percent yields changed between 1 and 2 percentage units with each unit change in tenderometer reading.

Experience by the authors indicates that fresh pea yield comparison at a common maturity is essential to good research. Harvesting eac treatment at 2 or more times and interpolating the yield at 1C tenderometer is preferred. When only 1 harvest is possible, yields c be adjusted to 100 tenderometer by using a percent yield-tenderom eter scale (Fig. 4) which provides more reliable data than merely usin the unadjusted yields.

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