Effect of gibberellic acid (GA3) and aminoethoxyvinylglycine (AVG) on late-season peach [*Prunus persica* (L.) Batsch] varieties in middle Georgia THE UNIVERSITY OF GEORGIA College of AGRICULTURAL &



ENVIRONMENTAL SCIENCES



The peach ripening season in middle Georgia spans five months beginning in the middle of May and concluding in early September. Approximately, 60 different peach varieties are currently being grown in Georgia and ripen throughout this market season in which each variety is available for one to two weeks. Within the season, there are time points when variety ripening times may not overlap thus producing several days in which no fruit is available. This is clearly a problem in peach production in middle Georgia for certain late season varieties. Plant growth regulators (PGRs) are widely used in apples, cherries, and other fruits. Gibberellic acid (GA3) and aminoethoxyvinylglycine (AVG) treatments in stone fruit have shown to increase fruit firmness, inhibit/decrease ethylene production, delay maturity and shift harvest windows, and reduce fruit drop (Byers, 1997; Cline, 2006).

Study the effect of GA3 and AVG on delaying maturity, increasing fruit firmness, and shifting the ripening window of two late season ripening varieties.

Materials and Methods

Plant materials. Trees of 'Early August Prince' (850 CU) and 'Ruston Red' (850 CU) peaches budded to 'Guardian' rootstock were established in 2007 and 2001, respectively. 'Early August Prince' variety was used from two farms in Pearson Farms and Lane Southern Orchards, Fort Valley, GA. 'Ruston Red' variety was available in one farm in Lane Southern Orchards, Fort Valley, GA. A total of approx. 20 acres per variety were available. Plots were maintained using the recommended procedures in the Southeastern peach, nectarine, and plum pest management and culture guide.

Applications. ProGibb® is 4% gibberellic acid (GA3 - promotes growth and elongation of cells) liquid formulation and Retain® is 15% aminoethoxyvinylglycine (AVG - ethylene inhibitor) soluble powder formulation, both produced by fermentation. In 2014, plant growth regulators were applied with an airblast sprayer (333g/A of Retain[®], 20fl oz/A of ProGibb[®] 4% in a 100 gal/A spray volume, and organosilicone adjuvant 0.1% v/v). Applications were made on early-mid June, approximately 2-4 weeks before fruit harvest. Control plots were left untreated at the same locations for comparisons. A total of three replications, single tree plots, were used for treated and untreated comparisons. Trees were not commercially harvested until the project was over.

Variables. Sample fruit was harvested from treated and untreated trees and fruit characteristics were taken. Fruit was harvested on July 8th, 11th, 14th, 17th, 21st, 24th, 28th, 31st, and August 8th for 'Early August Prince' and on July 8th, 11th, 14th, 17th, and 21st for 'Ruston Red'. Five fruit per plot were harvested and kept in a cooler with ice overnight to be evaluated the following day. Each fruit was rated individually. Fruit were evaluated for several characteristics: blush (%), redness in the flesh (%), peach fuzz (1-9 scale, 1=undesirable and 9=almost none), fruit tip (1-9 scale, 1=highly pronounced and 9=almost none), firmness (1-9 scale, 1=soft and 9=highly firm; kgf, N, N/g), split pit, flesh to pit length (mm), weight (g), and perimeter (mm). The subjective 1-9 scale represented value of 1 = undesirable to 9 = optimal. Blush and redness in flesh were rated as percent coverage. Split pit was rated as present or absent. Firmness was measured using a 1-9 scale and the Wagner Model FT 30 fruit penetrometer with the FT 516 tip (8mm diameter).

Data analyses. Data analyses were performed using the PROC GLM procedure in SAS Software (Cary, NC). Mean comparisons for each treatment were performed using Fisher's protected LSD test, p-value <0.05.

References

Byers, R.E 1997. Peach and nectarine fruit softening following aminoethoxyvinylglycine sprays and dips. HortScience 32:86-88. Cline, J.A. 2006. Effect of aminoethoxyvinylglycine and surfactans on preharvest drop, maturity, and fruit quality of two processing peach cultivars. HortScience 41:377-383.

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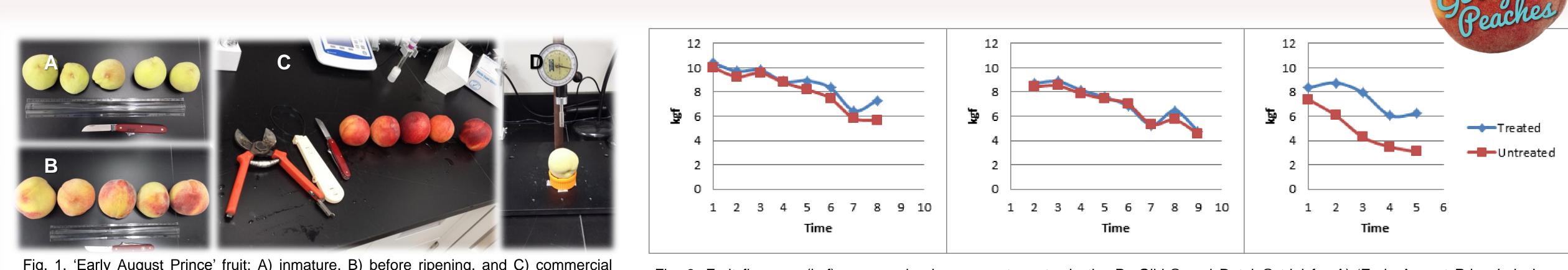


Fig. 1. 'Early August Prince' fruit: A) inmature, B) before ripening, and C) commercial ripening. D) Firmness measured using the Wagner Model FT 30 fruit penetrometer with the FT 516 tip (8mm diameter).

Table 1. ProGibb® and Retain® trial measured by fruit characteristics in Fort Valley, GA during 2014 peach season^{z,y,x}.

'Early August Prince' in Lane Southern Orchards, Fort Valley, GA

Time	Time Growe	r Treatment	N Obs Blush	redflesh	fuzz	tip	firmness	firmS1	firmS2	firmAVE	firmS1N	firmS2N	firmAVEN	firmS1Nperg	firmS2Nperg	firmAVENperg	splitpit	fleshpitS1	fleshpitS2	fleshpitAVE	weight	Perimeter
7/8/2014	1 Lane	TREAT	15 5.33	0.00	8.00 a	6.13	9.00	10.43	10.33	10.38	102.25	101.34	101.80	1.06	1.05	1.05	0.27	16.27	16.67	16.47	99.84	56.73
7/8/2014	1 Lane	UNT	15 3.33	0.00	7.67 b	6.47	9.00	9.96	10.00	9.98	97.68	98.07	97.87	1.03	1.04	1.03	0.47	15.73	16.13	15.93	97.39	56.80
7/11/2014	2 Lane	TREAT	15 8.67	3.33	7.00 a	4.87	9.00	9.64	9.77	9.71	94.54	95.85	95.19	0.95	0.97	0.96	0.47	16.80	16.07	16.43	104.20	58.20
7/11/2014	2 Lane	UNT	15 9.33	6.67	7.00 a	4.53	9.00	9.29	9.23	9.26	91.07	90.49	90.78	0.89	0.89	0.89	0.20	16.40	16.67	16.53	104.03	58.27
7/14/2014	3 Lane	TREAT	15 10.00	9.33	6.67 a	5.07	9.00 a	9.81	9.81	9.81	96.17	96.24	96.21	0.81	0.80	0.81	0.53	17.33	17.27	17.30	124.12	62.00
7/14/2014	3 Lane	UNT	15 7.33	8.67	7.00 a	5.07	7.67 b	9.68	9.44	9.56	94.93	92.58	93.76	0.80	0.79	0.80	0.40	17.00	17.00	17.00	119.39	61.33
7/17/2014	4 Lane	TREAT	15 10.00	10.00 a	7.33 a	5.53	9.00	8.89	8.81	8.85	87.22	86.43	86.82	0.66	0.66	0.66	0.40	18.00	19.20	18.60	137.73	64.27
7/17/2014	4 Lane	UNT	15 10.67	6.67 b	6.67 b	5.33	9.00	8.89	8.64	8.77	87.22	84.73	85.97	0.76	0.74	0.75	0.27	18.33	18.47	18.40	118.13	61.40
7/21/2014	5 Lane	TREAT	15 18.00	10.00	6.67 b	6.00	8.93	9.26	8.59	8.92	90.81	84.21	87.51	0.58 a	0.54 a	0.56 a	0.40	18.93 b) 19.93 b) 19.43 b	161.11	67.87
7/21/2014	5 Lane	UNT	15 18.00	10.00	7.33 a	6.93	8.93	8.51	7.89	8.20	83.42	77.34	80.39	0.50 b	0.47 b	0.48 k	0.53	20.93 a	21.67 a	1 21.30 a	169.28	69.53
7/24/2014	6 Lane	TREAT	15 22.00	10.00	7.33	5.67	9.00	8.28 a	8.39 a	8.34 a	81.20 a	82.31 a	81.76 a	0.45 a	0.46 a	0.46 a	0.27	20.67	20.87	20.80	180.64	70.73
7/24/2014	6 Lane	UNT	15 20.67	10.00	7.67	5.40	9.00	7.51 b	7.42 b	7.46 k	73.62 b	72.77 b	o 73.19 b	0.40 b	0.39 b	0.40 k	0.13	21.80	21.33	21.57	187.70	71.87
7/28/2014	7 Lane	TREAT	15 50.67	10.00	7.00	6.60	8.67	6.83	6.09	6.46	66.95	59.69	63.32	0.33	0.29	0.31	0.27	21.73	22.27	22.00	205.96	74.60
7/28/2014	7 Lane	UNT	15 53.33	10.00	7.00	7.00	8.87	6.02	5.65	5.84	59.04	55.44	57.24	0.28	0.26	0.27	0.27	22.60	21.93	22.27	215.26	76.13
7/31/2014	8 Lane	TREAT	15 67.33	10.00	7.00	7.33 a	9.00 a	7.38 a	7.23 a	7.30 a	72.38 a	70.87 a	71.62 a	0.36 a	0.35 a	0.35 a	0.20	22.93	22.80	22.87	207.86	74.47
7/31/2014	8 Lane	UNT	15 58.00	10.00	7.00	6.93 b	8.67 b	5.59 b	5.77 b	5.68 k	54.85 b	56.55 b	55.70 b	0.27 b	0.28 b	0.28 k	0.00	23.33	22.93	23.13	205.56	74.67

	ugust Prince' in Pear		FOIT VA	ney, G	A																
Time	Time Grower Treatment	N Obs Blush	redflesh	fuzz	tip	firmness	firmS1	firmS2	firmAVE	firmS1N	firmS2N	firmAVEN	firmS1Nperg	firmS2Nperg	firmAVENperg	splitpit	fleshpitS1	fleshpitS2	fleshpitAVE	weight	Perimeter
7/11/2014	2 Pearson TREAT	15 12.00	4.00 b	7.00 b	5.00	7.67 b	8.84	8.61	8.72	86.70	84.41	85.55	0.68	0.66	0.67	0.60	17.40	17.60	17.50	130.45	62.47
7/11/2014	2 Pearson UNT	30 9.33	8.00 a	7.50 a	5.30	9.00 a	8.52	8.36	8.44	83.52	82.02	82.77	0.61	0.60	0.60	0.60	18.13	18.00	18.07	142.32	64.50
7/14/2014	3 Pearson TREAT	15 23.33 a	8.67	7.67 a	5.60	9.00	8.95	8.79 a	ı 8.87 a	87.74	86.24 a	86.99 a	0.56	0.55 a	0.56	0.60	19.13	19.33	19.23	158.25	67.40
7/14/2014	3 Pearson UNT	30 15.33 b	9.00	6.83 b	5.57	9.00	8.71	8.31 b	o 8.51 b	85.39	81.50 b	83.44 b	0.53	0.51 b	0.52	0.47	18.47	19.13	18.80	164.14	68.10
7/17/2014	4 Pearson TREAT	15 27.33	10.00	7.00	6.20 a	9.00	8.25	8.05	8.15	80.87	78.91	79.89	0.51	0.49	0.50	0.47	19.67	19.33	19.50	162.32	68.20 b
7/17/2014	4 Pearson UNT	30 27.00	10.00	7.00	5.60 b	9.00	7.94	7.78	7.86	77.87	76.33	77.10	0.45	0.44	0.45	0.53	20.67	20.50	20.58	177.70	71.17 a
7/21/2014	5 Pearson TREAT	15 46.67	13.33 a	7.00	5.87	8.60	7.67	7.47	7.57	75.25	73.29	74.27	0.40	0.39	0.40	0.27	21.33	21.33	21.33	196.16	73.00
7/21/2014	5 Pearson UNT	30 41.33	10.33 b	7.00	5.90	8.83	7.61	7.28	7.44	74.63	71.36	73.00	0.38	0.36	0.37	0.50	22.33	22.07	22.20	200.95	73.87
7/24/2014	6 Pearson TREAT	15 54.67	10.00	8.00 a	6.07	8.93	6.77	6.93	6.85	66.36	67.93	67.15	0.29	0.30	0.29	0.27	23.80	24.27	24.03	230.55	77.53
7/24/2014	6 Pearson UNT	30 53.67	10.00	7.17 b	5.77	8.97	7.03	6.99	7.01	68.98	68.58	68.78	0.30	0.30	0.30	0.30	24.50	24.67	24.58	234.07	78.00
7/28/2014	7 Pearson TREAT	15 61.33	10.00	7.00	6.67	8.93 a	5.43	5.11	5.27	53.22	50.15	51.68	0.28	0.26	0.27	0.07	21.93	23.47	22.70 k	195.99	73.00
7/28/2014	7 Pearson UNT	30 55.00	10.00	7.00	6.50	8.80 b	5.41	5.26	5.34	53.09	51.62	52.35	0.26	0.25	0.26	0.10	24.08	a 23.77	23.92 a	206.13	74.60
7/31/2014	8 Pearson TREAT	15 68.00	10.67	7.00	6.87	8.93	6.53	6.37	6.45	64.01	62.44	63.22	0.35	0.34	0.34	0.20	24.07	23.80	23.93	191.94	71.93
7/31/2014	8 Pearson UNT	30 67.67	10.33	7.00	7.13	8.90	5.72	5.68	5.70	56.13	55.74	55.93	0.30	0.29	0.29	0.20	23.87	24.37	24.12	199.39	73.30
8/4/2014	9 Pearson TREAT	15 77.33 b	16.67 b	6.67 a	5.87 b	8.87	4.43	5.09	4.76	43.48	49.88	46.68	0.18	0.21	0.19	0.07	26.47	26.07	26.27	249.11	80.20 a
8/4/2014	9 Pearson UNT	15 87.14 a	22.86 a	6.29 b	6.43 a	8.71	4.34	4.74	4.54	42.52	46.51	44.52	0.19	0.21	0.20	0.07	25.36	25.93	25.64	225.89	77.00 b

7/31/2014	8 Pearso	n UNT	30 67.	67 10	.33 7.	00 7.1	13 8.9	0 5.7	'2 5.6	58 5.7	56.13	3 55.74	55.93	0.30	0.29	0.29	0.20	23.87	24.37	24.12	199.39	73.30
8/4/2014	9 Pearso	n TREAT	15 77.	33 b 16	67 b 6.	67 a 5.8	87 b 8.8	7 4.4	3 5.0)9 4.7	43.48	8 49.88	46.68	0.18	3 0.21	0.19	0.07	26.47	26.07	26.27	249.11	80.20 a
8/4/2014	9 Pearso	n UNT	15 87.	14 a 22	86 a 6.	29 b 6.4	43 a 8.7	1 4.3	4.7	74 4.5	4 42.52	2 46.51	. 44.52	0.19	0.21	0.20	0.07	25.36	25.93	25.64	225.89	77.00 b
'Rustor	n Red' in La	ane Sout	hern Orcha	ards, Fo	rt Vall	ey, GA	A															
	Time Grower	Treatment	N Obs Blush	redflesh	fuzz	tip	firmness	firmS1	firmS2	firmAVE	firmS1N	firmS2N	firmAVEN	firmS1Nperg	firmS2Nperg	firmAVENperg	splitpit	fleshpitS1	fleshpitS2	fleshpitAVE	weight	Perimeter
7/8/2014	1 Lane	TREAT	15 56.00	6.67 k	7.00	5.00	8.93	8.45	8.25	8.35	82.84	80.94	81.89	0.31	0.30	0.31	1.00	24.87	24.80	24.83	274.66	80.93
7/8/2014	1 Lane	UNT	15 52.67	10.00 a	7.00	4.80	8.80	7.49	7.27	7.38	73.42	71.26	72.34	0.27	0.26	0.26	1.00	24.87	25.73	25.30	299.05	84.33
7/11/2014	2 Lane	TREAT	15 60.00	9.33	6.00	4.67	9.00 a	8.81 a	8.70 a	8.76 a	86.43 a	85.32 a	85.88 a	0.36 a	o 0.35 a	0.35 a	0.93	23.93	24.13	24.03	247.15 b	78.40 b
7/11/2014	2 Lane	UNT	15 66.67	10.00	6.00	3.27	8.47 b	5.66 b	6.49 b	6.08 b	55.51 b	63.68 b	59.59 b	0.20 b	o 0.22 b	0.21 b	1.00	25.07	25.40	25.23	320.02 a	85.33 a
7/14/2014	3 Lane	TREAT	15 62.67 b	10.00	6.00	5.00	9.00 a	7.82 a	8.05 a	7.94 a	76.69 a	78.98 a	77.83 a	0.30 a	o 0.31 a	0.31 a	0.80	25.27	24.60	24.93	256.61 b	78.67 b
7/14/2014	3 Lane	UNT	15 86.00 a	9.33	5.67	5.40	8.07 b	4.63 b	3.95 b	9 4.29 b	45.44 b	38.70 b	42.07 b	0.16 b	0.14 b	0.15 b	0.93	24.53	24.27	24.40	297.60 a	83.73 a
7/17/2014	4 Lane	TREAT	15 82.00	10.00	6.33	5.13	8.20 a	6.22 a	5.93 a	6.07 a	61.00 a	58.12 a	59.56 a	0.21	0.20	0.20	0.73	26.53	26.07	26.30	304.90	84.27
7/17/2014	4 Lane	UNT	15 83.33	10.00	6.00	5.13	6.93 b	3.76 b	3.20 b	o 3.48 b	36.87 b	31.38 b	34.13 b	0.15	0.13	0.14	0.93	24.87	24.53	24.70	288.84	84.60
7/21/2014	5 Lane	TREAT	15 62.00	10.67	5.00	5.07	8.53 a	6.56 a	6.23 a	6.22 a	64.31 a	61.13 a	61.00 a	0.24 a	a 0.24 a	0.23 a	0.53	24.73	24.80	24.77	277.17	81.00
7/21/2014	5 Lane	UNT	15 72.00	10.00	5.00	5.27	7.53 b	2.91 b	3.41 b	3.08 b	28.51 b	33.41 b	30.20 b	0.10 b	o 0.11 b	0.10 b	0.53	24.73	24.73	24.73	286.73	81.47

^zBlush= percentage coverage of red blush. Red in flesh= percentage coverage of red color in the flesh. Fuzz, tip, and firmness = 1-9 subjective scale, with 1 undesirable to 9 optima measured by penetrometer in kilograms-force (kgf). FirmS2= firmness in side 2 as measured by penetrometer. FirmAVE= firmness average between side 1 and side 2. FirmS1N, Firm in N= newtons. Calculated using the following equation N= kilogram-force (kgf) x 9.807. FirmS1Nperg, FirmS2Nperg, and FirmAVENperg calculated by dividing the Newtons per gram in mm. Weight was measured in grams per fruit. Perimeter was measured in mm. ^yMean comparisons within each harvest date represented by different letters are significantly different using Fisher's protected LSD test, p-value < 0.05. *Date for first commercial harvest for 'Early August Prince' in Lane Southern Orchards and Pearson Farms was 07/28/14 and 07/24/14, respectively. 'Ruston Red' commercial harvest started on 07/08/14.

- different. Analyses were carried out per variety and location (Table 1). • Overall, fuzz, tip, and split pit showed no difference between treated and untreated (Table 1)
- for most of the harvest dates (Table 1).

Fig. 2. Fruit firmness (kgf) measured using a penetrometer in the ProGibb® and Retain® trial for A) 'Early August Prince' in Lane Southern Orchards, Fort Valley, GA, B) 'Early August Prince' in Pearson Farms, Fort Valley, GA, and C) 'Ruston Red' in Lane Southern Orchards, Fort Valley, GA.

Results

The effect of locations (Lane Southern Orchards and Pearson Farms) and varieties ('Early August Prince' and 'Ruston Red') were fo

• Percent blush, red flesh, perimeter, and weight for the treated and untreated did show some significant differences; however, these differences were not seen

• Differences in fruit firmness were seen for 'Early August Prince' and 'Ruston Red' in Lane Southern Orchards for almost all plots after the first commercial harvest (Table 1, Fig. 2). The fruit treated with plant growth regulators, ProGibb® and Retain®, were firmer than the untreated fruit, especially in 'Ruston Red'. 'Early August Prince' firmness in Pearson Farms did not show significant differences among treated and untreated fruit (Table 1). • Results were encouraging, however, they were not consistent across varieties and locations (Additional trials 2015 Season).

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al. FirmS1= firmness in side 1 as nS2N, and Firm AVEN measured hs of fruit. Fleshpit was measured

