California Melon Research Board Report

Evaluation of plant growth regulator application to concentrate fruit set and reduce the period of melon harvest

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Abstract
Uniformity of melon crop maturation is highly desirable. Condensing a melon field harvest period represents an opportunity to substantially reduce expenses. Plant growth regulators are one tool that may be useful in concentrating fruit set. Several plant growth regulators are currently available for increasing yield and quality of other crops. In 2018, the rates and application timing of ethephon followed by an application of 1-napthaleneacetic acid (NAA) was evaluated at University of California West Side Research and Extension Center. On 26 Jun, seeds of Olympic Gold Western Shipper and Caribbean King Harper-type cantaloupe were sown into a Panoche clay loam soil in two separate experiments. Treatments were identical in each study: A product registered for other purposes, Florel, was applied at rates to achieve levels of the active ingredient (ethephon) at 300, 400 and 500 ppm. This material was applied either at the 3- or 9-true leaf stage of melon plant development. PoMaxa (NAA) was applied 24 days after the ethephon applications. An untreated control was included. The Olympic Gold variety was initially stunted by the application of 500 ppm ethephon at 3 true leaf stage of plant development. Early symptoms were limited to altered bloom and stunted growth. However, many of the Olympic Gold fruit receiving this treatment were elongated to an oblong form that would be unmarketable. This treatment had a significant decline in marketable yield due to that condition. However, a significant interaction between treatment rates and harvest interval was observed for Olympic Gold. The treatments had very few subtle effects on Caribbean King. Clearly, there is a variety-specific response. Additional work is needed to fully assess the potential of these chemistries.

Significance, need and benefit to melon industry

Plant growth regulators (PGRs) impact maturation, yield and quality in other crops. The purpose of this study is to screen currently available PGRs for their ability to concentrate cantaloupe fruit set.

Methods

A Western Shipper and a Harper Type LSL cantaloupe were tested for response to plant growth regulators in separate experiments with identical treatments. On 26 Jun, cv. Olympic Gold (Sakata) Western Shipper and Caribbean King (Rik Zwaan) Harper-type LSL seeds were sown into a Panoche clay loam soil at University of California West Side Research and Extension Center. The field was sprinkler-irrigated to emergence. All irrigations after plant emergence were applied with buried drip at a 10-inch depth. Beds

measured 80 inches center-to-center. Fertilization, irrigation and pest management was like commercial practice.

Treatments were focused on timing and concentration of Florel (ethephon), which was then followed by PoMaxa (NAA). The treatments were arranged in a four-replication split-plot design as follows:

Main Plot Treatments: Application timing
- M1 - First application at 3 true leaf stage of plant development
- M2 - First application at 9 true leaves

Florel rate (ethephon concentration) followed by PoMaxa 2.4 fl oz/a (24 days after Florel)
- S1 - 300 ppm ethephon
- S2 - 400 ppm ethephon
- S3 - 500 ppm ethephon
- S4 - untreated

Performance of these treatments was determined primarily through yield and quality. On 14, 21 and 24 Sep, 13 row feet were harvested from each plot of the Olympic Gold experiment when the melons were at ¾ to full slip. On 12, 20 and 25 Sep, the Caribbean King experiment was harvested: Stem cracking and skin color under the net were used as indicators of maturity. Each fruit was sized (6, 9, 12, 15, 18 and 23), cull. In addition, rot, sunburn and fruit distortions were noted. From each plot on the first two harvest dates, 3 marketable fruit were tested for solids with a digital refractometer and flesh firmness was determined with a hand-held penetrometer. A factorial Analysis of Variance was performed on the data and Least Significant Difference at a probability of 0.05 ($LSD_{0.05}$) is presented.

Results

Under the conditions of this study, plant regulator applications had impacts on plant growth. Olympic Gold responded to the 500 ppm application of ethephon at 3rd true leaf stage of development, which was observable approximately one week after application (Figure 1). In addition, the ethephon applications had influence on flowering in the Olympic Gold variety, but there were no apparent differences in flowering among treatments in the Caribbean King variety (Table 1). An application of 500 ppm ethephon to the Olympic Gold variety at 3-true leaves resulted in a significant reduction in marketable yield (Table 2). This reduction is yield is due to distortions of the treated fruit, causing them to be graded as culls (Table 2; Figure 2). There were some distortions in the early 300 and 400 ppm ethephon applications, but at an incidence that was significantly lower than the plots receiving the 500 ppm application.

Solids and fruit firmness similar among treatments. With an average solids level of 9.33 ^{o}brix in the Caribbean King and 8.89 ^{o}brix in the Olympic Gold, the levels are low. One of the challenges of cantaloupes in the Central San Joaquin Valley in Aug and Sep melons was whitefly and it is possible that the whitefly levels contributed to the low sugars issues this season. Although there were 5 insecticide applications during the season, the population densities remained very high.

For the Olympic Gold variety, significant harvest date x ethephon treatment timing interaction existed regarding distorted fruit P=0.0066, treatment timing and concentration

P=0.0066 (Table 3). The bulk of the damage occurred only at the high rate and early treatment timing. Also, it most severely affected the earliest harvest. The impact on the Caribbean King was minimal (Tables 4, 5)

The desired result was not achieved. However, there may have been more subtle alterations in the harvest period that would become clearer with additional work. Varietal response variation was substantial and the results of this study suggests inclusion of a varietal component is an important part of any future studies.

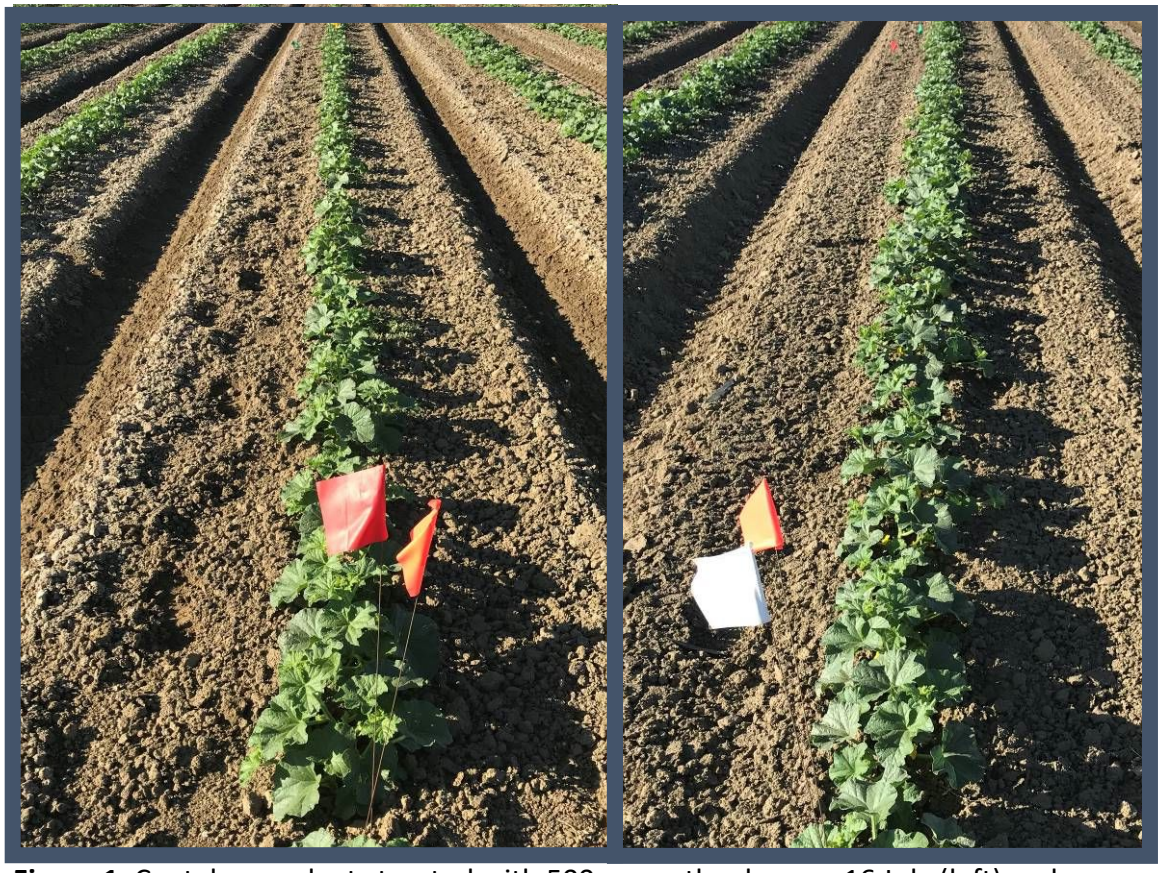

Figure 1. Cantaloupe plants treated with 500 ppm ethephon on 16 July (left) and untreated plants (right) on 24 Jul.

Table 1. Influence of ethephon on flowering on cantaloupes directs seeded on 26 Jun.

Application timing[z]	Ethephon concentration (ppm)[y]	Flowers per plant[x]	
		Olympic Gold	Caribbean King
3 leaf (16 Jul)	300	0.91	1.84
	400	0.33	1.58
	500	0.67	1.00
	untreated	1.58	2.67
9 leaf (23 Jul)	300	1.49	2.59
	400	1.16	2.67
	500	0.92	2.33
	untreated	2.42	2.75
LSD ($P_{0.05}$)[w]		1.543	NS[v]

[z] Florel was applied at 3 true leaves (16 Jul) or 9 true leaves (23 Jul).Twenty-four days after the initial application, PoMaxa (NAA) was applied. All applications were made with a CO_2-pressurized sprayer at the equivalent of 40 gallons per acre.

[y] Florel was applied at 38, 41 and 63 fl oz/a. The ethephon concentrations were 300, 400 or 500 ppm.

[x] The number of flowers on each of three representative plants per plot were recorded and average number of flowers per plant is presented.

[w] Numbers that differ by Least Significant Difference at the bottom of the column are significantly different at a probability of 5%.

[v] Columns of means above "NS" do not differ significantly from one another at a probability above 5%.

Table 2. Timing and concentration of ethephon with NAA applied 24 days after initial treatment on harvest date, yield and quality of Olympic Gold cantaloupe.

Application timing[z]	Ethephon concentration (ppm)[y]	fruit per size category[x] 6	9	12	15	18	yield (cartons/ acre)[w]	dis-torted fruit[v]	Culls[u]
3 leaf & 24 days after treatment	**300**	1.75	10.50	7.75	8.25	5.00	1542.75	5.50	7.00
	400	1.50	5.50	10.25	9.50	7.00	1455.49	8.25	10.75
	500	0.25	2.75	3.75	3.00	1.75	506.11	22.25	25.25
	untreated	2.50	8.75	11.25	10.50	2.00	1664.91	2.25	4.00
9 leaf & 24 days after treatment	**300**	0.50	8.75	15.00	10.50	4.50	1724.25	0.25	2.50
	400	1.00	7.75	14.75	11.50	3.50	1713.78	0.50	2.00
	500	0.50	6.50	13.25	13.75	4.00	1647.46	0.00	2.25
	untreated	0.25	10.00	14.75	13.75	5.75	1933.67	0.00	1.25
LSD ($P_{0.05}$)[t]		NS[s]	4.830	4.478	5.567	3.741	559.3	7.811	10.53

[z] Florel was applied at 3 true leaves (16 Jul) or 9 true leaves (23 Jul).Twenty-four days after the initial application, PoMaxa (NAA) was applied. All applications were made with a CO_2-pressurized sprayer at the equivalent of 40 gallons per acre.

[y] Florel was applied at 38, 41 and 63 fl oz/a. The ethephon concentrations were 300, 400 or 500 ppm.

[x] Fruit were harvested from 13.1 ft of each plot. Average number of fruit per plot are reported in size categories based on how many fruit of a uniform size will fit into a standard carton.

[w] Cartons per acre are calculated based on harvested area and fruit size.

[v] Distortions were primarily elongated fruit, and this category is separated because of the clear relationship between this symptom and the treatment. However, these fruit are also included in the cull category.

[u] Culls include undersized and rotten fruit in addition to the distorted fruit, which accounted for the majority of this category.

[t] Numbers within a column that differ by Least Significant Difference at the bottom of the column are significantly different at a probability of 5%.

[s] Columns of means above "NS" do not differ significantly from one another at a probability above 5%.

Figure 2. Cantaloupe plants treated with 500 ppm ethephon at the first harvest bore oblong fruit atypical of the Olympic Gold Western Shipper variety.

Table 3. Influence of timing and concentration of ethephon with applied 24 days after initial treatment on harvest date, yield and quality of Olympic Gold cantaloupe.

Harvest[z]	Application timing[y]	Ethephon concentration (ppm)[x]	number of fruit per size category[w]					yield (cartons /acre)[v]	dis-torted[u]	Culls[t]	firmness (lbf)	solids (°brix)
			6	9	12	15	18					
14 Sep	3 leaf & 24 dat	**300**	1.25	5.75	4.25	5.50	1.00	816.06	4.25	4.25	5.36	10.58
		400	1.00	2.50	6.50	6.00	5.00	836.31	4.75	5.25	4.88	10.08
		500	0.00	0.25	0.00	0.00	0.00	13.96	16.00	16.00	5.38	9.58
		untreated	0.25	4.00	6.00	5.25	0.75	692.50	0.00	0.50	5.67	9.50
	9 leaf & 24 dat	**300**	0.00	3.50	8.25	5.75	1.25	768.59	0.25	0.75	5.82	10.23
		400	0.25	3.50	9.50	6.75	1.00	868.42	0.00	0.50	4.24	9.18
		500	0.00	3.00	9.00	8.50	1.75	878.19	0.00	0.00	5.75	9.70
		untreated	0.00	2.75	8.50	6.00	1.25	745.56	0.00	0.25	5.81	10.23
21 Sep	3 leaf & 24 dat	**300**	0.50	3.50	3.50	2.25	2.00	515.19	1.25	2.00	5.30	8.80
		400	0.25	2.75	3.75	2.75	1.50	465.62	3.50	5.00	4.80	8.60
		500	0.25	2.50	3.25	3.00	1.50	439.10	6.25	9.00	4.68	8.05
		untreated	1.00	3.25	3.25	3.00	1.00	529.85	2.25	3.25	5.70	8.95
	9 leaf & 24 dat	**300**	0.50	4.00	5.00	4.25	2.50	686.92	0.00	1.25	5.87	9.00
		400	0.50	3.00	5.25	4.50	2.00	635.96	0.50	1.50	4.20	8.65
		500	0.50	3.00	3.75	4.50	2.25	580.11	0.00	1.50	5.38	8.80
		untreated	0.00	2.75	4.25	5.75	2.00	562.23	0.00	1.00	5.78	9.30
24 Sep	3 leaf & 24 dat	**300**	0.25	1.50	1.75	1.75	1.00	264.58	0.00	0.75	-------	-------
		400	0.00	0.00	0.50	0.25	0.00	29.32	0.00	0.50	-------	-------
		500	0.25	2.00	2.75	2.00	1.75	363.70	0.00	0.25	-------	-------
		untreated	0.00	1.25	0.00	0.50	2.00	142.41	0.00	0.25	-------	-------
	9 leaf & 24 dat	**300**	0.25	0.25	0.00	0.75	0.50	74.00	0.00	0.50	-------	-------
		400	0.00	0.00	0.50	0.00	0.25	27.92	0.00	0.00	-------	-------
		500	1.25	1.50	2.00	2.25	0.25	354.63	0.00	0.75	-------	-------
		untreated	0.00	1.25	1.75	0.50	0.75	180.80	0.00	0.00	-------	-------
LSD ($P_{0.05}$)[t]			NS[s]-	2.680	3.278	3.377	3.055	381.60	5.072	5.087	NS	NS
Probability (P)												
Harvest date			NS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037	0.0001	NS	NS
Timing			NS	NS	0.0000	0.0028	0.0466	0.0090	0.0007	0.0005	NS	NS
Concentration			NS	0.0130	NS	NS	0.0339	0.0071	0.0061	0.0023	NS	NS
Harvest date x timing			NS	NS	0.0017	0.0869	NS	NS	0.0066	0.0035	NS	NS
Harvest date x concentration			NS	NS	NS	NS	0.0958	NS	0.0829	NS	NS	NS
Timing x concentration			NS	NS	NS	NS	NS	0.0683	0.0047	0.0033	NS	NS
Harvest date x timing x concentration			NS	NS	NS	NS	NS	0.0404	NS	NS	NS	NS

[z] Fruit at ¾ to full slip were harvested.

[y] Florel was applied at 3 true leaves (16 Jul) or 9 true leaves (23 Jul).Twenty-four days after the initial application, PoMaxa (NAA) was applied. All applications were made with a CO_2-pressurized sprayer at the equivalent of 40 gallons per acre.

[x] Florel was applied at 38, 41 and 63 fl oz/a. {ethephon (the active ingredient) concentrations were at 300, 400 or 500 ppm}

[w] Fruit were harvested from 13.1 ft of each plot.

[v] Cartons per acre are calculated based on harvested area and fruit size.

[u] Distortions were primarily elongated fruit.

[t] Numbers that differ by Least Significant Difference at the bottom of the column are significantly different at a probability of 5%.

[s] Columns of means above "NS" do not differ significantly from one another at a probability above 5%.

Table 4. Impact of timing and concentration of ethephon with NAA applied 24 days after initial treatment on yield and quality of Caribbean King Harper-type LSL cantaloupe with multiple harvests pooled

Application timing[y]	Ethephon concentration (ppm)[x]	number of fruit per size category[w]					yield (cartons/acre)[v]	rot
		6	9	12	15	18		
3 leaf & 24 dat	300	16.75	2.00	1.75	0.75	0.00	1600.86	0.75
	400	12.75	3.25	2.50	0.75	0.00	1368.80	0.00
	500	13.50	4.00	2.00	1.25	0.00	1468.55	0.75
	untreated	16.25	3.75	0.50	1.00	0.00	1612.64	0.00
9 leaf & 24 dat	300	18.00	3.75	4.00	0.75	0.00	1895.26	0.25
	400	20.25	3.25	1.00	0.25	0.00	1913.27	0.25
	500	18.00	4.50	1.00	0.00	0.00	1787.20	0.00
	untreated	14.25	3.00	1.75	1.25	0.00	1465.09	0.25
		6.306	NS[s]	2.738	NS	NS	496.3	NS

[y] Florel was applied at 3 true leaves (16 Jul) or 9 true leaves (23 Jul). PoMaxa (NAA) was applied 24 days after the Florel application. All applications were made with a CO_2-pressurized sprayer at the equivalent of 40 gallons per acre.

[x] Florel was applied at 38, 41 and 63 fl oz/a. {ethephon (the active ingredient) concentrations were at 300, 400 or 500 ppm}

[w] Mature fruit were harvested from 13.1 ft of each plot on 12, 20 and 25 Sep based cracking at the stem and the color of the skin under the net..

[v] Cartons per acre were calculated based on harvested area and fruit size.

[u] Distortions were primarily elongated fruit.

[t] Numbers that differ by Least Significant Difference at the bottom of the column are significantly different at a probability of 5%.

[s] Columns of means above "NS" do not differ significantly from one another at a probability above 5%.

Table 5. Influence of timing and concentration of ethephon with NAA applied 24 days after initial treatment on harvest date, yield and quality of Caribbean King Harper LSL.

Harvest[z]	Application timing[y]	Ethephon concentration (ppm)[x]	number of fruit per size category[w]				yield	rot	firmness (lbf)	solids (°brix)
			6	9	12					
12Sep	3 leaf & 24 dat	**300**	1.25	5.75	4.25	5.50	816.06	4.25	4.48	10.15
		400	1.00	2.50	6.50	6.00	836.31	4.75	4.40	10.23
		500	0.00	0.25	0.00	0.00	13.96	16.00	4.91	10.38
		untreated	0.25	4.00	6.00	5.25	692.50	0.00	4.91	10.43
	9 leaf & 24 dat	**300**	0.00	3.50	8.25	5.75	768.59	0.25	4.40	10.40
		400	0.25	3.50	9.50	6.75	868.42	0.00	5.82	10.38
		500	0.00	3.00	9.00	8.50	878.19	0.00	5.14	10.30
		untreated	0.00	2.75	8.50	6.00	745.56	0.00	4.56	10.33
20 Sep	3 leaf & 24 dat	**300**	0.50	3.50	3.50	2.25	515.19	1.25	4.37	8.58
		400	0.25	2.75	3.75	2.75	465.62	3.50	1.87	4.40
		500	0.25	2.50	3.25	3.00	439.10	6.25	4.37	8.25
		untreated	1.00	3.25	3.25	3.00	529.85	2.25	4.55	7.75
	9 leaf & 24 dat	**300**	0.50	4.00	5.00	4.25	686.92	0.00	3.35	6.15
		400	0.50	3.00	5.25	4.50	635.96	0.50	4.62	7.85
		500	0.50	3.00	3.75	4.50	580.11	0.00	3.95	8.30
		untreated	0.00	2.75	4.25	5.75	580.11	0.00	4.69	8.30
25 Sep	3 leaf & 24 dat	**300**	0.25	1.50	1.75	1.75	264.58	0.00	-------	-------
		400	0.00	0.00	0.50	0.25	29.32	0.00	-------	-------
		500	0.25	2.00	2.75	2.00	363.70	0.00	-------	-------
		untreated	0.00	1.25	0.00	0.50	142.41	0.00	-------	-------
	9 leaf & 24 dat	**300**	0.25	0.25	0.00	0.75	74.00	0.00	-------	-------
		400	0.00	0.00	0.50	0.00	27.92	0.00	-------	-------
		500	1.25	1.50	2.00	2.25	354.63	0.00	-------	-------
		untreated	0.00	1.25	1.75	0.50	180.80	0.00	-------	-------
LSD ($P_{0.05}$)[t]			4.230	NS[t]	NS	NS	371.9	NS	NS	NS
Interaction Probability (P)										
Harvest date P			0.0000		NS	0.0003	NS	NS	0.0635	0.0006
Timing P			0.0467		NS	0.0368	NS	NS	NS	NS
Concentration P			NS		NS	NS	NS	NS	NS	NS
Harvest date x timing P			NS		NS	NS	NS	NS	NS	NS
Harvest date x concentration P			0.0122		NS	NS	0.0687	NS	NS	NS
Timing x concentration P			NS		NS	NS	NS	NS	NS	NS
Harvest date x timing x concentration P			NS		0.0950	NS	NS	NS	NS	NS

[z] Fruit were harvested based on cracking at the stem end and by color of the skin under the net.

[y] Florel was applied at 3 true leaves (16 Jul) or 9 true leaves (23 Jul).Twenty-four days after the initial application, PoMaxa (NAA) was applied. All applications were made with a CO_2-pressurized sprayer at the equivalent of 40 gallons per acre.

[x] Florel was applied at 38, 41 and 63 fl oz/a. {ethephon (the active ingredient) concentrations were at 300, 400 or 500 ppm}

[w] Fruit were harvested from 13.1 ft of each plot.

[v] Cartons per acre are calculated based on harvested area and fruit size.

[u] Numbers that differ by Least Significant Difference at the bottom of the column are significantly different at a probability of 5%.

[t] Columns of means above "NS" do not differ significantly from one another at a probability above 5%.