UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

Vegetable Views

Stanislaus County

Summer 2025

2024 Grafted Watermelon Trial Updates

The 2024 on-farm grafted watermelon trials continued to focus on the assessment of watermelon rootstock-scion combinations to compare differences between grafted and non-grafted plants in terms of yield, quality, canopy development, nitrogen uptake, and water application. All field trials are also being repeated in 2025, and the results will be shared after the season.

I. Watermelon rootstock variety trial updates

This grafted watermelon project entered its sixth year since 2019. The 2024 watermelon rootstock variety trial continued to identify top-performing rootstock-scion combinations that can outperform non-grafted plants. In the 2024 trial, four rootstocks that ranked as top performers from past years' trials were included (Table 1).

- *Trial set up.* The trial was implemented on a commercial field in Escalon, CA. Each rootstock was grafted onto the same scion, 'Warrior.' Non-grafted plants were used as a control. A seeded variety, 'Sentinel' was used as the pollenizer. Each treatment plot was 80 feet long containing 13 grafted or nongrafted triploid plants and 4 grafted or nongrafted pollenizers. All treatments were replicated four times. The trial was transplanted on April 26, 2024.

- *In-season field management and data collection.* After transplanting, our team separated the watermelon vines between each treatment row to ease the data collection and harvest (Figure 1a). This was performed three times before the first harvest. Separating the watermelon vines between rows not only keeps the fruit growing on top of its marked row, ensuring that all data stays accurate, but it also maintains a visible walkway while harvesting and collecting data (Figures 1a and 1b). We made two harvests with the help of the farm crew on July 10 and July 19. The grower's schedule and number of harvests for the rest of the field were slightly different from the trial area. Marketable fruit from each treatment row was counted, weighed, and then transformed into yield per acre (Table 2).

- *Fruit quality. Fruits from the first harvest were tested for quality (Table 3).* Fruit length and width were measured by yardstick. Sugar content (^{0}Brix) was measured by scooping the center flesh of each half and reading the results through a portable, digital reflectometer. Fruit/flesh firmness was measured using a fruit penetrometer at the spots 1/3 and 2/3 distance from the blossom end after a melon was cut into half. Rind thickness at the blossom and stem ends were measured with a digital caliper.

Table 1. List of rootstocks that were used in the 2024 watermelon rootstock variety trial.

Rootstock	Type
Carnivor (CAR)	Interspecific hybrid squash (*Cucurbita maxima* x *Cucurbita moschata*)
Camelforce (CAM)	Interspecific hybrid squash
Cobalt (COB)	Interspecific hybrid squash
Carolina Strongback (CSB)	Citron rootstock (*Citrusllus amarus*)

Table 2. Fruit yield from each harvest and total yield for the 2024 watermelon rootstock variety trial.

	First Harvest (July 10, 2024)			Second Harvest (July 19, 2024)			Total	
Rootstock	**Avg. Wt (lbs.)**	**No/acre**	**Tons/acre**	**Avg. Wt (lbs.)**	**No/acre**	**Tons/acre**	**No/acre**	**Tons/acre**
CAR	19.5 A*	1822 C	17.8 C	19.4 A	1473 A	14.3 A	3295 B	32.1 AB
CAM	18 A	1996 BC	17.8 C	18 AB	1298 B	11.5 C	3294 B	29.3 BC
COB	18.5 A	2229 B	20.7 BC	19.2 A	1434 AB	13.9 AB	3663 A	34.6 A
CSB	18.3 A	2287 B	21.1 AB	17.7 B	1357 AB	12 BC	3644 A	33.1 AB
NG	16.9 B	2810 A	24.3 A	13.7 C	446 C	4.1 D	3256 B	28.4 C

*Figures with different letters indicate a significant difference at $P < 0.05$.

Table 3. Fruit quality for grafted and non-grafted watermelons for the 2024 watermelon rootstock variety trial.

Rootstock	Length (in.)	Width (in.)	Blossom rind (cm.)	Stem rind (cm.)	^{0}Brix	Firmness (kg/cm2)
CAR	11.0*	9	1.4	2.1	11.7	3.6*
CAM	10.8	8.7	1.5	2.1	11.3	4.0*
COB	11.1*	8.8	1.3	2.3	11.9	3.8*
CSB	11.0*	8.3	1.3	1.9	12.2*	3.2
NG	10.3	8.3	1.1	1.9	11.3	2.5

*Indicates the figure is significantly greater than the nongrafted control (NG) at $P < 0.05$.

- *Results.* Cobalt produced the highest total yield for both fruit number and total weight, followed by Carolina Strongback (Table 2). The biggest yield difference occurred in the second harvest with non-grafted plants having a large decrease in fruit produced. After grafting, the total yield is higher for all rootstocks except for Camelforce when compared to non-grafted plants. For fruit quality, the main differences between grafted and non-grafted were observed in fruit length and firmness, with increases found in three rootstocks (Table 3). Carolina Strongback produced the highest °Brix among all the rootstocks and was observed to have more popularity during fruit quality evaluations.

Figures 1a and 1b. The difference between separated vines compared to natural/non-separated watermelon vines in the 2024 rootstock variety trial (Photos were on June 13, 2024).

II. Watermelon irrigation and nitrogen trial updates

The watermelon field that was used for the 2024 rootstock variety trial was simultaneously imbedded by this irrigation/nitrogen trial. Funded by the National Watermelon Association, the objective of this study is to understand the nitrogen and irrigation dynamics for grafted watermelons from the non-grafted counterpart. The trial evaluated nitrogen uptake patterns, canopy development, and monitored irrigation application using the CropManage online decision-support tool. A flow meter was installed and connected to a datalogger to pull real-time irrigation data. Data was collected from two rootstocks, Camelforce (CAM) and Cobalt (COB), and a non-grafted (NG) control. After all plants were transplanted and throughout the growing season, canopy coverage data was collected from each treatment row using a Green Seeker handheld crop sensor (Figure 2). This data showed the overall watermelon vine growth over time as the field continued to be harvested. Aboveground plant tissue, vine runners, and soil samples were collected three times throughout the season to measure plant and soil nitrate content (Figure 3 and 4).

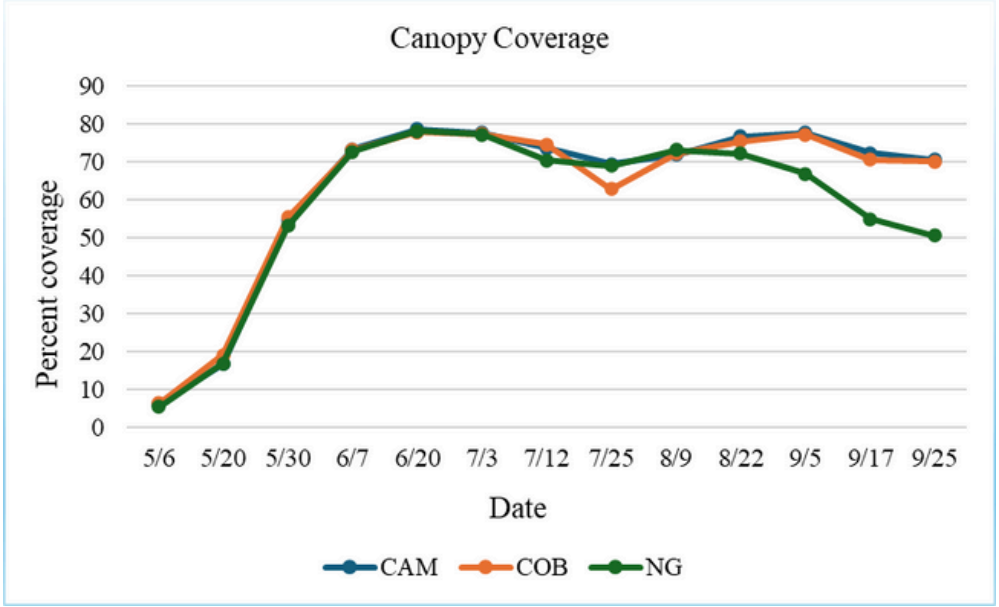

Figure 2. Differences in percent canopy coverage among grafted and non-grafted plants taken from May 6 to September 25, 2024.

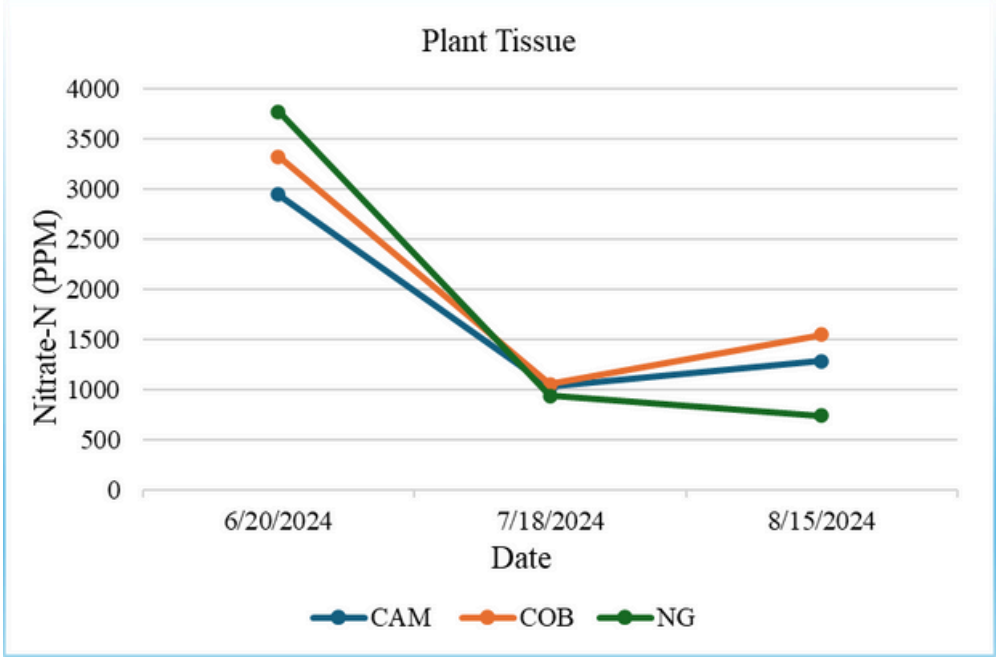

Figure 3. Differences in plant tissue nitrate content among grafted and non-grafted watermelons from June-August 2024.

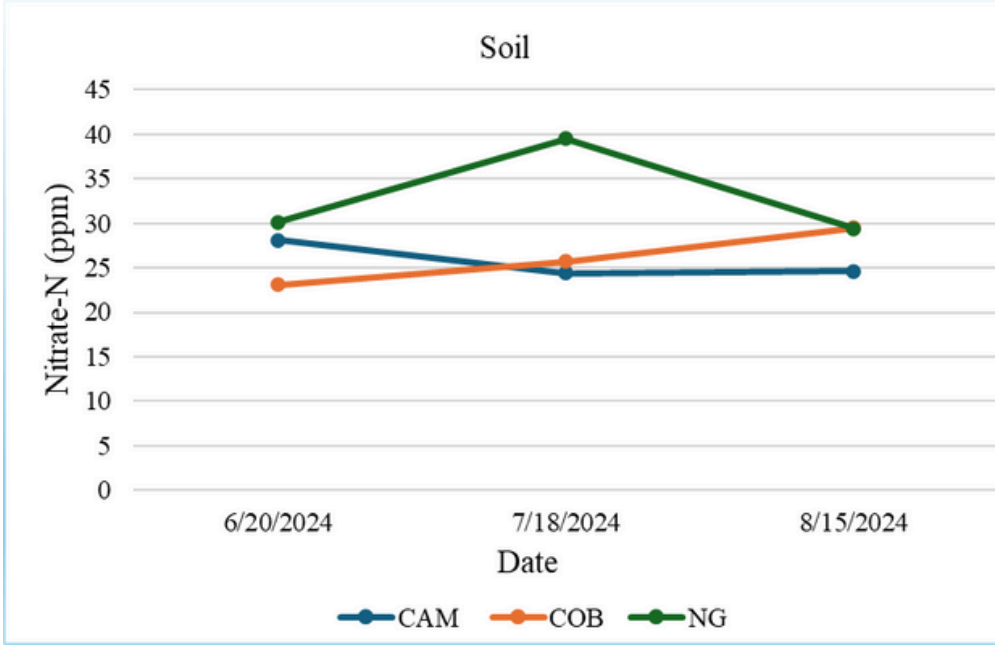

Figure 4. Differences in soil nitrate content among grafted and non-grafted watermelons from June-August 2024.

- *Canopy coverage.* Watermelon vines started to quickly grow in the beginning of the season. Immediately after the first harvest (July 10, 2024), the canopy coverage decreased, then slightly and slowly grew again, and finally steadied out towards the end of the season (Figure 2). Canopies of Camelforce and Cobalt followed a similar pattern, while canopies in non-grafted plots decreased the most, consistently having the lowest percent coverage after the beginning of August 2024.

- *Plant tissue and soil nitrate.* Overall, the dynamics of plant tissue and soil nitrate over the three measurements demonstrated different patterns of nitrogen uptake between grafted and non-grafted watermelons. The sharp decrease of plant tissue nitrate from June 20 to July 18 for both grafted and non-grafted plants indicated nitrate translocation from vegetative tissues to fruit (Figure 3). During this period, plant nitrogen uptake slowed down, leading to a slight increase or being steady in soil nitrate content. However, the sharp increase of soil nitrate in nongrafted plots indicated soil accumulation of nitrate from grower's fertigation events (Figure 4). After July 18, with continuous application of N fertilizers with the hope of vigorous vine regrowth and continued fruit production, tissue nitrate for grafted plants showed a slight increase, accompanied by an increase or being flat in soil nitrate (Figures 3 and 4). However, vines of non-grafted plants have already began senescence, leading to a decrease in tissue nitrate content. Although we did not measure nitrate leaching, it might be the reason for the sharp decrease of soil nitrate in non-grafted plots, especially when irrigation and fertilization continued to be applied to the whole field.

III. Watermelon scion variety trial updates

This project was conducted to understand the suitability of different scions when grafted onto common watermelon rootstocks. Six scions were used and grafted onto three commonly used rootstocks (Table 4). The six scions were categorized by different horticultural characteristics such as maturity, fruit size, rind pattern, and color, and were coded from SC1 to SC6 (Table 5).

- *Trial set up.* Each row was 60 feet and contained 10 triploids and 3 pollenizers. Sentinel was used as the pollenizer for this trial. All treatments were replicated three times. Grafted watermelon plants were transplanted on May 14, 2024, in a commercial field in Stockton, CA.
- *In-season field management and data collection.* Like the rootstock variety trial, our team separated the vines between each treatment row after transplanting to maintain accurate harvest data. Canopy coverage was also collected using the same approach in the other trial. This was done after transplanting and throughout the growing season as the field continued to be harvested. Canopy data did not show any major differences among all combinations. With the help of the farm crew, we made three harvests: August 5, August 12, and August 26. We counted and weighed marketable fruit from all treatment rows and transformed the data into average yield per acre (Table 6).

- *Fruit quality.* Fruits from the first harvest were tested for quality (Table 7). All quality measurements in this trial followed the same approach as the watermelon rootstock variety trial.

Table 4. List of rootstocks that were used in the 2024 watermelon scion variety trial.

Rootstock	**Type**
Camelforce (CAM)	Interspecific hybrid squash
Cobalt (COB)	Interspecific hybrid squash
Carolina Strongback (CSB)	Citron rootstock

Table 5. List of six scions that were grafted onto the rootstocks for the 2024 watermelon scion variety trial.

Scion	**Rind Type**	**Description**
SC1	Crimson Sweet	Medium to large sized, blocky shaped
SC2	Crimson Sweet	Blocky shaped fruit
SC3	Crimson Sweet	Round/oval shaped
SC4	Crimson Sweet	Uniform, large oval-shaped fruit
SC5	Allsweet	Uniform, globe-shaped
SC6	Mottle Stripe	Round/blocky shaped

- *Results.* Yield from plants grafted onto Carolina Strongback (CSB) were lower than the other two rootstocks for all scions except for SC1 and SC6 (Table 6). However, fruit number did not follow the same trend. Plants grafted onto Camelforce (CAM) produced the highest yield except for SC6 on CSB for fruit number (Table 6). Fruit quality demonstrated the differences mainly in sugar content (^{0}Brix) and fruit firmness with fruits grafted onto CSB accumulating the highest sugar content and producing the softest flesh. In summary, we made frequency tables ranking the top performers among rootstock/scion combinations for total yield (tons/acre and number/acre) and ^{0}Brix (Table 8a-c).

Table 6. Fruit yield from each harvest and total yield for the 2024 watermelon scion variety trial.

		First Harvest (August 5, 2024)			Second Harvest (August 12, 2024)			Third Harvest (August 26, 2024)			Total	
Scion	Rootstock	Avg. weight (lbs.)	No/acre	Tons/acre	Avg. weight (lbs.)	No/acre	Tons/acre	Avg. weight (lbs.)	No/acre	Tons/acre	No/acre	Tons/acre
SC1	CAM	17.1	1591	13.5	16.7	3700	31.1	17	622	5.4	5913 A**	50.0 A
	COB	17.8	1867	17.5	17	2835	23.8	14.3*	795	5.7	5498 B	47.0 B
	CSB	17.6	1418	12.6	16.6	3596	30.1	14.7*	1003	7.3	6017 A	49.9 A
SC2	CAM	21.1	1625	17.1	19.8	3562	35.2	14.1*	311	2.2	5498 A	54.6 A
	COB	19.1	1418	13.6	17.4	3216	27.8	15.0*	519	4.3	5152 AB	45.7 B
	CSB	19.4	1556	14.8	17.5	2144	18.8	12.8*	761	5	4461 B	38.6 C
SC3	CAM	13.8	3112	20.4	13.7	2766	19.4	10.3*	1037	5.3	6916 A	45.0 A
	COB	13.2	2524	16.6	13.8	2663	18.4	11.1*	311	1.8	5498 B	36.8 B
	CSB	11.5	1971	11.4	12.1	2905	17.7	9.5*	795	3.8	5671 B	32.8 B
SC4	CAM	15.1	1971	14.8	16.9	3907	33.3	12.3*	553	3.3	6432 A	51.5 A
	COB	18.2	1349	12.2	17.9	3804	34.5	15.4*	380	2.9	5533 B	49.6 A
	CSB	16.1	1591	12.6	16.6	2870	23.4	16.4*	726	5.9	5187 B	41.8 B
SC5	CAM	16.3	2974	24	16.7	2144	17.9	13.7*	657	4.3	5775 A	46.2 A
	COB	17.9	1729	15.3	16.2	3181	25.7	13.4*	519	3.5	5429 AB	44.5 AB
	CSB	15.8	1314	10.7	14.6	3181	23.2	13.0*	657	4.2	5152 B	38.0 B
SC6	CAM	19.3	1902	18.3	17.5	3250	29	13.6*	346	2.3	5498 B	49.6 A
	COB	17.5	2178	19	16.7	2697	22.4	14.5*	415	3	5290 B	44.3 B
	CSB	17.7	1867	16.3	15.7	4080	32.1	13.0*	380	2.5	6328 A	50.9 A

*Indicates the average fruit weight in the third harvest was lower than fruits from the first two harvests for the corresponding combinations.

**Figures with different letters indicate a significant difference at $P < 0.05$ compared among the three rootstocks grafted onto the same scion.

Table 7. Fruit quality for grafted and non-grafted watermelons for the 2024 watermelon scion variety trial.

Scion	Rootstock	Length (in.)	Width (in.)	Blossom rind (cm.)	Stem rind (cm.)	°Brix	Firmness (kg/cm2)
SC1	CAM	11	8.7	0.9	1.9	11.6	5.2
	COB	11.3	9	0.6	1.6	11.8	4.6
	CSB	11.1	8.8	0.7	2	12.6*	3.4*
SC2	CAM	11.7	9.1	0.9	1.3	11.7	4.8
	COB	11.6	8.6	0.6	1.4	12	4.4
	CSB	11.9	8.9	0.7	1.5	12.0*	3.8*
SC3	CAM	9.4	8.2	0.8	1.2	11.9	4.2
	COB	10.3	8.3	0.9	1.2	11.8	4.1
	CSB	8.8	8	0.8	1.6	12.2*	3.1*
SC4	CAM	11.3	8.7	1	1.8	11.4	4.5
	COB	10.9	8.4	0.9	1.4	11.9	4.5
	CSB	11.3	8.6	0.7	1.7	12.5*	3.2*
SC5	CAM	10.1	9.1	0.7	1.3	12	3.4
	COB	10	8.9	0.6	1.4	11.3	4
	CSB	10.7	9	1	1.6	12*	3.3*
SC6	CAM	10.9	9.1	0.9	1.6	12.2	4.3
	COB	10.7	8.6	0.7	1.7	12.5	3.6
	CSB	10.5	8.4	0.5	1.4	13.4*	3.3*

All the studies have already been repeated in 2025, and the results will be shared after the season is complete. More information about watermelon grafting and topics related to other crops, including a review article about the development of watermelon grafting research programs and Fusarium Stem and Vine Decline in processing tomatoes will be available soon.

Table 8a: Total yield (Tons/acre)

Scion	**CAM**	**COB**	**CSB**
SC1	1st	2nd	1st
SC2	1st	2nd	3rd
SC3	1st	2nd	3rd
SC4	1st	2nd	3rd
SC5	1st	2nd	3rd
SC6	1st	2nd	1st
Frequencies	6	0	2

Table 8b: Total yield (No./acre)

Scion	**CAM**	**COB**	**CSB**
SC1	2nd	3rd	1st
SC2	1st	2nd	3rd
SC3	1st	3rd	2nd
SC4	1st	2nd	3rd
SC5	1st	2nd	3rd
SC6	2nd	3rd	1st
Frequencies	4	0	2

Table 8c: ^{0}Brix (Sugar content)

Scion	**CAM**	**COB**	**CSB**
SC1	2nd	2nd	1st
SC2	2nd	1st	1st
SC3	2nd	2nd	1st
SC4	3rd	2nd	1st
SC5	1st	2nd	1st
SC6	2nd	2nd	1st
Frequencies	1	1	6