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MELON GRAFTING WITH MELON ROOTSTOCKS EXPERIMENT 2021

Experimental field site. This study was carried out in 2021 at Washington State University Northwestern Washington Research and Extension Center (WSU NWREC) Mount Vernon, WA (48°43'24" N, 122°39'09" W, elevation 6 m). The experimental field site is located in the Pacific Northwest, with a cool, humid summer climate, with 16 ºC average daily temperature, 11 ºC average minimum and 21 ºC average maximum temperature, and 78% average relative humidity (RH) during the growing season of mid-May through August (AgWeatherNet, 2020). The soil type is Skagit silt loam (superactive, nonacid, mesic Fluvaquentic Endoaquepts) (USDA NRCS, 2019).

Experimental trial design and plot establishment. Cantaloupe cv. Athena (Syngenta Seeds, Minneapolis, MN) was grafted onto three different melon rootstock cultivars: Magic melon, USVLF118 and USVLF17. Two additional rootstock cvs. USVLF49 and USVLF152 were received but had very low germination (< 5%) and hence were discarded from the experiment. All rootstocks were obtained from USDA Agricultural Research Service (William Patrick Wechter, Research Plant Pathologist, Charleston, South Carolina). 'Athena' nongrafted, and 'Athena' grafted onto commercial rootstocks 'Carnivor' and 'Super Shintosa' were grown in an adjacent melon grafting experiment and were included in this study for statistical comparison. All experimental methods from seeding through harvesting, number of plants per plot as well as data collection were the same for the two experiments and were carried out at the same time for all treatments. The experiments had a randomized complete block design with 3 replications and 12 plants per plot. Raised beds were covered with black soil-biodegradable plastic mulch (BDM) (17.8 µm, 1.2-m-wide; Organix Solutions, Grove, MN). Raised beds covered with black polyethylene (PE) mulch (25.4 µm, 1.2-m-wide; Filmtech, Allentown, PA) were included on the sides of the experiments as reference for all treatments. The reference bed with the USDA rootstocks included 12 plants per plot and the reference bed with the commercial rootstocks included 6 plants per plot.

Seeds were sown in the greenhouse in 72-cell trays. 'Athena' was sown on 8 Apr. while rootstock cultivars were sown on 13 Apr. so that each reached the appropriate size for grafting on the planned day of grafting; the scion cultivar had two true leaves and rootstock cultivars had one true leaf. Seedlings were grafted on 26 and 27 Apr. with the one-cotyledon method (Miles et al., 2016). The grafted plants were placed in a healing chamber maintained at 24 ºC temperature and 95–100% RH, and followed a 9-day site-specific protocol (Miles et al., 2016) that is summarized here. The healing chamber was covered with clear plastic (0.15 mm polythene; Ginegar Plastic Products, Ginegar, Israel) to maintain high RH, and then with black fabric (Contractor Landscape Fabric; American Nettings & Fabric, Ferndale, WA) to limit light penetration to the plants. A thin film of water was added to the floor of the chamber to attain 100% RH inside the chamber when it was closed. For 1 and 2 days after grafting (DAG), plants were sealed in the chamber to maintain

complete darkness. On 3 DAG, the chamber was opened (the plastic and fabric were lifted up from one long side of the chamber) for 5 min and water was added to the floor of the chamber. On 4 DAG, the chamber was opened for 15 min and the light level was increased by folding the black fabric halfway up the front side of the chamber. On 5 and 6 DAG, the chamber was opened for 45 min and 1.5 h, respectively, water was added to the floor of the chamber and the black fabric was folded up from all the sides of the chamber such that only the top remained covered with the black fabric. On 7 and 8 DAG, the chamber was opened for 4 and 6 h, respectively, water was added to the floor of the chamber, and the top of the chamber remained covered with the black fabric. On 9 DAG, plants were removed from the chamber, placed on the greenhouse bench for 5 days, and then transferred to an open-ended high tunnel for 10 days to harden off.

Fertilizer (16N–7P–13K; Wilbur-Ellis, San Francisco, CA) was applied to the center of each row at the rate of 112 $kg \cdot ha^{-1}$ of nitrogen with a 1.8 m drop-spreader (Gandy, Owatonna, MN) and the bed was formed, incorporating the fertilizer. Drip irrigation tape (T-Tape, Model 508-08-340, 0.20 mm, 20-cm emitter spacing, 4.23 $L \cdot min^{-1}$ per 100 m flowrate; Rivulis, San Diego, CA) was laid simultaneously during laying BDM and PE mulch. Raised beds were 15-20 cm high and 0.8 m wide, spaced 3 m center-to-center. Wide between-row spacing was used to keep plants separate for ease of fruit harvest and data collection. Transplant holes were made with a custom dibble in a single row on the center of the bed with 0.9 m in-row spacing. On 20 May, plants were transplanted with the graft union at least 2.5 cm above the soil line.

Data collection.

Weather data. Air temperature, RH, solar radiation, and rainfall data during the cropping season were collected from the WSU AgWeatherNet station located approximately 140 m from the experimental field plots. Soil temperature and volumetric water content were measured at 10 cm depth under the mulch and in a non-mulched area of the bed every 15 min using data loggers (Hobo Onset, Bourne, MA). Temperature and moisture probes (S-TMB-M002 and S-SMC-M005 respectively; Onset Computer, Corp., Bourne, MA) were placed in the center of each experimental BDM plot of the second replicate, in the center of a plot in one of the PE mulch reference beds, and at the end of a raised bed in a non-mulched area of one of the rows. Average soil temperature and volumetric water content were calculated for BDM plots.

Plant growth. Plant establishment was measured as the total number of live plants per plot. The number of live plants was recorded 1 week after transplanting and then once a week until the first harvest. Percent canopy cover was measured using the application Canopeo (Patrignani and Ochsner, 2015) two weeks after transplanting and then twice per month, on the 15 and 30 of each month until first fruit set. Length of the longest vine was measured from the base of the crown to the tip of the vine for the center six plants in each plot. Longest vine length was recorded two weeks after transplanting and then twice per month, on the 15 and 30 of each month till first harvest. The number of vines per plant was measured as the total number of lateral vines (vines arising from the main vine) for the center six plants in each plot. Lateral vine number was recorded four weeks after transplanting and then twice per month, on the 15 and 30 of each month till first harvest.

Fruit harvest. Melons were assessed for maturity two times per week, starting 60 days after transplanting. Fruit were harvested at three-quarters to full-slip stage. Number of days from transplanting to first harvest were recorded in each plot. For the center 10 plants in each plot, total number and weight of harvested fruit were recorded at each harvest and average fruit number per plant and average fruit weight were calculated.

Fruit quality. Three representative fruit per plot were randomly selected at each harvest and fruit length and diameter along with firmness, TSS, titratable acidity and pH were measured. A drill-press penetrometer (FDIX 10, 50 x 0.02 N; Wagner instruments, Greenwich, CT) fixed with a 6-mm cylindrical blunt-end tip was used to measure fruit firmness (reported as Newton, N). A disc of peel (skin depth) was removed from four sides of each fruit. After calibration, the plunger head was placed against the flesh in the peeled area of the fruit, steady downward pressure was applied until the plunger penetrated the fruit flesh to the depth-mark on the plunger, and the reading on penetrometer was recorded. Longitudinal slices from stem-end to calyx-end were taken from each fruit, a piece of fruit flesh was cut from the middle of the slice, the core and peel were removed, and the fruit piece was squeezed to extract the juice into a 50 mL beaker. For each sample, 2–3 drops of fruit juice were placed on the digital refractometer (MISCO, Cleveland, OH) prism plate, and the TSS (% measured as ^{o}Brix) value was recorded. The prism plate was cleaned with deionized water after each sample and wiped dry. For each sample, 10 mL of juice was placed in a titrator sampling cup for auto titration (HI922 autosampler, Hanna instruments, Smithfield, RI). The maximum titrant volume (0.1 M NaOH) was set at 25 mL and deionized water was dispensed into the sampling cup for 12 seconds. The sample was titrated until the end point of pH 8.2, and the reading was recorded. Lastly, for each fruit juice sample, 2–3 drops were placed on a pocket pH meter (PAL-pH, ATAGO CO., LTD, Tokyo, Japan) prism plate and the pH value was recorded. The prism plate was cleaned with deionized water after each sample and wiped dry.

Results.

Environmental and soil conditions. The average air temperature was 17 °C with average minimum temperature 11 °C and average maximum temperature 23 °C during the growing season (20 May through 31 Aug.) (Table 1). Average daily RH was 75%. Total precipitation and solar radiation were 59 mm and 2192 $MJ \cdot m^{-2}$, respectively. Average soil temperature and average volumetric water content at 10-cm depth were greatest under PE mulch (22 °C and 0.23 $cm^3 \cdot cm^3$, respectively), intermediate under BDM (21 °C and 0.21 $cm^3 \cdot cm^3$, respectively), and lowest in bare ground (20.3 °C and 0.19 $cm^3 \cdot cm^3$, respectively).

Plant growth. Plant establishment was about 100% for all treatments throughout the growing season (data not presented). Percent canopy cover differed due to grafting treatment ($P = 0.0003$) and increased over the growing season ($P \leq 0.0001$), and there was an interaction between grafting treatment and week after transplanting ($P \leq 0.0001$). 'Athena' grafted onto 'Carnivor' had the greatest canopy cover throughout the season (Table 2). 'Athena' grafted onto melon rootstocks had the lowest canopy cover at weeks 2 to 6 after transplanting but canopy cover was similar to commercial rootstocks at 8 weeks after transplanting. Nongrafted 'Athena' had intermediate canopy cover weeks 2 to 6 after transplanting but the lowest on week 8 after transplanting. The trend was similar in reference plots. However, canopy cover in reference plots was generally greater for all treatments throughout the growing season compared with BDM plots: 14–60%

greater at week 2, 3–78% greater at week 4, 11–46% greater at week 6, and 4–11% greater at week 8.

The length of the longest vine differed due to grafting, increased over the growing season, and there was an interaction between grafting treatment and week after transplanting ($P \leq 0.0001$ for all). 'Athena' grafted onto 'Super Shintosa' had the greatest vine length throughout the growing season while 'Athena' grafted onto melon rootstocks and nongrafted 'Athena' had the lowest (Table 3). 'Athena' grafted onto 'Carnivor' had intermediate vine length 2 weeks after transplanting and thereafter was similar to 'Athena' grafted onto 'Super Shintosa'. The trend was similar in reference plots and the length of the longest vine was comparable for all treatments between BDM and reference plots at all weeks. At week 10, vine length was greater by 3–18% in nongrafted 'Athena' and grafted 'Athena' onto 'Super Shintosa', 'USVLF17', and 'USVLF118' in reference plot.

The number of lateral vines differed due to both grafting treatment ($P = 0.0001$) and week after transplanting ($P \leq 0.0001$), and there was an interaction between grafting treatment and week after transplanting ($P = 0.0085$). 'Athena' grafted onto 'Carnivor' and 'Super Shintosa' tended to have the greatest number of lateral vines throughout the growing season while 'Athena' grafted onto melon rootstocks tended to have the lowest (Table 4). 'Athena' grafted onto 'USVLF118' had numerically fewer vines than all other treatments on three of the four measurement dates. At week 10, there was no significant difference in lateral vine numbers among treatments (5.6 on average). Lateral vine number were comparable for all treatments between BDM and reference plots at all weeks.

Fruit harvest. First fruit harvest was 87 days on average and did not differ due to grafting treatment ($P = 0.18$) but there was a difference in average number of fruit, average fruit weight, fruit length and diameter due to grafting ($P \leq 0.0001$ for all) (Table 5). Number of fruit and average weight per fruit were significantly greater for 'Athena' grafted onto 'Super Shintosa' and 'Carnivor' (8.2 per plant and 1.7 kg, respectively), intermediate for nongrafted 'Athena' (6.6 per plant and 1.25 kg, respectively), and lowest for 'Athena' grafted onto melon rootstocks (4.7 per plant and 1.0 kg, respectively). 'Athena' grafted onto 'Super Shintosa' and 'Carnivor' also had significantly greater fruit length and diameter (16.3 cm and 14.8 cm, respectively). There was no significant difference in fruit length between nongrafted 'Athena' and 'Athena' grafted onto melon rootstocks (14.3 cm on average) but fruit diameter was lower for 'Athena' grafted onto melon rootstocks (average 12.4 cm) than nongrafted 'Athena' (13.5 cm). In reference plots, first fruit harvest was earlier for nongrafted 'Athena' and 'Athena' grafted onto 'Carnivor' and 'USVLF118' by 1–6 days compared to BDM plots. Number of fruit per plant was greater by 2–69% in BDM plots compared to reference plots for all treatments. Average weight per fruit was 9–27% greater, and fruit length was 3–8% greater in reference plots compared to BDM plots for 'Athena' grafted onto melon rootstocks while they were similar for nongrafted 'Athena' and 'Athena' grafted onto 'Super Shintosa' and 'Carnivor'. Fruit diameter was 7% greater for 'Athena' grafted onto 'USVLF118' in reference plots compared to BDM plots.

Fruit quality. Fruit firmness and TA differed due to grafting ($P = 0.03$ for both), but there was no difference in TSS or pH due to grafting ($P = 0.07$ and $P = 0.40$, respectively) (Table 6). 'Athena' grafted onto 'Super Shintosa' and 'Carnivor' had the greatest fruit firmness (37 N) while 'Athena'

grafted onto ‘USVLF118’ had the lowest (21.6 N). Fruit firmness of ‘Athena’ grafted onto ‘Magic melon’ and ‘USVLF17’ (28.2 N on average) was similar to all other treatments. Average TSS for all treatments was 12.4% and average pH was 6.35. ‘Athena’ grafted onto ‘Carnivor’ had the greatest TA while ‘Athena’ grafted onto ‘USVLF118’ and ‘Magic melon’ had the lowest, and all other treatments were intermediate. Fruit firmness was 3–8% greater for ‘Athena’ grafted onto melon rootstocks in reference plots compared to BDM plots while TA was 6–9% greater in nongrafted ‘Athena’ and ‘Athena’ grafted onto ‘Super Shintosa’. TSS and pH were comparable between reference and BDM plots for all treatments.

Table 1. Environmental and soil conditions during the growing season at Mount Vernon, WA, in 2021.

Environmental parameters[z]	2021[y]		
Average daily air temperature (°C)	17		
Average daily max air temperature (°C)	23		
Average daily min air temperature (°C)	11		
Total solar radiation ($MJ \cdot m^{-2}$)	2192		
Relative humidity (%)	75		
Total rainfall (mm)	59		
	Non-mulched[x]	BDM[w]	PE
Soil temperature (°C)[v]	20.3	21	22
Volumetric water content ($cm^3 \cdot cm^3$)[v]	0.19	0.21	0.23

[z]Data from Washington State University Ag WeatherNet Station located 140 m from the field site.
[y]Growing season was 20 May to 31 Aug. 2021.
[x]Soil temperature and volumetric water content were measured at the end of a raised bed in a non-mulched area.
[w]BDM was black soil-biodegradable plastic mulch (17.8 µm; Organix Solutions, Grove, MN) and PE was polyethylene mulch (25.4 µm; Filmtech, Allentown, PA).
[v]Measured every 15 min at 10 cm depth with data loggers (Hobo Onset, Bourne, MA) in the center of each experimental BDM plot of the second replicate, in the center of a plot in one of the PE mulch reference beds, and at the end of a raised bed in a non-mulched area of one of the rows. Soil temperature and volumetric water content under the BDM is the average of all BDM plots.

Table 2. Canopy cover (%) of cantaloupe cv. Athena nongrafted and grafted onto five rootstock cvs. Super Shintosa, Carnivor, Magic melon, USVLF17, USVLF118 grown with black soil-biodegradable plastic mulch (BDM) and measured every two weeks from 20 May to 15 July at Mount Vernon, WA, in 2021.

Treatment[z]	Canopy cover (%)			
	2 WAT[y,x]	4 WAT	6 WAT	8 WAT[x]
Athena	1.1 ab[w]	3.0 bc	41.3 bc	60.1 c
A/Super Shintosa	1.5 a	4.7 ab	50.1 ab	70.9 b
A/Carnivor	1.4 a	5.5 a	63.4 a	84.2 a
A/Magic Melon	0.7 bc	2.1 c	40.1 bc	80.4 ab
A/USVLF17	0.7 bc	1.7 c	30.6 c	78.9 ab
A/USVLF118	0.5 c	1.5 c	28.9 c	78.1 ab
P-value	0.0001	0.0006	0.001	0.0001
Reference plots[v]				
Athena	1.1	3.1	47.1	66.5
A/Super Shintosa	1.5	6.9	49.0	74.7
A/Carnivor	2.0	9.8	72.1	87.6
A/Magic Melon	1.0	2.1	45.8	84.4
A/USVLF17	0.8	1.4	33.8	84.2
A/USVLF118	0.8	2.2	42.3	83.0

[z]All grafted plants had cantaloupe cv. Athena (A) as the scion and are denoted as scion/rootstock.
[y]WAT denotes week after transplanting.
[x]Data was log-transformed to meet the assumptions of normality.
[w]All means presented are non-transformed. Means followed by the same letter in the same column are not significantly different at $P < 0.05$; means were discriminated using Tukey's honestly significant difference.
[v]Reference plots covered with PE mulch were included on the sides of the experiments for all treatments. The reference plots with the USDA rootstocks included 12 plants per plot and the reference plot with the commercial rootstocks included 6 plants per plot.

Table 3. Longest vine length (cm) of cantaloupe cv. Athena nongrafted and grafted onto five rootstock cvs. Super Shintosa, Carnivor, Magic melon, USVLF17, USVLF118 grown with black soil-biodegradable plastic mulch (BDM) and measured every two weeks from 20 May to 31 July at Mount Vernon, WA, in 2021.

Treatment[z]	Longest vine length (cm)				
	2 WAT[y]	4 WAT	6 WAT	8 WAT	10 WAT[x]
Athena	12.4 c[w]	17.9 b	67.4 abc	149.0 ab	170.0 b
A/Super Shintosa	20.9 a	32.8 a	81.6 ab	167.0 a	211.0 a
A/Carnivor	16.2 b	26.9 a	84.9 a	171.0 a	215.0 a
A/Magic Melon	9.6 c	13.5 b	59.1 bc	126.0 b	144.0 b
A/USVLF17	10.8 c	13.9 b	54.2 c	124.0 b	146.0 b
A/USVLF118	11.3 c	13.6 b	50.2 c	122.0 b	144.0 b
P-value	< 0.0001	< 0.0001	0.002	0.0003	< 0.0001
Reference plots[v]					
Athena	11.9	18.5	74.2	137.7	175.7
A/Super Shintosa	20.4	39.2	77.5	155.3	231.0
A/Carnivor	14.8	28.8	92.2	188.1	214.8
A/Magic Melon	11.0	15.3	69.0	122.5	140.0
A/USVLF17	10.8	13.7	53.3	123.5	158.0
A/USVLF118	10.6	14.3	73.3	150.0	169.3

[z]All grafted plants had cantaloupe cv. Athena (A) as the scion and are denoted as scion/rootstock.
[y]WAT denotes week after transplanting
[x]Data was log-transformed to meet the assumptions of normality.
[w]All means presented are non-transformed. Means followed by the same letter in the same column are not significantly different at $P < 0.05$; means were discriminated using Tukey's honestly significant difference.
[v]Reference plots covered with PE mulch were included on the sides of the experiments for all treatments. The reference plots with the USDA rootstocks included 12 plants per plot and the reference plot with the commercial rootstocks included 6 plants per plot.

Table 4. Lateral vine numbers of cantaloupe cv. Athena nongrafted and grafted onto five rootstock cvs. Super Shintosa, Carnivor, Magic melon, USVLF17, USVLF118 grown with black soil-biodegradable plastic mulch (BDM) and measured every two weeks from 20 May to 31 July at Mount Vernon, WA, in 2021.

Treatment[z]	Lateral vine number			
	4 WAT[y]	6 WAT	8 WAT	10 WAT
Athena	2.4 bc[x]	4.7 bc	5.6 ab	5.6
A/Super Shintosa	4.2 a	5.3 ab	5.7 ab	5.7
A/Carnivor	3.7 ab	6.0 a	6.2 a	6.2
A/Magic Melon	1.6 c	4.9 bc	5.3 ab	5.7
A/USVLF17	1.8 c	4.3 c	5.2 ab	5.2
A/USVLF118	1.5 c	4.4 bc	5.1 b	5.1
P-value	0.0007	0.0007	0.05	0.17
Reference plots[w]				
Athena	1.8	5.0	5.7	5.7
A/Super Shintosa	4.7	5.3	5.7	5.7
A/Carnivor	4.3	6.0	6.2	6.2
A/Magic Melon	1.8	5.0	5.2	5.2
A/USVLF17	1.5	4.3	5.2	5.2
A/USVLF118	1.5	5.7	5.8	5.8

[z]All grafted plants had cantaloupe cv. Athena (A) as the scion and are denoted as scion/rootstock.
[y]WAT denotes week after transplanting.
[x]All means presented are non-transformed. Means followed by the same letter in the same column are not significantly different at $P \leq 0.05$; means were discriminated using Tukey's honestly significant difference.
[w]Reference plots covered with PE mulch were included on the sides of the experiments for all treatments. The reference plots with the USDA rootstocks included 12 plants per plot and the reference plot with the commercial rootstocks included 6 plants per plot.

Table 5. Days to first harvest, average number of fruit and weight per fruit (kilograms) per plant, and fruit length and diameter (cm) of cantaloupe cv. Athena nongrafted and grafted onto five rootstock cvs. Super Shintosa, Carnivor, Magic melon, USVLF17, USVLF118 grown with black soil-biodegradable plastic mulch (BDM) at Mount Vernon, WA, in 2021.

Treatment[z]	Days to first harvest[y]	No. of fruit	Wt. per fruit (kg)	Fruit length (cm)	Fruit diameter (cm)
Athena	86.7	6.6 bc[x]	1.3 b	14.5 b	13.5 b
A/Super Shintosa	89.0	7.4 ab	1.6 a	16.2 a	14.6 a
A/Carnivor	89.7	8.9 a	1.8 a	16.4 a	14.9 a
A/Magic Melon	84.0	5.1 cd	1.1 c	14.2 b	12.7 c
A/USVLF17	85.7	4.9 cd	1.0 c	13.8 b	12.3 c
A/USVLF118	89.0	4.2 d	1.1 c	14.5 b	12.3 c
P-value	0.18	0.0001	< 0.0001	< 0.0001	< 0.0001
Reference plots[w]					
Athena	85.5	3.9	1.2	14.5	13.2
A/Super Shintosa	91.0	6.0	1.6	16.1	14.3
A/Carnivor	85.5	8.7	1.7	15.9	14.9
A/Magic Melon	89.0	4.3	1.2	14.6	12.3
A/USVLF17	89.0	4.4	1.1	14.6	12.3
A/USVLF118	84.0	3.6	1.4	15.6	13.1

[z]All grafted plants had cantaloupe cv. Athena (A) as the scion and are denoted as scion/rootstock.
[y]Data was analyzed using Kruskal Wallis test as no transformation satisfied the assumptions of normality.
[x]Means followed by the same letter in the same column are not significantly different at $P < 0.05$; means were discriminated using Tukey's honestly significant difference.

[w]Reference plots covered with PE mulch were included on the sides of the experiments for all treatments. The reference plots with the USDA rootstocks included 12 plants per plot and the reference plot with the commercial rootstocks included 6 plants per plot.

Table 6. Fruit firmness (Newton, N), total soluble solids (TSS, %), titratable acidity (gL^{-1}), and pH of cantaloupe cv. Athena nongrafted and grafted onto five rootstock cvs. Super Shintosa, Carnivor, Magic melon, USVLF17, USVLF118 grown with black soil-biodegradable plastic mulch (BDM) at Mount Vernon, WA, in 2021.

Treatment[z]	Fruit firmness (N)	TSS (%)	TA (gL^{-1})	pH
Athena	30.9 ab[y]	13.0	0.78 ab	6.34
A/Super Shintosa	37.0 a	13.2	0.79 ab	6.31
A/Carnivor	36.9 a	13.1	0.82 a	6.33
A/Magic Melon	26.2 ab	11.8	0.68 b	6.34
A/USVLF17	27.5 ab	10.8	0.69 ab	6.35
A/USVLF118	21.6 b	12.2	0.67 b	6.41
P-value	0.03	0.07	0.03	0.40
Reference plots[x]				
Athena	30.9	12.5	0.85	6.35
A/Super Shintosa	34.7	12.4	0.84	6.29
A/Carnivor	34.5	12.9	0.72	6.28
A/Magic Melon	27.8	10.9	0.61	6.45
A/USVLF17	28.2	11.0	0.60	6.45
A/USVLF118	23.4	12.7	0.66	6.43

[z]All grafted plants had cantaloupe cv. Athena (A) as the scion and are denoted as scion/rootstock.
[y]Means followed by the same letter in the same column are not significantly different at $P < 0.05$; means were discriminated using Tukey's honestly significant difference.
[x]Reference plots covered with PE mulch were included on the sides of the experiments for all treatments. The reference plots with the USDA rootstocks included 12 plants per plot and the reference plot with the commercial rootstocks included 6 plants per plot.

Melon rootstock (left) and ‘Athena’ (right) ready for grafting.

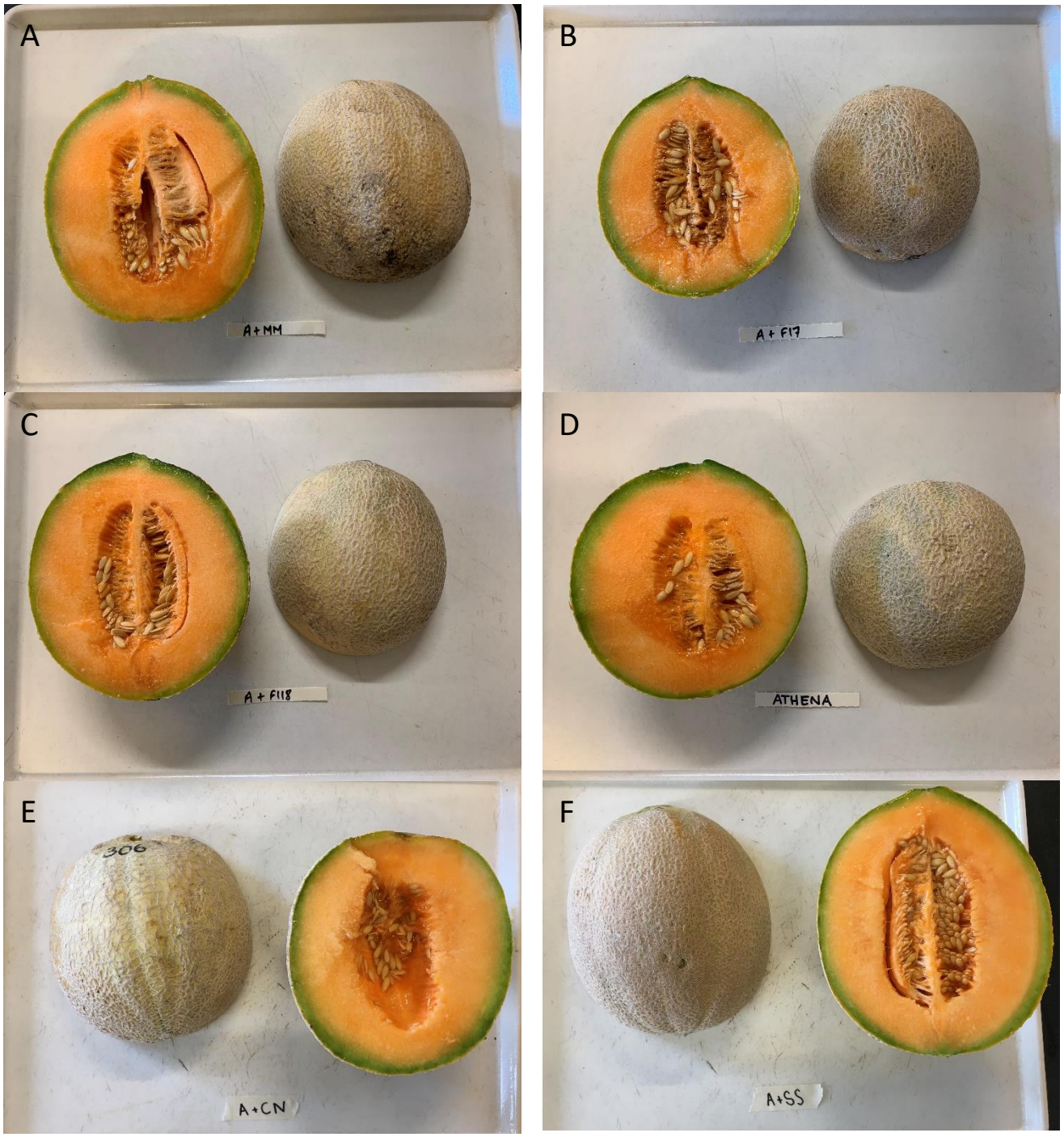
Grafted plants ready to go into the healing chamber.

Healing chambers with grafted plants inside.

Grafted plants exposed to light during the healing process.

Transplanted grafted plants on 20 May 2021.

Experimental site at WSU NWREC on 15 July 2021.



Cantaloupe cultivars (scion/rootstock) ‘Athena/Magic Melon’ (A), ‘Athena/F17’ (B), ‘Athena/F118’ (C), nongrafted ‘Athena’ (D), ‘Athena/Carnivor’ (E), ‘Athena/Super Shintosa’ (F).

Fruit length measurement.

Fruit samples during quality assessment.