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Melon Survival, Yield and Quality in Nevada's High Desert Climate

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Introduction

Nevada's climate

Nevada is the driest state in the U.S. (Nevada State Climate Office, n.d.), with average annual precipitation of 10.3 inches statewide and a range of 7.1 inches to 12.85 inches across the state. The growing season for warm-season crops in the state ranges from less than 90 days up to 180 days (Kratsch et al., 2010), with an average for most growers at about 120 days (Bristow et al., 2021). High fluctuation between day and night temperatures are characteristic of our high desert climate, and relative humidity as low as 10% at midday in summer causes vapor pressure deficits to rise well above the acceptable range for many crops (Heckler et al., 2020). This leads to high crop transpiration demand and a need to attend to proper irrigation and mulching practices. In fact, weather is considered the most important factor limiting crop yields in Nevada (Kratsch et al., 2023)

What do we grow?

In terms of crop production volume, the main crops grown in Nevada are alfalfa, onion and garlic, but specialty crop production of leafy greens, tomatoes, peppers, squashes and cantaloupes, in particular, is increasing due to high demand for local produce in urban areas (Kratsch et al., 2023). In response, an increasing number of peri-urban farms are popping up that grow a high diversity of crops, up to 17 crops per farm (Kratsch et al., 2023). Farms with less than 10 acres comprise 23% of the total number of farms in the state (Nevada Department of Agriculture, 2021).

Who grows melons?

Specialty crop farmers who supply local markets grow cantaloupe and honeydew melons. In fact, there is a history of a cantaloupe industry in Nevada as early as the 1920s (Fallon Cantaloupe Festival, n.d.). Nevada's high-altitude climate favors cantaloupe with high fruit quality. More farmers are interested in growing melons, but they indicate a need for assistance with trials and selection of melon varieties suitable for Nevada's climate (Kratsch et al., 2023).

Objectives of this study

- To learn which melon varieties do well in Nevada's dry, short-season climate by performing variety trials that evaluate flowering time and melon yield parameters.

- To evaluate the quality of melon varieties by measuring total soluble solids at the time of harvest.
- To observe factors that limit yield by monitoring for pests and disease problems.

Materials and Methods

Melon (honeydew and cantaloupe) variety trials were conducted at the Desert Farming Initiative (DFI) at the Experiment Station's Valley Road Field Lab of the University of Nevada, Reno over a period of three years: 2020, 2021 and 2022. In 2020, we screened 12 varieties for suitability to our climate and narrowed the list to the top six varieties (three honeydew and three cantaloupe) for further evaluation in 2021 and 2022 (Table 1).

Table 1. Melon (honeydew and cantaloupe) varieties evaluated at the University's Desert Farming Initiative in 2020, 2021 and 2022.

2020	2021	2022
1. Dream Dew (H)	Dream Dew (H)	Dream Dew (H)
2. Santa Fe (H)	Santa Fe (H)	Santa Fe (H)
3. Honey Pac (H)	Honey Pac (H)	Honey Pac (H)
4. Honey White (H)		
5. Infinite Gold (C)		
6. Athena F1 (C)	Athena F1 (C)	Athena F1 (C)
7. Sarah's Choice (C)	Sarah's Choice (C)	Sarah's Choice (C)
8. Iperione (C)		
9. Melidor (Galia hybrid) (C)		
10. Caribbean JackPot RZ F1 (C)		
11. Karameza F1 (C)	Karameza F1 (C)	Karameza F1 (C)
12. Zapaca Gold (C)		

Note: H = Honeydew variety; C = Cantaloupe variety.

In 2021 and 2022, seeds were started in containers in the greenhouse, and seedlings were transplanted to field plots in early June, after risk of frost. The experiments were arranged in a randomized complete block design with four replications. An experimental unit for each of the six varieties consisted of 20 plants [6 varieties X 20 plants X 4 replications = 480 total plants]. The soil type is a sandy loam (69% sand, 18% silt, 13% clay), and elevation is 4,567 feet.

Seedlings were planted in 20-foot rows with 2-foot in-row spacing. Buffer rows of melons were planted to the north and south ends of the bed, with 20 feet of buffer plants at the ends of each row. Data was not collected on buffer plants. Field plots were managed using organic production standards. Plants were fertilized with a liquid fish fertilizer (3-3-.3; Organic Gem ®, Advanced Marine Technologies, New Bedford, MA) by way of fertigation through drip lines approximately every two weeks. Drip tape with 8-inch emitter spacing was used to irrigate plants on a three-day-per-week schedule, for a total of 8.4 inches of water applied over the season. Weekly overnight irrigation was used to supplement this schedule and bring fields back up to field capacity to prevent plant water stress. Plants were grown under plastic mulch in 2021 and either plastic or paper mulch in 2022. Due to problems with *Fusarium* species infestation of plants in the 2020 trials, seedlings were sprayed around the rooting zone with a fungicide (Serenade® ASO Biological Fungicide, Bayer Crop Science, Pittsburgh, PA).

Measurements of total soluble solids (sugars) in fruit were made two to three days after harvest by measuring °Brix values. Four fruits of each variety per replication were collected for measurement. Cubes (1-inch square) were cut from midway between the center and the rind, along the equatorial center of the melon. Brix° was measured by squeezing the melon juice directly onto the measuring prism of a RHB-32ATC Brix refractometer. The measuring prism was cleaned between each reading.

Monitoring for insect pests was conducted weekly in the morning on the same day of the week. Counting on leaves and stems was the sampling method used. Observations were made using a 10x magnifying hand lens when necessary.

Statistical analysis was performed using a two-way analysis of variance for randomized complete block design, with post hoc tests for significance using pairwise comparison t-tests. Analyses were completed using RStudio 4.1.2 version (R Core Team, 2021) and the following packages: lmerTest (Kuznetsova et al., 2017), ggplot2 (Wickham, 2016) and Rstax (Kassambara, 2021).

Results and Discussion

The melon varieties selected for the initial screening trials in 2020 were those used previously in Nevada and surrounding states or were recommended by local growers. The overall melon yield and plant survival in 2020 were variable due to high pressure from disease (*Fusarium* species) (Table 2). Plant survival ranged from 81% (Athena F1; cantaloupe) to 28% (Honey White; honeydew). Average fruit yield ranged from 3.0 fruits per plant (Karameza F1; cantaloupe) to 0.65 fruits per plant (Caribbean JackPot RZ F1; cantaloupe).

Variety selection

The three honeydew varieties selected for further evaluation exhibited the highest plant survival rates (Honey Pac, 69%; Dream Dew, 61%; Santa Fe, 47%) and the greatest per-plant fruit yield (Dream Dew, 2.7 fruits per plant; Santa Fe, 2.4 fruits per plant; Honey Pac, 1.7 fruits per plant) (Table 2).

The cantaloupe varieties Athena F1 and Sarah's Choice were selected for their high plant survival rates (81% and 78%, respectively) and their reasonable per-plant fruit yields (1.3 fruits per plant and 1.2 fruits per plant, respectively) (Table 2). The cantaloupe variety Karameza F1 was selected because of its exceptional (among cantaloupe varieties) per-plant fruit yield (3.0 fruits per plant) and its reasonable plant survival rate (61%).

Table 2. Plant survival and average fruit yield of melon (honeydew and cantaloupe) varieties evaluated at the University's Desert Farming Initiative from June – September 2020. The six varieties selected for further evaluation are indicated by an asterisk. Data shows mean ± standard error.

Variety	Plant survival at first harvest (%)	Significant difference	Number of fruits per plant	Significant difference
1. Dream Dew (H)*	61 ± 13	abcd	2.7 ± 0.85	abcde
2. Santa Fe (H)*	47 ± 12	bcd	2.4 ± 0.36	abc
3. Honey Pac (H)*	69 ± 12	ab	1.7 ± 0.25	ab
4. Honey White (H)	28 ± 8	d	1.0 ± 0.36	cde
5. Infinite Gold (C)	53 ± 9	abcd	1.9 ± 0.29	abc
6. Athena F1 (C)*	81 ± 8	a	1.3 ± 0.18	abcd
7. Sarah's Choice (C)*	78 ± 7	ab	1.2 ± 0.12	d
8. Iperione (C)	69 ± 10	abc	0.69 ± 0.12	e
9. Melidor (Galia hybrid) (C)	42m ± 12	cd	1.1 ± 0.37	bcde

10. Caribbean JackPot RZ F1 (C)	39 ± 15	bcd	0.65 ± 0.24	e
11. Karameza F1 (C)*	61 ± 14	abc	3.0 ± 0.61	a
12. Zapaca Gold (C)	47± 12	bcd	1.3 ± 0.31	abcd

Note: H = Honeydew variety; C = Cantaloupe variety; varieties in the same column that have the same letter(s) after the mean are not significantly different for that parameter at P<0.05.

Evaluation of selected varieties

Plant survival of the six varieties evaluated in 2021 and 2022 was similar across varieties, with cantaloupes showing a slight advantage over honeydew varieties (Table 3). Plant survival ranged from 67% (Sarah's Choice cantaloupe) to 40% (Santa Fe honeydew).

Cantaloupes flowered earlier in our climate than did honeydews (Table 3). This is an important factor in areas with a short growing season and gives cantaloupes an advantage over honeydews in increased time to produce fruits before first frost occurs. Days to flowering ranged from 25 to 31. The cantaloupe varieties Sarah's Choice and Athena F1 were the first to exhibit female flowers (25 and 26 days after transplant, respectively).

Table 3. Plant survival and days after transplant to first female flower of melon (honeydew and cantaloupe) varieties evaluated at the University's Desert Farming Initiative from June – September 2021 and 2022. Data is combined for both years and shows mean ± standard error.

Variety	Plant survival at first harvest (%)	Significant difference	Days after transplant to first female flower	Significant difference
1. Dream Dew (H)	48 ± 7.2	bc	31 ±1.3	a
2. Santa Fe (H)	40 ± 6.8	c	30 ± 1.6	a
3. Honey Pac (H)	49 ± 8.6	bc	31 ±1.8	a
6. Athena F1 (C)	55 ± 6.9	bc	26 ± 1.4	b
7. Sarah's Choice (C)	67 ± 5.0	a	25 ± 1.2	b
11. Karameza F1 (C)	59 ± 8.2	ab	29 ± 1.2	a

Note: H = Honeydew variety; C = Cantaloupe variety; varieties in the same column that have the same letter(s) after the mean are not significantly different for that parameter at P<0.05.

The average number of fruits produced per plant was consistent among varieties, with the exception of the cantaloupe variety Athena F1, which produced an average of 1.8 fruits per plant (Table 4). This is in comparison to the other five melon varieties, which produced an average of 1.0 to 1.1 fruits per plant. Overall, the number of fruits per plant were low, likely due to water stress and lower nutrient availability. Yet, this shows that under stress conditions the performance of the varieties was similar in relation to fruit load, with the exception of Athena F1.

Honeydew melons produced larger fruits than cantaloupes (Table 4). Honeydew varieties produced fruits weighing an average of 4.6 lbs. (Honey Pac) to 3.5 lbs. (Dream Dew). The average fruit weight of cantaloupe varieties ranged from 2.5 lbs. (Athena F1) to 2.2 lbs. (Sarah's Choice).

Table 4. Average per-plant fruit yield and fruit weight of melon (honeydew and cantaloupe) varieties evaluated at the UNR Desert Farming Initiative from June – September 2021 and 2022. Data is combined for both years and shows mean ± standard error.

Variety	Number of fruits per plant	Significant difference	Average fruit weight (lbs.)	Significant difference
1. Dream Dew (H)	1.1 ± 0.24	b	3.5 ± 0.46	bc
2. Santa Fe (H)	1.0 ± 0.16	b	3.9 ± 0.33	ab

3. Honey Pac (H)	1.1 ± 0.23	b	4.6 ± 0.36	a
6. Athena F1 (C)	1.8 ± 0.22	a	2.5 ± 0.25	cd
7. Sarah's Choice (C)	1.1 ± 0.20	b	2.2 ± 0.23	d
11. Karameza F1 (C)	1.1 ± 0.2b	b	2.3 ± 0.27	cd

Note: H = Honeydew variety; C = Cantaloupe variety; varieties in the same column that have the same letter(s) after the mean are not significantly different for that parameter at P<0.05.

Most varieties had similar overall yield (Table 5). Athena F1 (cantaloupe) and Honey Pac (honeydew) were the highest yielding varieties at 9333 lbs. of fruit per acre and 7929 lbs. of fruit per acre, respectively. The lowest yielding variety was Santa Fe (honeydew), with 5207 lbs. of fruit per acre.

Total soluble solids content was similar among melon varieties (Table 5). Karameza cantaloupe variety had the highest total soluble solids content of all melon varieties, with an average °Brix value of 13.2. The total soluble solids content of Santa Fe honeydew variety was similarly high at a °Brix of 12.3.

°Brix is commonly used as an indicator of crop quality, since °Brix measurements indicate soluble solids content and represent potential sweetness of the fruit (Kleinhenz and Bumgarner, 2013). Evaluation of fruit quality requires knowledge of the range of values typically expected of quality fruits for the crop of interest. According to USDA crop grading standards, melon fruits with °Brix values of at least 9 to 11 are considered to have good to very good internal quality (USDA Agricultural Marketing Service, n.d.).

Many factors directly influence the soluble solids contents of fruit, including variety selection, crop maturity at harvest, and cultural management factors such as irrigation timing (Kleinhenz and Bumgarner, 2013). Reduced water availability during fruit development can increase the soluble solids contents (sweetness) of fruit. However, reduced water availability may also lower fruit yield, so growers must design an irrigation strategy that supports high fruit quality while maintaining acceptable fruit yields. Because of minimal precipitation during the growing season, Nevada's high desert climate provides a unique opportunity to precisely control water availability during melon production in a way that can maximize both fruit quality and fruit yields.

Table 5. Total fruit yield of melon (honeydew and cantaloupe) varieties evaluated at the University's Desert Farming Initiative from June – September 2021 and 2022. Total soluble solids content was measured only in melons from the 2022 trial. Data is combined for both years and shows mean ± standard error.

Variety	Total fruit yield (lbs./acre)	Significant difference	Total soluble solids (°Brix)	Significant difference
1. Dream Dew (H)	7,279 ± 1,313	ab	11.7 ± 0.30	b
2. Santa Fe (H)	5,207 ± 859	b	12.3 ± 0.51	ab
3. Honey Pac (H)	7,928 ± 1,353	a	11.8 ± 0.43	b
6. Athena F1 (C)	9,333 ± 1,152	a	11.8 ± 0.24	b
7. Sarah's Choice (C)	6,168 ± 788	ab	11.7 ± 0.36	b
11. Karameza F1 (C)	6,789 ± 1,082	ab	13.2 ± 0.35	a

Note: H = Honeydew variety; C = Cantaloupe variety; varieties in the same column that have the same letter(s) after the mean are not significantly different for that parameter at P<0.05. °Brix indicates the proportion of dissolved solids (sugars) in a given amount of liquid. One-degree Brix is equivalent to 1 gram of sucrose in 100 grams of solution (i.e., 1 °Brix = 1% sugar) (Jaywant et al., 2022).

Insect pest pressure

Most insect pests of melons feed on many types of plants and migrate into melons from surrounding crops and weed hosts (Palumbo and Kerns, 1998). We found false chinch bugs, leafhoppers and squash bugs in the greatest numbers over the course of the growing season. Average false chinch bug, leafhopper and squash bug densities (number of adults /10 plants /week) were 20.0, 10.4 and 5.6, respectively. No correlation was found between insect density and melon variety. No damage to plants was found that could be attributed to insect infestation. Although not counted, large numbers of beneficial insects, including spiders and ladybird beetles, were also present and may have kept insect pests under control.

Conclusions

Three honeydew varieties (Dream Dew, Santa Fe, Honey Pac) and three cantaloupe varieties (Athena F1, Sarah's Choice, Karameza F1) were selected for further evaluation for their superior survival and yield from an initial trial of 12 melon varieties.

The six selected varieties exhibited similar survival, yield and fruit quality traits, but some varieties were distinctive for particular traits:

- Cantaloupe varieties showed a slight advantage over honeydew varieties for plant survival in northern Nevada's high desert climate. Cantaloupe varieties also flowered earlier, allowing more time for fruit development.
- Honeydew varieties produced larger fruits than cantaloupe varieties.
- Athena F1 cantaloupe produced the most fruits per plant and, along with Honey Pac honeydew, was strong in total fruit yield.
- Karameza F1 cantaloupe exhibited the highest soluble solids content (sweetness), although Santa Fe honeydew was a close second.

Growers must weigh a number of factors when selecting melon cultivars for production. Climate is a critical determinant in northern Nevada, where high evaporative demand, low precipitation, wide fluctuation between day and night temperatures, and a short growing season can affect plant survival and fruit yield and quality. But, other factors may influence a grower's choice. Public demand for one variety over another or for a particular melon trait is a consideration. In terms of fruit quality, soluble solids (sweetness) is only one of a number of factors to consider, including fruit appearance, texture and flavor. A grower's cropping pattern, including size of operation, number of crop types grown and production method (organic versus conventional) influences the suitability of a melon variety for a grower. Susceptibility of a variety to insects or disease and the grower's target market (local versus national/international) may also play a role.

Through a series of variety trials, we have identified six melon varieties for consideration by growers in Nevada's high desert climate. No one variety stood out as clearly superior, but all have merit, depending on the unique needs of each grower.

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