

Radish Varieties for Summer Production

In a Nutshell:

- Heat decreases radish marketable harvest yield and quality, causing plants to bolt, roots to get woody, and flavor to get sharp and bitter.
- Carmen & Maja Black and Terry Troxel tested 7 varieties of radishes for their heat tolerance, investigating whether they could be planted as summer radishes to meet summer demand for fresh local vegetables.

Key Findings:

- Troxel, who harvested throughout the summer, found that high August temperatures drove down yields due to bolting.
- Daikon stood out for Troxel as heat-tolerant and high yielding.
- The Blacks had the highest yields from Donato.

BACKGROUND

Heat tolerance has been the subject of previous PFI trials for broccoli, head lettuce, and cabbage [1], [2], [3]. This year the focus was on radishes, as Iowa farmers aim to establish optimal practices to grow local produce throughout the summer.

Radishes grow well in cooler conditions. Heat and drought conditions rob the swollen taproot of the moisture which makes it juicy and tender. Heat stress also triggers bolting in radishes, when the plant shifts life-strategy paths, supporting flowers and going to seed. This reduces the amount of energy that the plant stores in the root, again reducing the quality of taproot [4].

Cooperators trialed several different strains of radishes to see which would best handle the summer heat. Troxel hoped to add diversity to her cropping system and CSA lineup. Carmen Black cited seed companies' focus on coastal production areas as a reason for suboptimal applicability and accuracy of advice, prescribed practices, and varietal traits. Conducting this study in Iowa, she hoped to identify varieties that would perform well in the local conditions.

There are several possible criteria that can be used to evaluate the radish varieties. These include:

- Taste — this can range from mild to peppery; hot growing conditions tend to lead to more 'hot', peppery, bitter, radishes
- Radish appearance — the ideal is blemish-free and regularly shaped spheres, with vibrant exterior colors and white flesh
- Field hold — radishes with a wider window before they start to get woody or mealy make it easier to have a more marketable harvest

Cooperators

Carmen and Maja Black, Sundog
Farm – Solon, IA

Terry Troxel, Iowana Farm – Crescent,
IA

Funding

IDALS

Ceres Trust



Radishes harvested, washed, and ready for bunching for sale. Photo taken at Blacks' farm, July 2024.

- Even maturation and harvest — reduces the work of managing readiness within the plot and the risk of missing the harvest window for part of the crop
- Stem strength — this is important for ‘bunching’ the radishes for sale and distribution
- Heat tolerance — as noted above, heat negatively affects several of these criteria. The goal of this trial is to identify radishes that can be grown in the Iowa summer.

METHODS

Design

The cooperators tested the following radish varieties: Bacchus, Crunchy King, Donato, Golden Helios, Purple Plum, Cherry Belle, and Japanese Daikon (**Table 1**). The plot layouts used in the Blacks’ experiment are shown in **Table A1**. Troxel planted three successions of radishes between April and June but did not replicate variety treatments. Treatment plot sizes and management details for each farm are shown in **Table 2**.

Measurements

Both farms collected yield data by plot, measuring the weight of all marketable radishes, with their tops, from each plot. The Blacks also weighed those radishes that were harvested that were not marketable, categorized as ‘seconds’. Troxel evaluated the strength of the stems as either: 1–unacceptable, 2–acceptable, or 3–preferred. Troxel also documented the proportion of plants of each variety that had bolted at harvest.

Data analysis

We used Fischer’s LSD at a 95% confidence level to determine if there were significant differences between varieties. For each metric, the difference between any two varieties was compared with the LSD. A difference greater than or equal to the LSD indicates the presence of a statistically significant treatment effect, meaning one treatment outperformed the other and the farmer can expect the same results to occur 95 out of 100 times under the same conditions. A difference smaller than the LSD indicates the difference is not statistically significant and the treatment had no effect. We can perform this analysis because the cooperators had completely randomized and replicated experimental designs (**Figure A1**). We could not perform statistical analyses on Troxel’s results due to lack of replication.

Table 1. Radish varieties grown by cooperators and relevant attributes in 2024.

VARIETY	HYBRID or OP	DAYS TO MATURITY	RELEVANT TRAITS
Bacchus	F1	24	Purple, flavor gets hot in summer heat
Crunchy King	F1	23	Red, even maturing, longer harvest win-dow, dense top
Donato	F1	21	Red, mildew resistant, heat tolerant, good field holding
Golden Helios	OP	26	Yellow, sweet mild flavor
Purple Plum	OP	25-30	Purple, hardy and adaptable
Cherry Belle	OP	25	Red, zesty peppery flavor, prefers 50-70 °F
Japanese Daikon	OP	27	White, long bulb, cooks well

Bacchus, Crunchy king, and Donato are F1 hybrids from Johnny’s seed company [5], [6], [7].



Radish harvest at the Blacks’ farm. Photo taken July 2024.

TABLE 2. Design and management practices by trial in 2024.

	BLACK	TROXEL SUCCESSION 1	TROXEL SUCCESSION 2	TROXEL SUCCESSION 3
Planting date	June 14	Mar. 20 in flats, transplanted Apr. 28	May 26	June 30
Harvest period (alternative to above row)	July 22 – Aug. 8	May 2 – June 2	June 10 – Aug. 4	Aug. 11 – Oct. 13
Varieties	Bacchus, Crunchy King, Donato	French Breakfast, Golden Helios, Japanese Daikon, Purple Plum	Cherry Belle, Golden Helios, Japanese Daikon, Purple Plum	Cherry Belle, Golden Helios, Japanese Daikon, Purple Plum
Irrigation	None needed	Drip as needed	Drip as needed	Drip as needed

RESULTS AND DISCUSSION

Black

The Blacks had significantly higher marketable yield from Donato, compared to Crunchy King and Bacchus (**Figure 1**). Crunchy King had significantly less seconds than Donato and Bacchus (**Table 3**).

Troxel

Troxel's harvest spanned early May to mid-October across the three successions (**Figure 2**). The first planting succession yielded a total of 443 pounds of marketable radishes. The second succession yielded 662 total pounds of marketable radishes of all varieties. The third planting succession saw a strong decrease in yields to 279 pounds, with Cherry Belle and Helios not yielding any radishes because they had all bolted, likely owing to climbing temperatures in August (**Figure A2**). Although Purple Plum yields were lower in succession 3 due to bolting, it did produce 77 pounds of marketable radishes, in contrast with Cherry Belle and Helios (**Figure 2**). It is clear that once bolting has started in the group, yield does not recover. Daikon resisted bolting and thereby maintained its high yields.

Daikon has a different development and cultivation history from the other varieties in this trial, being Japanese where the other varieties are based on European varieties. Daikon (which means 'radish' in Japanese) grow larger than the other varieties—Troxel noted that some individuals could be sliced like loaves of bread. Daikon increased its yield through the three successions, topping out at 202 pounds in the third succession.

Stem strength

Because the strength of the radish stem is important for bundling radishes into bunches for sale or distribution, the cooperators evaluated stem strength among varieties across the project. The Blacks did not find any of the stems to be problematic. Troxel found that stem strength decreased through the summer. The daikon radishes, whose yields resisted the summer heat, also maintained the highest stem strength, never dipping below an 'acceptable' rating.

Donato outperformed Bacchus and Crunchy King at the Blacks'

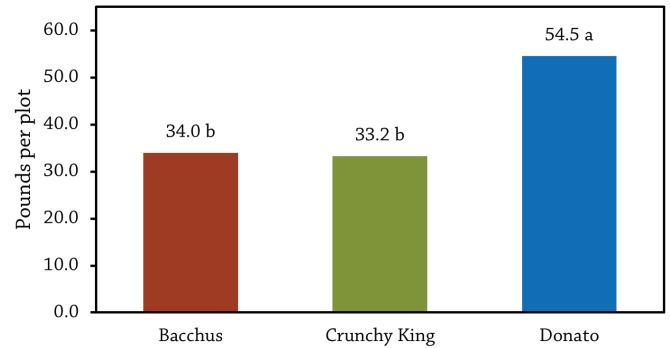


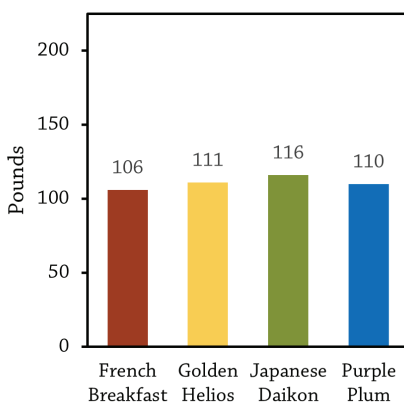
FIGURE 1. Cumulative radish yields across all harvest dates at Carmen & Maja Black's in 2024. Above each column is the variety average. Where the averages of any two treatments differ by more than the least significant difference (LSD = 14.7 lb/plot) the yields do not share any similar letters and are considered statistically different at the 95% confidence level. Where yield differences are less than the LSD, the yields share similar letters and are considered statistically similar.

TABLE 3. Radish yield — marketable and seconds — at the Blacks' farm in 2024.

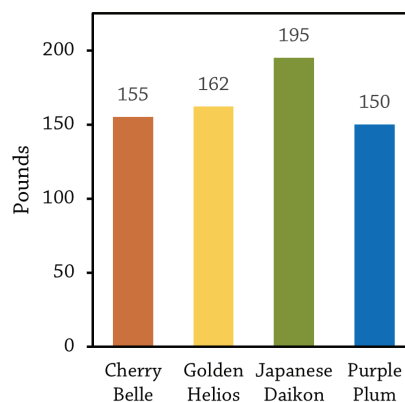
VARIETY	MARKETABLE (lb/plot)	SECONDS (lb/plot)	% SECONDS
Bacchus	34.0 b	7.9 a	19%
Crunchy King	33.2 b	2.9 b	8%
Donato	54.5 a	8.3 a	13%
LSD (95)	14.7	3.4	--

Within a column, when the difference between the two averages is greater than or equal to the corresponding least significant difference (LSD), the yields are considered statistically different at the 95% confidence interval. When the difference is less than the LSD, there is no significant statistical difference. Values with the same letter are not significantly different from each other. Seconds % calculated as proportion of the total (market + seconds) pounds of each variety that were designated as unmarketable.

Troxel Succession 1



Troxel Succession 2



Troxel Succession 3

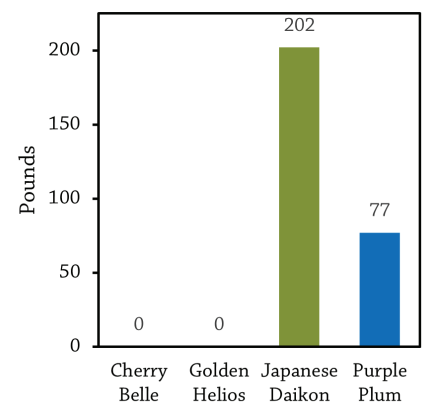
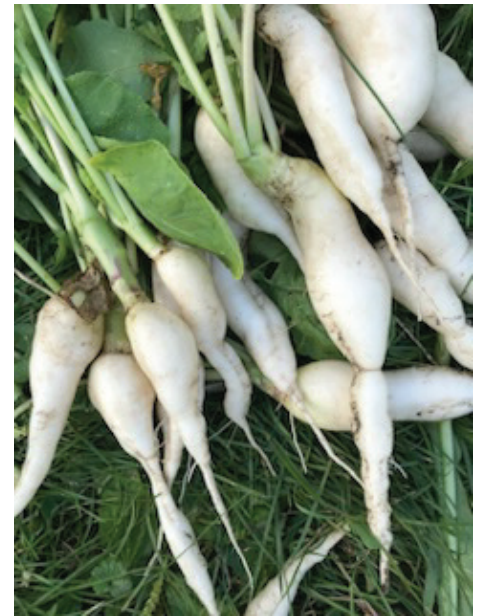


FIGURE 2. Radish yields from each succession 1 (May–June); 2 (June–Aug.); and 3 (Aug.–Oct.) at Terry Troxel's in 2024. Values above the columns are the cumulative yields of each variety in a succession. No statistical analysis could be made due to lack of replication.

CONCLUSIONS AND NEXT STEPS

Carmen & Maja Black found that they had a better harvest from the June planted radishes than from their more traditional April planting (not reported as part of this trial). Donato was the highest yielding variety, but all three varieties performed well. Carmen Black mentioned it was nice to have both purple and red radishes in bunches. In the future they will allocate more space in the crop rotation for June/July radishes than for March/April radish plantings.

Troxel was pleased with the performance and market acceptance of Daikon radishes. Participating in the trial gave her experience growing and marketing radishes that would enable her to expand the role radishes play in her crop rotation going forward.



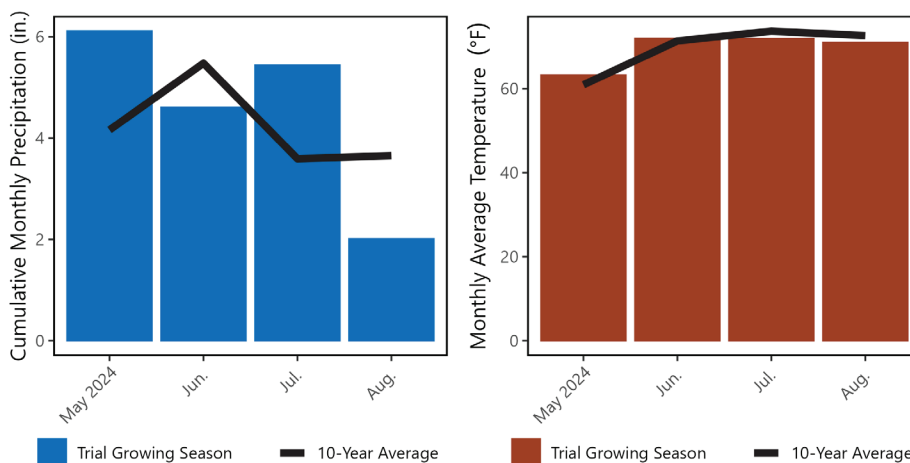
A sampling of Troxel's Daikon radish harvest. Photo taken August 2024.

APPENDIX – TRIAL DESIGN AND WEATHER CONDITIONS

REP 1	A	B	C
REP 2	C	A	B
REP 3	B	C	A
REP 4	A	C	B

FIGURE A1. Example randomized experimental design used by Black and Troxel.

Black



Troxel

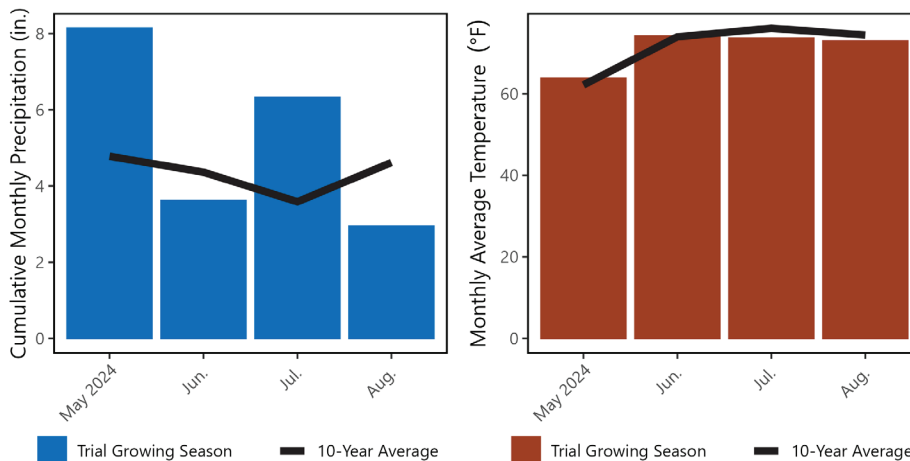


FIGURE A2. Monthly cumulative precipitation and average temperatures in Solon (Black) and Crescent (Troxel) during the radish growing season, May 2024 – August 2024 [8], [9].

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