Dry Farming Tomatoes in Raised Beds and Practical Use for the Home Gardener

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Left to Right: Early Girl variety tomatoes on the vine, after harvest, a rootstock Fortamino seedling, and beds mid-season.

Introduction

The goal for this study was to grow tomatoes using minimal water in raised beds. This may seem counter-intuitive. Typically raised beds lose water quicker than in-ground beds making them less desirable for dry farming, but they have other benefits for home gardeners. In a home environment raised beds offer functionality such as being self-contained with full control over soil and amendments that are added, pleasing aesthetics with a variety of materials for building, and they can be built on concrete, gravel, wooden decks, and other infrastructure. Additionally raised beds can serve as a more ergonomic and accessible option for some gardeners.

Dry farming practices also offer several benefits to the home gardener: hand watering is not required nor are irrigation lines, potential improved crop quality such as more intense flavors[1], and less water usage. If the benefits of dry farming can be combined with the benefits of raised beds then a versatile garden space becomes available that requires less work to maintain, requires less water input, provides ergonomic access, and still provides delicious bounty.

Objectives

- Determine whether tomatoes can be grown in raised beds using minimal water.
- Determine how much fruit yield there is from the plants grown.
- Determine how much fruit yield is blemished from either blossom end rot or otherwise.
- Determine how much edible flesh is left after removal of blemished parts of fruit in the kitchen.

Site Details

For this study Portland Community College Rock Creek Campus approved use of raised beds in their Learning Garden just west of Portland, OR. Six beds each measuring 6 feet wide by 8 feet long by 2 feet deep were used. Each bed was filled with a combination of compost made onsite and soil from the surrounding area characterized as Helvetia silt loam based on information drawn from the United States Department of Agriculture's Web Soil Survey tool[2]. This soil has

an estimated 9.3 inches of available water holding capacity in the first 5 feet of soil[3]. The bottom of the beds were lined with heavy weed fabric that was presumed to be intact, but did not necessarily stop roots from growing through. Each bed was in close proximity with 4 foot wide pathways between one another. The site was a full sun location with no shadows cast by obstructions over the beds.

Left to Right: Weeds pulled from beds and 24” sample of soil pulled from bed.

Planting Details

Originally each test bed was planted on 5/21 with six seedlings each that had been started from seed in February 2022. Each bed was divided into 6 partitions (2 rows by 3 columns) with each partition measuring approximately 8 sqft. Many of these seedlings died over the first several weeks due to prolonged spring rain, vermin damage, or other unknown factors. Of the original 36 seedlings only 10 survived, but they survived through to the end of the study. This group of plants was designated as “Plant Group A”.

On 6/25, five weeks after the initial planting, a second batch of seedlings was purchased from a nursery in 4” pots and planted. These 18 plants all survived until the end of the study and were designated as “Plant Group B”. For both plant groups each seedling was given 1 liter of water at planting. Initially tomato (*Solanum lycopersicum*) varieties were chosen based on favorable dry farming performance[4]. Plant Group A also included ungrafted rootstock tomatoes for observation. Due to time constraints and availability an assortment of tomato starts were used for Plant Group B based on what was available at the nursery, and not any known performance.

Weekly Maintenance

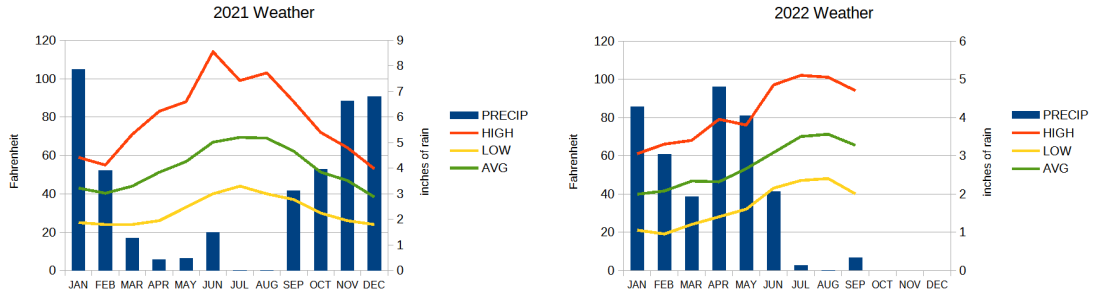
Once a week data and notes would be collected, and beds would be weeded. There were persistent weeds all season that were removed using an aggressive governance policy to minimize any siphoning of available water from the tomatoes. The tomato plants were not given any rigid support and were not pruned.

Throughout the experiment instances of disease or other ailments were monitored. No instances of disease were found, but there were signs of vermin damage. This damage was in the form of holes dug in the beds and fruit being partially eaten. Signs were posted designating these beds as a research project and asked that fruit not be picked. This was a highly accessible public space so there is a chance that some fruit was picked from the plants and not accounted for in the final data. Fruit damaged by vermin was noted but not included in any harvest data.

Signs of vermin damage and early season ailments for seedlings.

Weather Data

For the growing season of this study, from May through September, 6.6 inches of rain fell. 2022 also experienced a wet spring accumulating 10.8 inches of rain from March through May compared to 2.2 inches in 2021 during the same period[5]. Negligible amounts of rain fell from July through October with consistent daily high temperatures in excess of 85 degrees Fahrenheit. No shade was provided for the tomato plants throughout this study. During the summer months observations were made of slight yellowing and browning of older leaves on almost all plants, and the top several inches of soil having a light dusty quality from drying out.



Comparison of weather data from 2021 to 2022.

Harvest Methodology and Data

Fruit was harvested weekly from 8/27 through 10/8 with hand pruners. Fruit was divided into “unblemished” and “blemished” categories with the latter consisting of fruit that had blossom end rot or other characteristics that would be considered undesirable for market. The results of the season harvest are presented in Table 1.

- Annarita was the most productive variety based on total yield per plant.

- Smaller “cherry” type tomato varieties had significantly lower instances of blossom end rot and blemishes. These included Annarita, Husky Cherry Red, and Piennolo del Vesuvio.
- Sokolades and Piennolo del Vesuvio had no instances of blemished fruit in this study.
- The Fortamino rootstock tomato varieties were ungrafted and grew to impressive sizes, but little fruit was able to be harvested during the study.

Table 1. Harvest Yield

Variety	Unblemished Yield (oz)	Blemished Yield (oz)	Avg Fruit Size (oz)
Annarita	**46.3**	**0.72**	**0.76**
Astrakhanskie	**0**	**13.97**	**3.49**
Better Boy	**0**	**21.25**	**1.93**
Early Girl	**20.5**	**48.9**	**1.54**
Fortamino	**0**	**0.38**	**0.38**
Husky Cherry Red	**42.88**	**0.29**	**0.26**
Piennolo del Vesuvio	**50.7**	**0**	**0.32**
Sokolades	**26.22**	**0**	**2.02**
Super Fantastic	**104.47**	**137.06**	**0.97**

Left to Right: Mid-August Snapshot of bed, ripening tomatoes, and “blemished” tomatoes.

<u>Processing Methodology and Data</u>

While blemished fruit is not considered marketable it is still edible for the home gardener through removal of the blemishes. A variety of recipes were made using blemished tomatoes from this study. Tomatoes were weighed before processing and then after removal of the

blemished parts. Unblemished tomatoes from outside the study were also used for a variety of recipes to establish a baseline. The processing data is reflected in Table 2.

- Time spent removing blemished parts of the tomato was not taxing and similar in time spent processing the baseline group.
- The average weight loss for the baseline group was 14% while the average weight loss for the blemished group was 19%.
- The greatest loss of weight was for the Shrimp Etouffee recipe which primarily consisted of tomatoes with large masses caused by blossom end rot.
- The smallest loss of weight was for fresh cherry tomatoes in the baseline group which involved only removing stems. If this data point is removed then the average weight loss for the baseline group becomes 16%.
- Blanched tomatoes were boiled whole, flash cooled in ice, and then had their skins removed before being weighed for their post-process weight. Interestingly and conveniently masses caused by blossom end rot came away with the skin easily.

Table 2. Weight of Processed Blemished Tomatoes

Recipe	Baseline ?	Pre-Process Weight (oz)	Post-Process Weight (oz)	% Weight Loss
Blanched tomatoes for canning	**No**	**108.66**	**93.87**	**13.61%**
Chili	**No**	**36.6**	**32.47**	**11.28%**
Fire roasted tomatoes for soup	**No**	**33.1**	**28.2**	**14.80%**
Manhattan chowder	**No**	**54.2**	**43.1**	**20.48%**
Shrimp etouffee	**No**	**20.03**	**10.92**	**45.48%**
Tomato bisque soup	**No**	**24.08**	**18.93**	**21.39%**
Tomato sauce	**No**	**37.4**	**25.4**	**32.09%**
Tomato sauce	**No**	**42.42**	**36.52**	**13.91%**
Cherry tomatoes for fresh eating	**Yes**	**25.91**	**25.84**	**0.27%**
Cherry tomatoes for tomato sauce	**Yes**	**8.17**	**7.08**	**13.34%**
Tomato sauce	**Yes**	**53.6**	**47.5**	**11.38%**
Tomato sauce	**Yes**	**48.45**	**38.15**	**21.26%**
Tomato soup	**Yes**	**28.28**	**23.01**	**18.64%**

From Left to Right: Shakshuka, canned tomatoes, winter storage *ristra*, and tomato sauce. All prepared from dry farmed tomatoes with blossom end rot and other blemishes.

Summary

During the course of this study 32 lbs of tomatoes were harvested from plants grown in raised beds using only 1 liter of water per plant for a total of 28 liters. The City of Portland website cites a 2016 national study by the Water Research Foundation that an average eight minute shower uses 64 liters of water (17 gallons)[6]. The average yield in lbs/sq ft for this study was 0.11 lbs/sq ft which can be considered low[7]. High performing varieties for dry farming would potentially improve this yield . For instance the Annarita variety which performed best of all varieties in this study had a yield of 0.37 lbs/sqft. While there was a high instance of blemished fruit, a relatively small percentage of it was lost after processing. This retains a much greater amount of food that would otherwise go to waste.

Even for a small farms or market vendors (selling hot sauce, tomato sauce, et al)

This method of home gardening will not produce the biggest harvest, but for the home gardener dry farming in raised beds may provide other benefits. As the Pacific Northwest becomes more arid, water conservation may become a higher priority for home gardeners. They can still supplement their diets with fresh produce requiring little maintenance while being conservative in their water use.

Reflections

In a future study it would be interesting to see a larger sample size consisting of different sized beds across a large geographic range filled with both commonly used bagged soils and soil found onsite. This could provide good insight as to whether bed dimensions have a lower limit, and whether commonly available soils are appropriate for this method of home gardening. It would also be interesting to see yields from tomato plants that are considered good dry farming varieties as well as grafted varieties which have been noted to perform well[8]. Other vegetables and fruit may be more suited for dry farming in raised beds as well.

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References

[1] https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em9229.pdf
[2] https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
[3] https://smallfarms.oregonstate.edu/sites/agscid7/files/site.suitability.handout.2021.pdf
[4] https://agsci.oregonstate.edu/sites/agscid7/files/smallfarms/2021_winter_tomato_vareity_trial_report_final.pdf
[5] http://www.ncei.noaa.gov
[6] https://www.portland.gov/water/water-efficiency-programs/save-water-home
[7] https://sustainable-farming.rutgers.edu/wp-content/uploads/2017/12/urbanfringe-v07n01.pdf
[8] https://horticulture.oregonstate.edu/sites/agscid7/files/horticulture/oregon-vegetables/photos_of_grafted_high_performers_ags_edits.pdf