OSU Dry Farming Site Suitability Project

Dry farming is the practice of producing crops without irrigation during a dry growing season. In 2018 and 2019, the OSU Dry Farming Site Suitability Project grew squash and tomatoes at about 20 farm sites/year to better understand how site variables relate to crop yield and quality. We found that climate and soil physical properties were the major drivers of site suitability.

Climate and weather

Most of the water that plants take up from the soil is lost to the atmosphere through transpiration, which is the evaporation of water from leaves. Plants transpire more water when the air is hot and dry than when it is cool and humid. Thus, climate and weather are the major drivers of plant water use. This is why most commercial dry farmed tomatoes are grown in cool humid coastal areas in California. The Willamette Valley (WV) is hotter and drier than coastal California, so the WV may be less suitable for dry farming.

OSU Dry Farming Project research has shown that climate and weather may affect yields and fruit quality. Average tomato blossom end rot (BER) incidence in WV sites in 2018 was 37%, while tomatoes grown in coastal sites had almost no BER. In 2018, hot and dry WV sites had a higher incidence of BER than cool and humid WV sites. In 2019, sites that were partially sheltered from the wind and sun had larger fruit. In squash research, dry farm yields were higher in the cooler 2016 season than in the hotter 2017 season.

Soil Physical Properties

Plant roots absorb water from the soil, where it is held in the soil pores. Gravelly and sandy soils have large pores and little surface area, so they drain quickly and hold the least water. Clay soils have the most surface area and hold the most water, four times as much as sandy soils. However much of the water is unavailable to plants. A soil's available water holding capacity (AWHC) is the amount of plant available water it can hold, and is estimated by assessing the texture and depth of the soil's horizons.

A soil's AWHC is a strong determinant of dry farming success. In 2018, squash yields increased as soil AWHC increased. Additionally, Early Girl tomato fruit size increased and the proportion of fruit with BER decreased as AWHC increased. In 2019, tomato yields increased with increasing soil AWHC. Additionally, soils with impermeable layers may restrict root growth. In our work in 2019, as the depth of impermeable layers increased, yield of tomatoes and squash decreased.

Horizon (depth)	Texture	AWHC (in)
Ap (0-9")	Silt Loam	1.8
A2 (9-12")	Silt Loam	0.6
E (12-18")	Silty clay loam	1.1
Bt1 (18-26")	Clay	1.0
Bt2 (26-38")	Clay	1.4
BCt (38-44")	Silty clay loam	1.1
C (44-60")	Silt loam	3.2

Soil Texture Classes	AWHC (inch/inch)
Sandy loams	0.11-0.15
Silt loams	0.20-0.24
Silty clay loams	0.18-0.23
Clay loams	0.14-0.19
Silty clays	0.10-0.14

A soil's AWHC is calculated by multiplying the depth of each soil horizon by the AWHC of that soil horizon's soil texture class and then summing up all AWHCs.

Management: strategies to improve WV dry farm success

These management practices were associated with higher yields and quality of dry farmed tomato and squash in OSU research trials:

- pH 5.5-6.5
- Sufficient soil nutrients (as determined by soil test)
- Early planting date
- Variety shown to perform well when dry farmed

Tomato only:

- High planting density (10 to 30 sqft/plant)
- Grafting (Early Girl grafted onto Fortamino rootstock)

An example of a well managed dry farm

Blossom end rot on two tomatoes

Blossom end rot

Blossom end rot (BER) is a physiological disorder that can be very prevalent in dry farmed tomatoes. In 2019, the average farm lost 33% of their fruit to BER, though rates were as high as 90% at some farms. The proportion of fruit affected typically increases as the season progresses.

Our work suggests that %BER is higher on sites where luxurious early season growth (from high soil nutrient content) is followed by severe drought stress when soil moisture is depleted. Thus, soil nutrient content may interact with soil AWHC to determine BER rates.

In addition, sheltered sites (partial shade, wind barriers, high humidity due to overhead irrigation nearby) typically have lower % BER than exposed sites.

Additional Resources

Information on your site's climate can be found at: prism.oregonstate.edu/explorer/
Information on your site's soil (including AWHC) can be found at NRCS: websoilsurvey.sc.egov.usda.gov
Dry Farming in the Maritime Pacific Northwest: Intro to Dry Farming Organic Vegetables. Amy Garrett https://catalog.extension.oregonstate.edu/em9229
Dry farm tomato production in coastal California (extension bulletin)
https://casfs.ucsc.edu/about/publications/grower-guides/pdf-downloads/dry-farmed-tomatoes.pdf
Dry farm tomato production in coastal California (video)
https://www.youtube.com/watch?v=mcNarcVICmg
Comparative dry-farmed and irrigated squash production in the Willamette Valley.
https://journals.ashs.org/hortsci/view/journals/hortsci/54/7/article-p1190.xml

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