



# Strategies for Growing without Irrigation in Western Oregon

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**Oregon State**  
University

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Northwest Climate Hub  
U.S. DEPARTMENT OF AGRICULTURE



*RMA*

Risk Management Agency

# Introduction

- Cropping options on land without water?
- Climate change
  - reduced snowmelt
  - increased temperatures
  - drought
- Vegetable growers using surface water for irrigation were cut off early during the 2015 growing season - Some as early as June!
- Many new farmers have trouble finding land with unrestricted irrigation rights
- Water is expensive!





# Adapting to a Changing Climate: Conserving Water with Dry Farming Management Practices



<https://youtu.be/FRjDf7x9Tro>

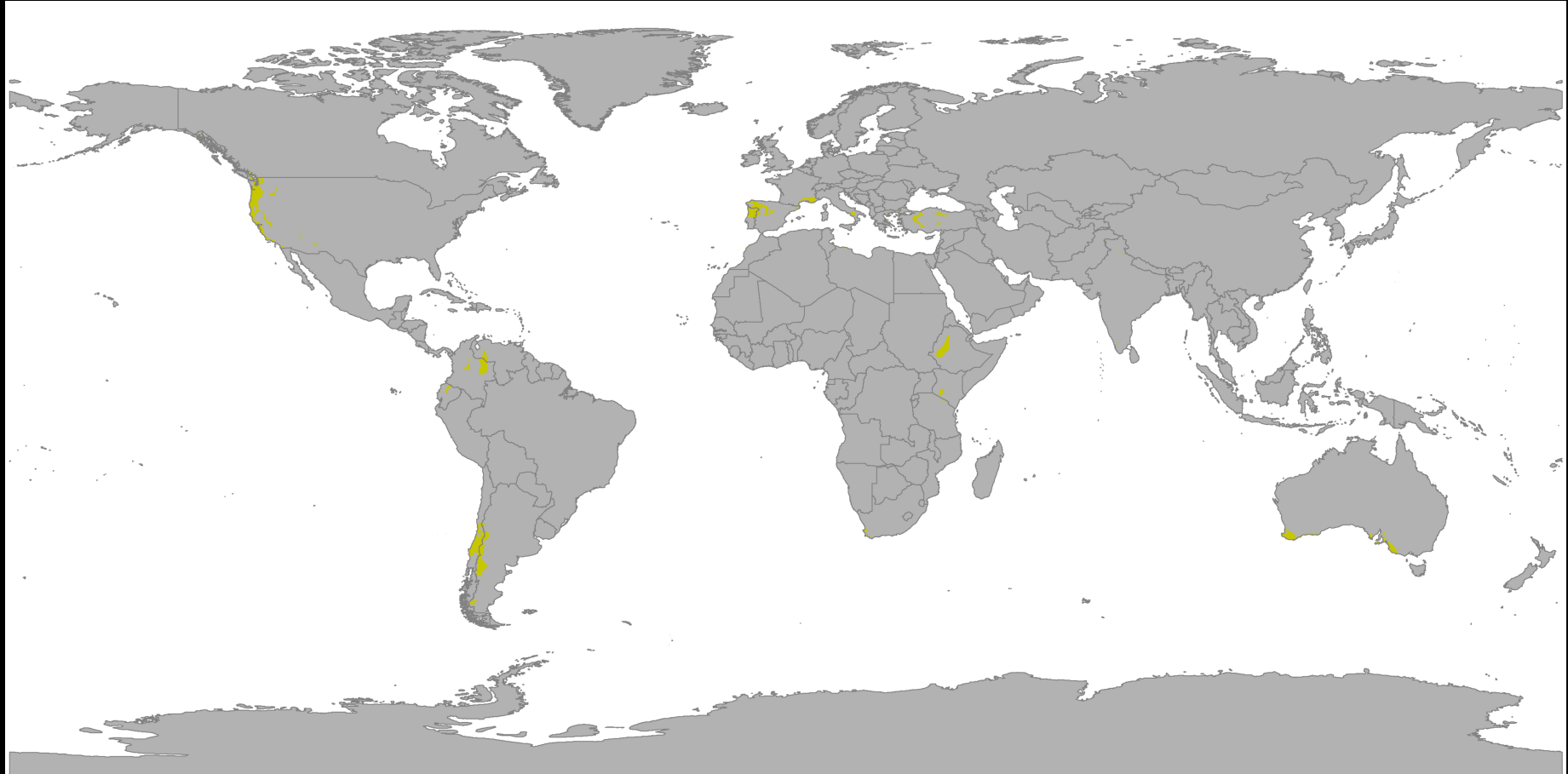
# What is dry farming?

- Crop production during a dry season like summers in the Willamette Valley in Oregon and Northern California
- Utilizes the residual moisture in the soil from the rainy season instead of depending on irrigation.





# Warm-summer Mediterranean Climate



Af	BWh	Csa	Cwa	Cfa	Dsa	Dwa	Dfa	ET
Am	BWk	Csb	Cwb	Cfb	Dsb	Dwb	Dfb	EF
Aw	BSh		Cwc	Cfc	Dsc	Dwc	Dfc	
	BSk				Dsd	Dwd	Dfd	

# Resources

Steve Solomon

- *Growing Vegetables West of the Cascades*
- *Water-Wise Vegetables*
- *Gardening Without Irrigation: or without much anyway*
- *Gardening when it counts*

Carol Deppe

- *The Resilient Gardener*

David Granatstein

- *Dryland Farming in the Pacific Northwest*

California Ag Water Stewardship Initiative

Widtsoe, John. 1920

- *Dry Farming: A System of Agriculture for Countries Under Low Rainfall.* 1920.



# The Dry Farming Project

- Work to date
  - Case studies
    - Western Oregon
    - Northern California
  - Demonstration
    - Field Day
    - Sensory Evaluation
    - Preliminary Yield Data
  - Grant funding
    - Expand Demonstration
    - *Growing Resilience: Water Management Workshop Series*
    - Participatory Climate Adaptation Research
      - *Dry Farming Collaborative*



# How Does Dry Farming Work?

- Starts with the soil!
  - Water-holding capacity
    - Clay
    - Organic matter - For each 1% increase in soil organic matter, soil water storage can increase by 16,500 gallons per acre-foot of applied water!
  - 4' of soil or more (Solomon)
- Site selection
  - Plants as indicators
  - Web Soil Survey
  - Soil auger



## 128B—Veneta loam, 0 to 7 percent slopes

### Map Unit Setting

National map unit symbol: 234m

Elevation: 300 to 800 feet

Mean annual precipitation: 40 to 60 inches

Mean annual air temperature: 52 to 54 degrees F

Frost-free period: 165 to 210 days

Farmland classification: All areas are prime farmland

### Typical profile

H1 - 0 to 14 inches: loam

H2 - 14 to 39 inches: clay loam

H3 - 39 to 60 inches: clay

### Properties and qualities

Slope: 0 to 7 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat):  
Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 36 to 72 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: High (about 10.3 inches)



# How Does Dry Farming Work?

- Soil preparation
  - Timing
- Planting technique
  - Plant when and where there is moisture
  - Increased plant spacing
  - Pressing soil around seed or transplant
    - Good seed soil contact
    - Creates capillary action wicking moisture to the surface to help seed germinate and get established
  - Pre-soaking seed (Deppe)
- Surface protection
  - Mulching – ‘dirt or dust mulch’ most common on small commercial farms

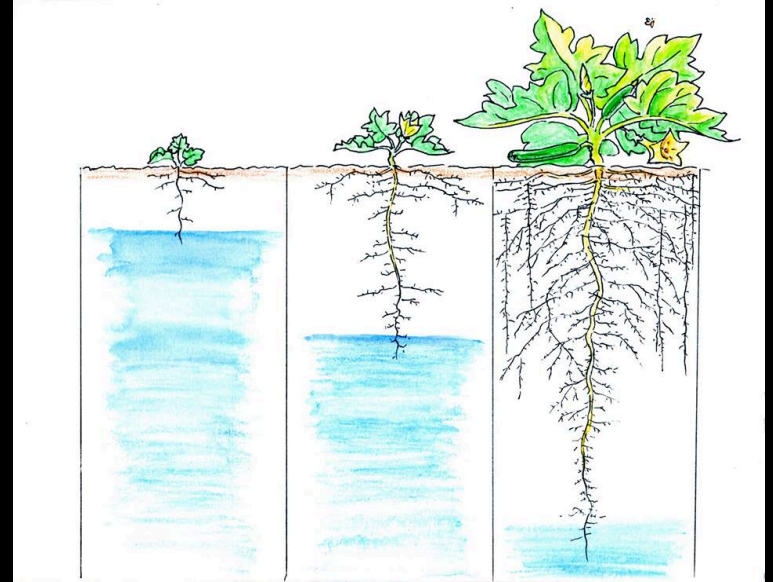
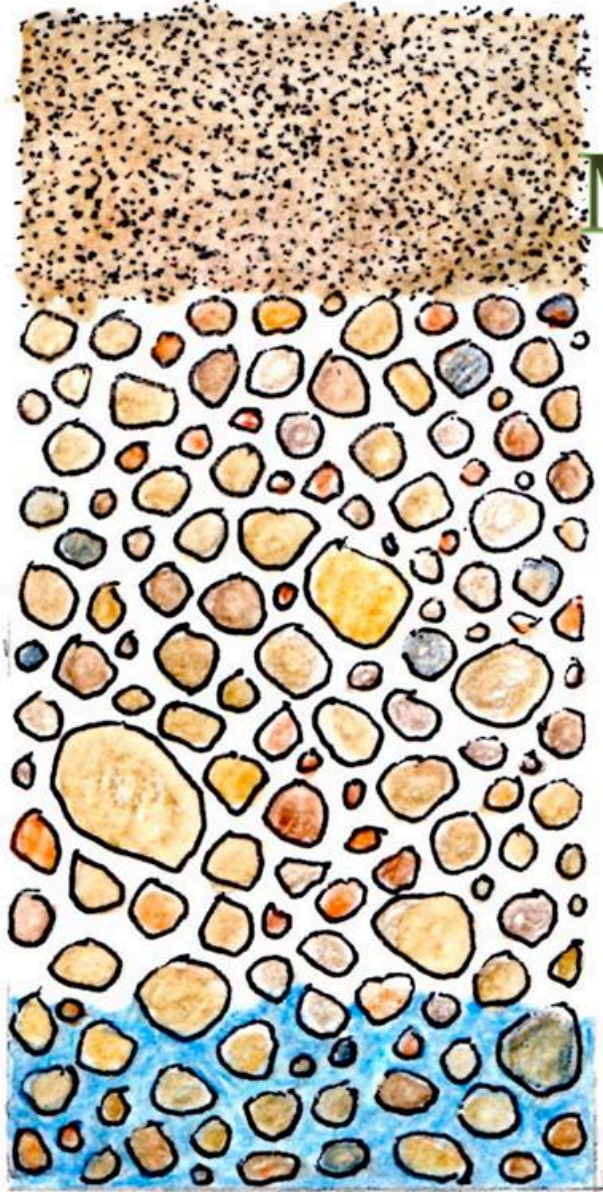
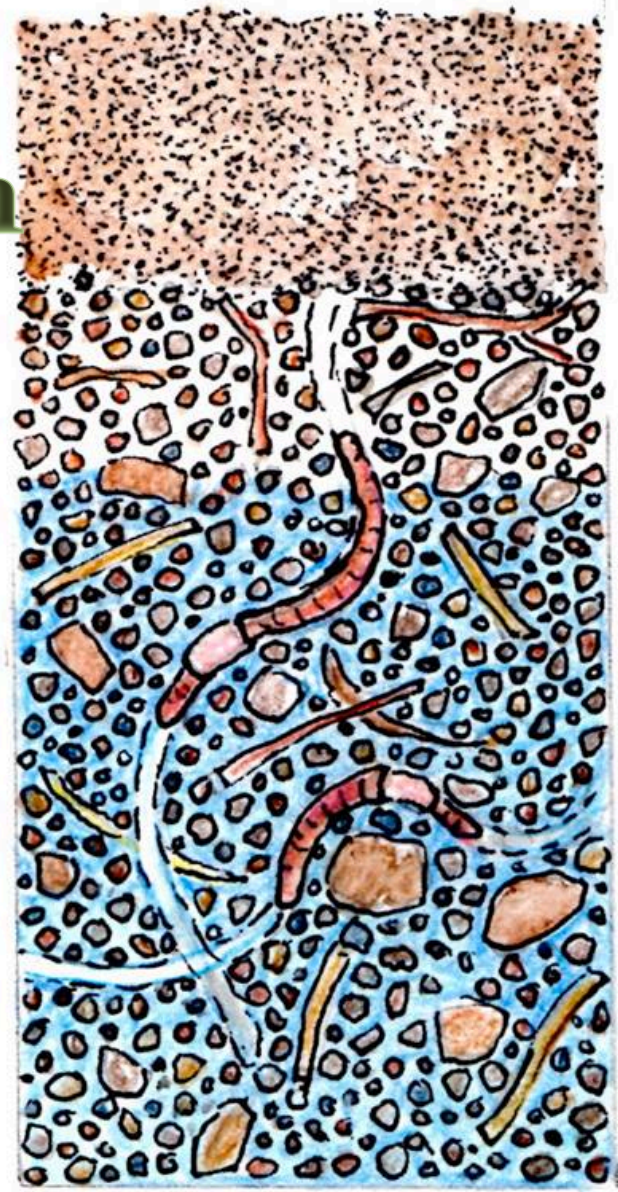


Illustration by Moria Peters

# Dust Mulch



Sand  
Poor Capillarity



Clay; Sandy/Silt Loams  
Good Capillarity

By Moria Peters



# Crop/Variety Selection

- Tomatoes
- Potatoes
- Watermelons
- Cantaloupes
- Winter squash
- Zucchini
- Dry Beans
- Corn
- Orchard crops
- Grapes





June 3, 2016





July 6, 2016



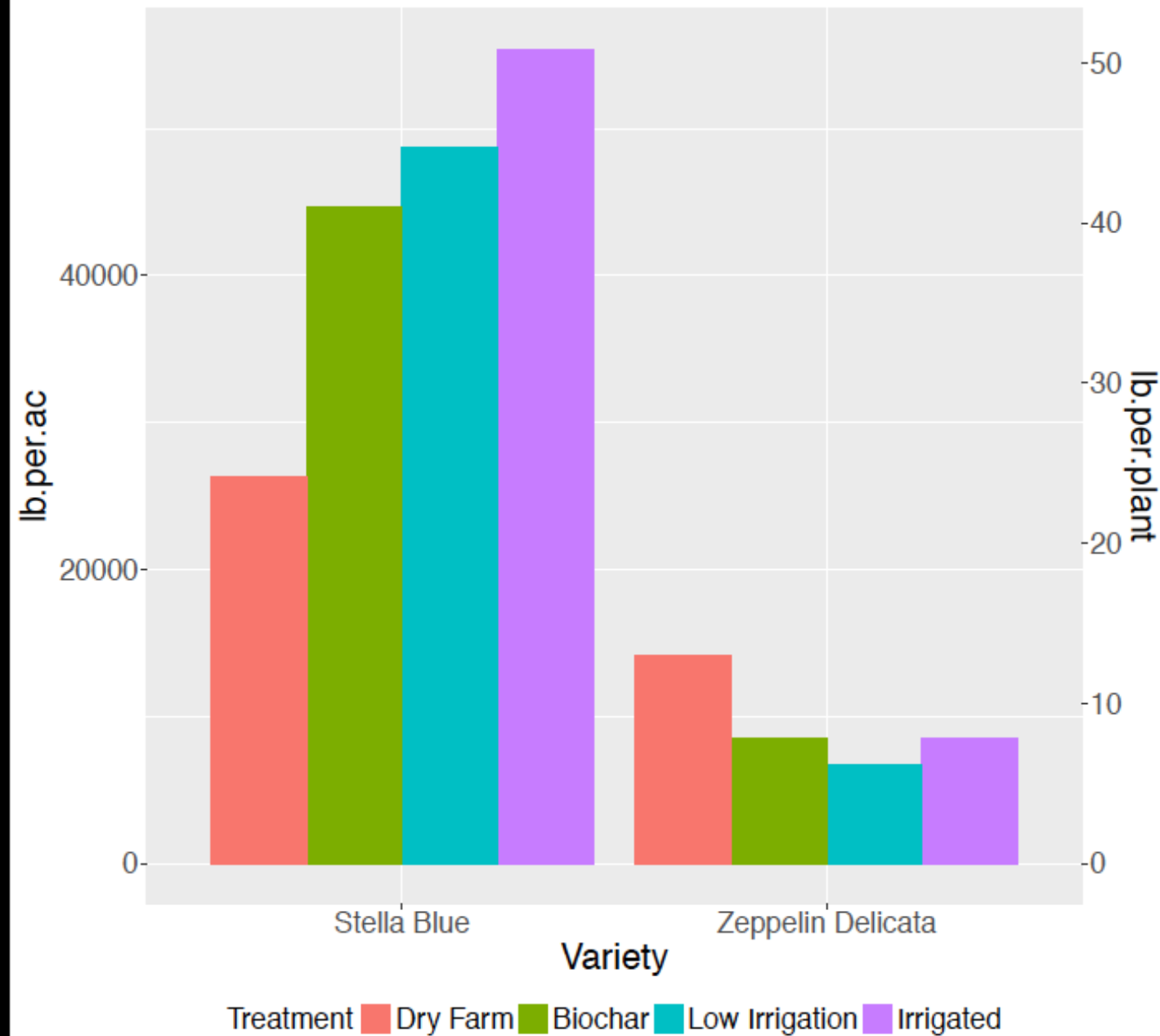


August 10, 2016



# Squash Marketable Yield

## Oak Creek OSU Demo 2016



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AnOvation Group LLC



# 'Dark Star' Zucchini

Corvallis, OR



July 6, 2015



July 15, 2015



July 27, 2015



September 25, 2015

New Moon Organics -  
Shively, Ca



August 18, 2015



# Gathering Together Farm 2016 Dry Farm Trial



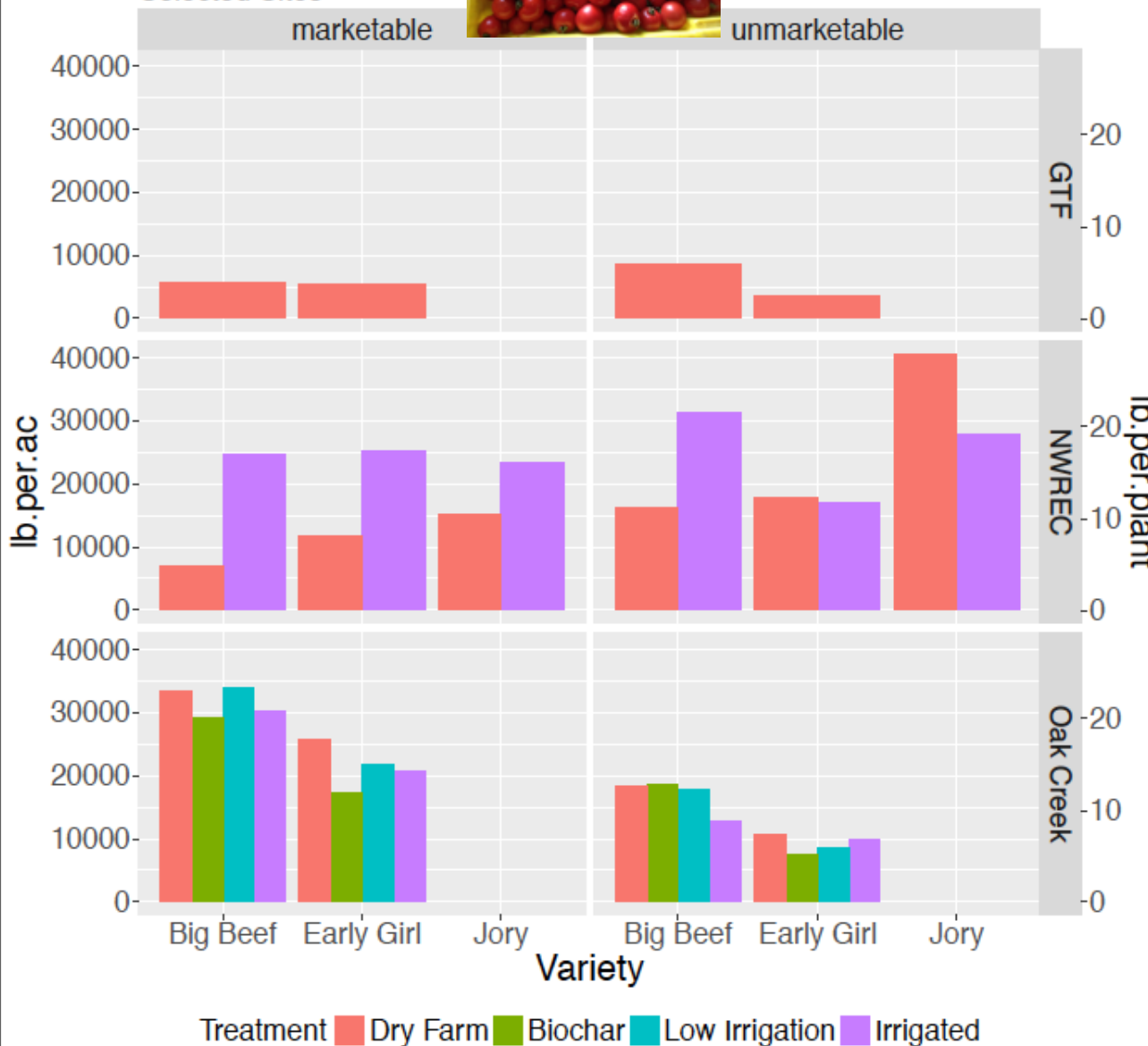
# Relative Soil Productivity Ratings by Classification

Soil	Native Productivity	Amendments	Drainage	Irrigation	Max Dry	Max Irrigated	Farm
Chapman	69	+9	0	24	76	100	Harcombe Farm
Chehalis	72	+5	0	+20	77	97	Gales Meadow Farm
Coburg	60	+5	+8	+20	73	93	Gathering Together Farm
Dayton	10	+22	+4	+27	36	63	Oak Creek
Helvetia	57	+5	+8	+20	70	90	Berry Lost
Latourell	70	+10	0	+20	80	100	North Willamette
McBee	55	+5	+9	+20	72	92	Gales Meadow Farm
Quatama	65	+5	+9	+20	79	99	North Willamette
Redbell	55	+5	+18	+20	73	93	Gathering Together Farm
Willamette	75	+5	0	+20	80	100	Oak Creek
Woodburn	65	+5	+8	+16	78	94	Oak Creek, Gowan Farm

Reference OSU 1982 Agricultural Ratings for Soils of the Willamette Valley, EC 1105 Oregon State University Extension.

(Huddleston EC 1105)  
Andy Gallagher – Red Hill Soils

# Tomato Yield Selected Sites



Soil Type	Native Prod.	Max Dry
Coburg	60	73
Redbell	55	73
Latourell	70	80
Quatama	65	79
Willamette	75	80
Woodburn	65	78

AnOvation Group LLC



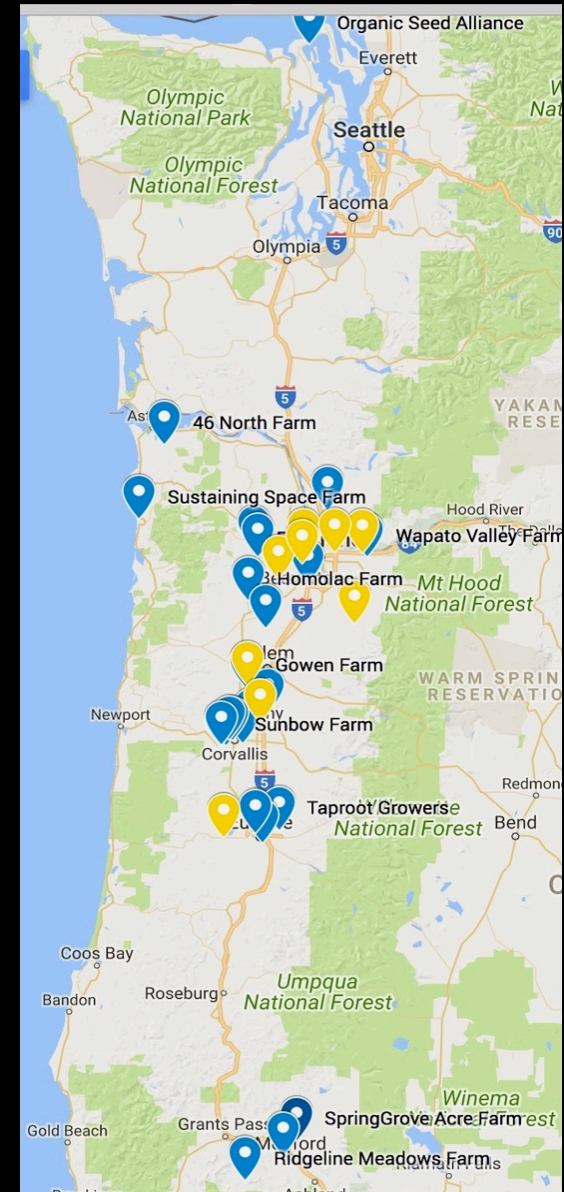
# Dry Farming Collaborative



Group of growers, extension educators, plant breeders, and agricultural professionals partnering to increase knowledge and awareness of dry farming management practices with a hands-on participatory approach.

# Dry Farming Collaborative

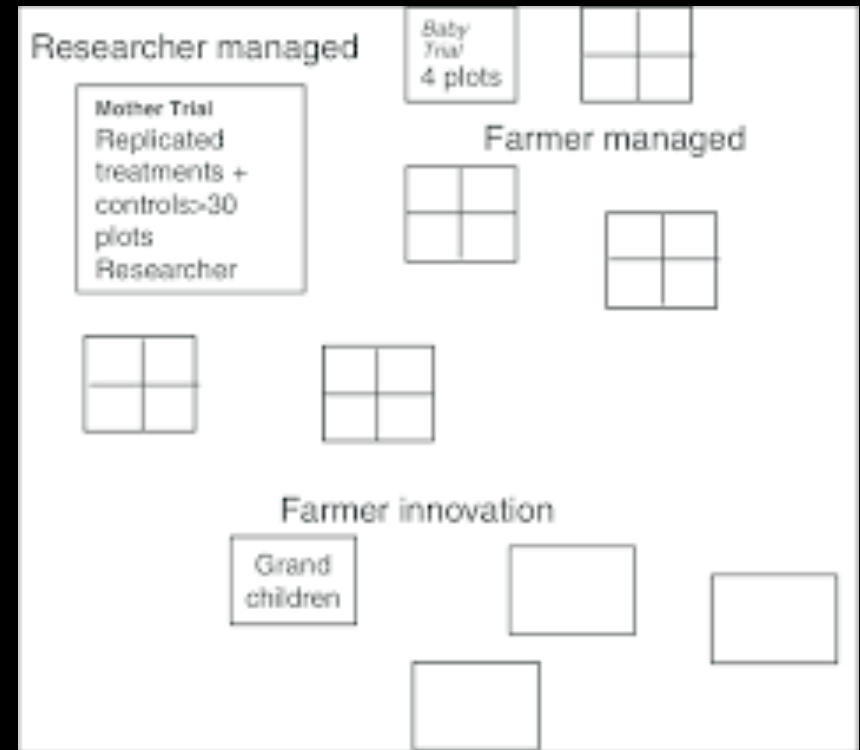
- 30 Trial Hosts
- Communication
  - Facebook Group (450+ members)
  - Email list (120+ members)
- Data Collection
  - Soil testing (5' cores)
  - Soil moisture monitoring
  - Yield
  - Sensory Evaluation
- Events
  - Winter Meeting
  - Field Days
  - Tasting events
  - Conference presentations





# 2017 Dry Farming Collaborative Replicated Variety Trials

- Farmer selected varieties
  - 5-8 varieties of each crop
  - Up to 20 replications of each crop across sites
- Mother – Daughter trial design
- Farmers designed replication size and protocol
- Intention to be inclusive of growers on different scales



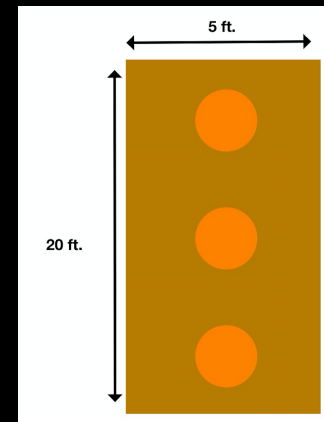
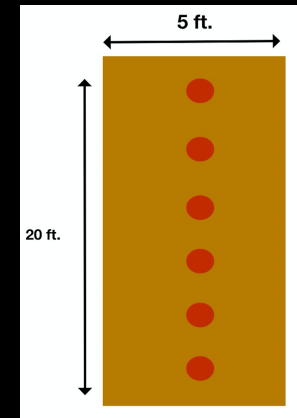
# 2017 -2018 DFC Replicated Variety Trials

- **Tomatoes:** Early Girl, Dirty Girl, Stupice, Big Beef, Perfect Rogue, Cour di Bue
- **Winter Squash:** Stella Blue, , Winter Sweet, Hidatsa, Zeppelin Delicata,, Lower Salmon River,, Little Gem
- **Zucchini:** Dark Star, Costata Romanesco, Goldini Zucchini, Rugosa Friulana, Genovese
- **Melon:** Eel River, , Christmas Watermelon, Desert King Watermelon, Rich Sweetness, Sweet Freckles, Piel de Sappo
- **Beans:**, Volga German, Whipple, Early Warwick, Beefy Resilient Grex
- **Corn:** Papas Red, Open Oak Party Mix Dent Corn, Magic Manna, Cascade Ruby Gold, Painted Mountain



# Mother – Daughter Trial Design

Tomato					Melon				Winter Squash				Zucchini			Dry Beans			Corn			
P R	E G	S T	C D B	C D B	S F	P S	E R	D K	H	L G	W S	L G	R F	C R	R F	B R	M S	V G	H B	C R	P M	P M
P R	C H B	E G	C H B	D G	D K	E R	P S	X M	D Z	L S	W S	S B	G	G	C R	V G	V G	E W	P R	C R	O P	C R
E G	C D B	B B	P R	D G	X M	R S	E R	R S	L S	D Z	L S	S B	D S	G Z	D S	W	M S	M S	O P	M M	O P	H B
E G f 2	S T	D G	B B	C H B	D K	X M	R S	D K	W S	H	S B	H	G Z	R F	G	B R	E W	B R	M M	P M	P R	M M
B B	E G f 2	E G f 2	S T	E G f 2	P S	S F	S F	P S	L G	H	D Z	W S	G Z	C R	D S	E W	W	W	O P	H B	P R	M M



1 rep = 100 sq ft  
Or ~10 sq meters

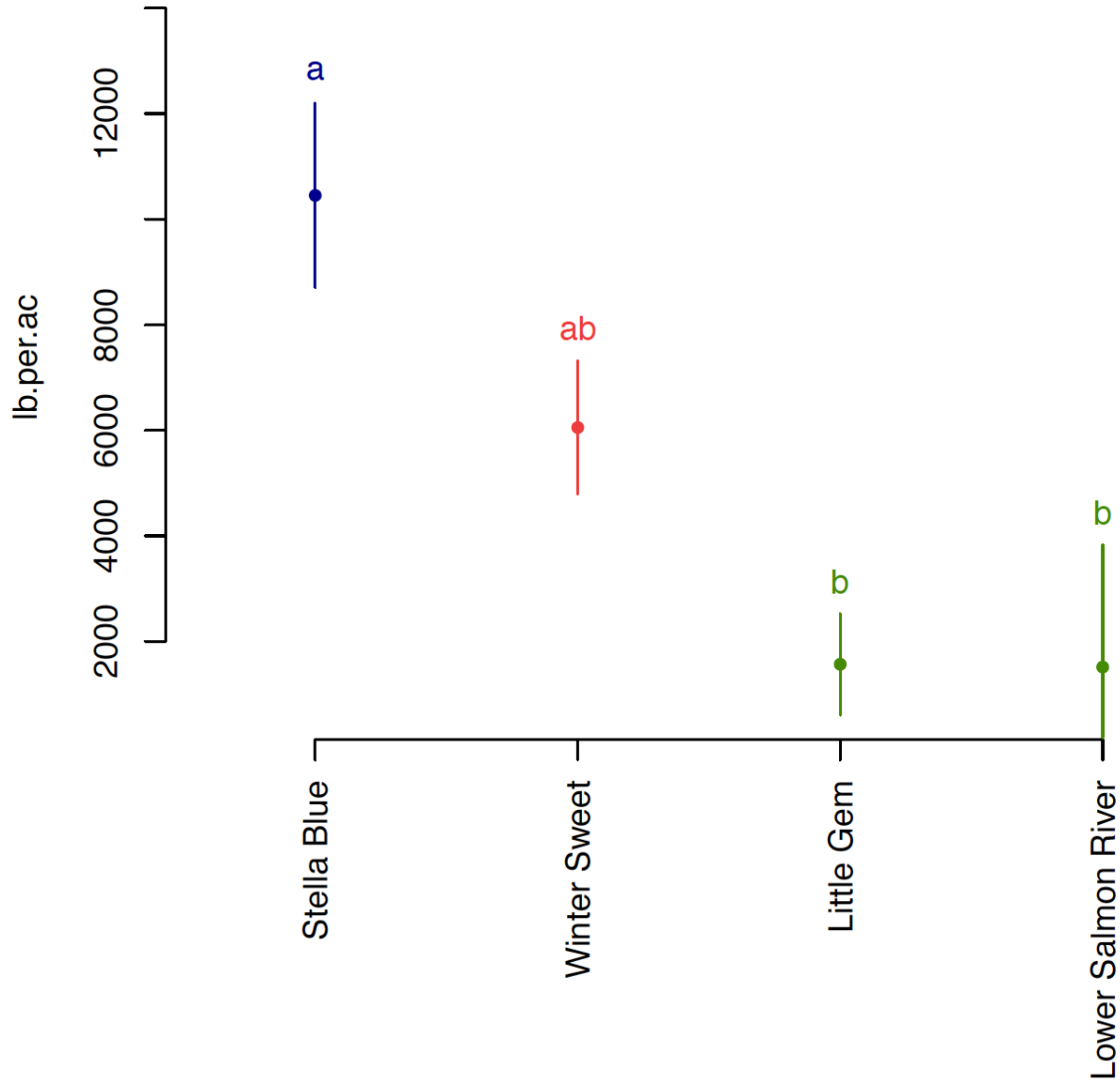
# 2017 DFC Participatory Science

## Tomato Yield Data

- 5 farms collected yield data on 11 tomato varieties
- Unbalanced design – *difficult to fit to a statistical model*
  - Not all farms grew all varieties
- Statistical analysis
  - Random effects
    - Genotype x environment
  - Fixed effects
    - Plant Density ( $p=0.14$ )
      - Results suggest density effect of about 3 lb/plant, density range was from 870-2700 plants/ac
    - Available Water-Holding Capacity ( $p=0.06$ )
      - Results suggest an extra inch of water holding capacity in the soil is worth a couplet thousand lbs per acre of yield

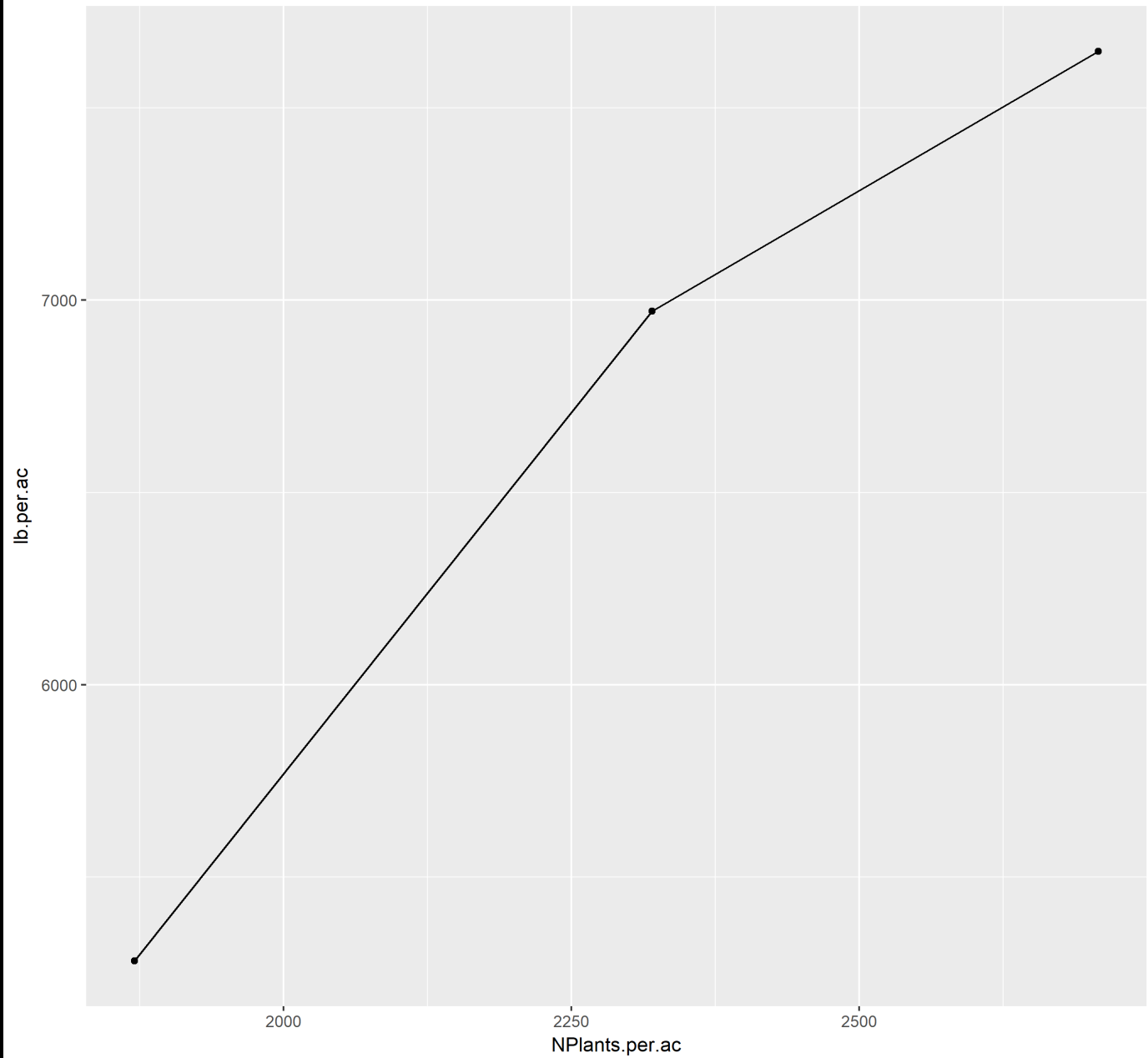


Squash Lewis Brown (Tukey HSD)



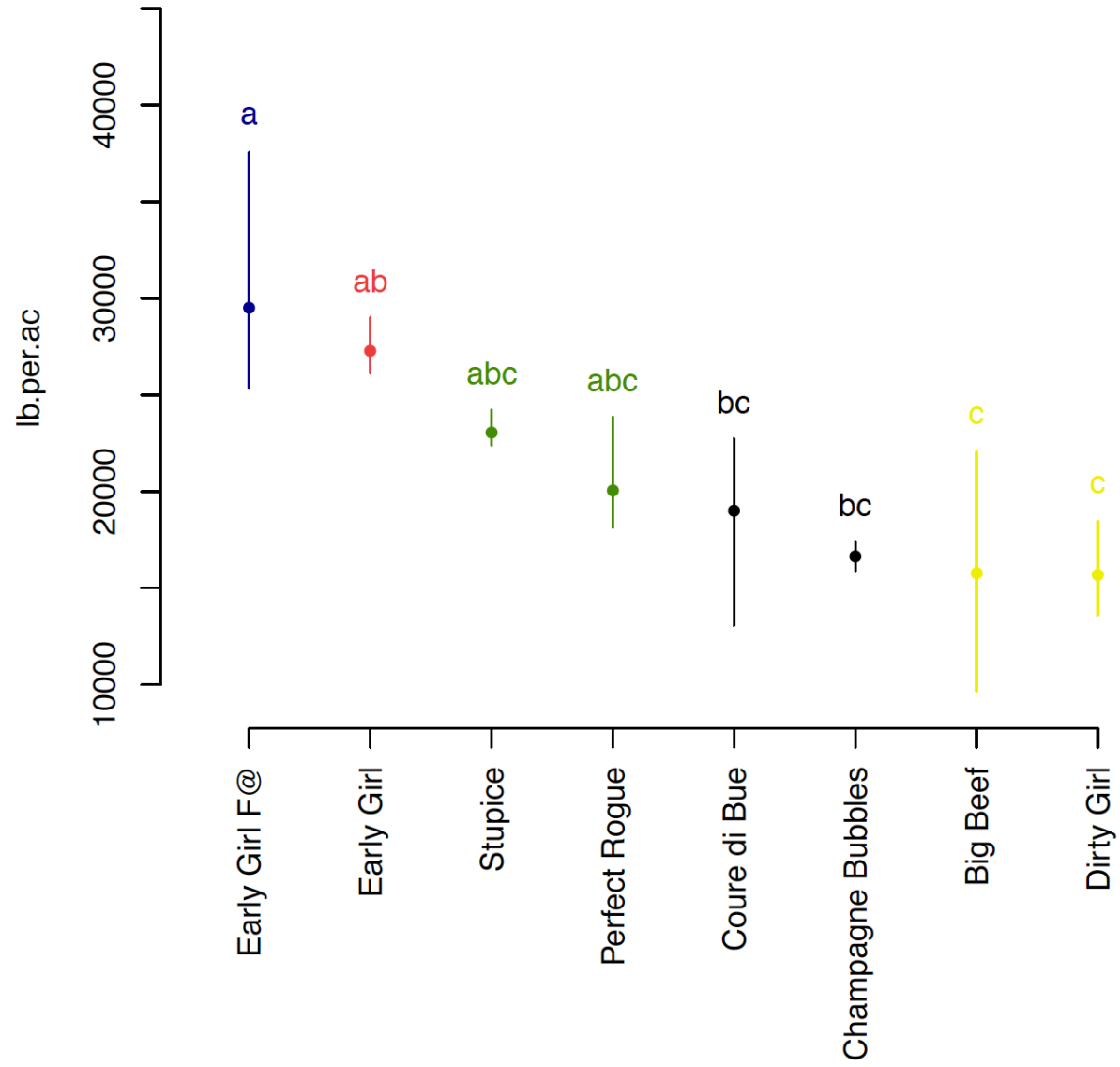
# Density Effect, Last Year's Rain, Big Beef Tomato

lm(lb.per.ac ~ -1 + NPlants.per.ac; p-value = 0.00044



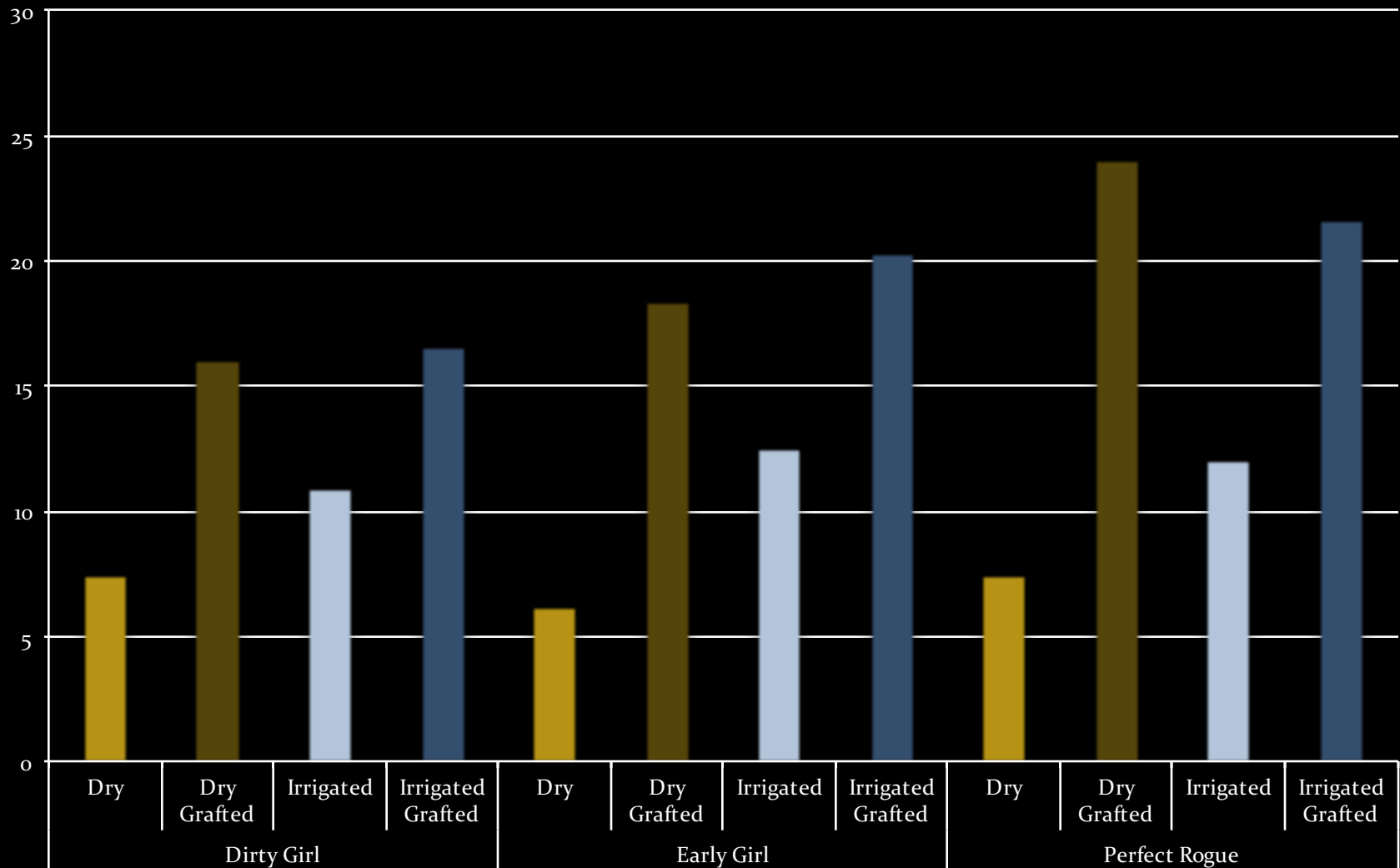


# Tomato Lewis Brown (Tukey HSD)



# 2017 Oak Creek Tomato Yield per Plant (lbs)

## Harvest 8/7 - 9/16





# Dry Farming Project

## Next Steps.....

- Developing Dry Farming page on OSU Small Farms website to be a resource hub for dry farming in our region
- Initiate dry farming extension publication series (release will begin in late 2018)
  - Intro to Dry Farming
  - Site assessment and selection
    - Soil moisture monitoring on 33 farms in 2018
  - Case studies
  - Variety Trial Report
- Continue to build network of growers
  - Collaborative learning
  - Participatory research
  - Expand our drought mitigation toolbox



# Topics of Interest

- Participatory Plant Breeding for Dry Farmed Systems
  - Beefy Resilient Grex – Carol Deppe (cross between Black Mitla tepary and Gaucha common bean)
- Dry Farmed Orchard Systems
- Hugelkultur
- Different types of mulching
  - Deep straw
  - Wood chips
  - Weed fabric
- Others?







For more info visit:

<http://smallfarms.oregonstate.edu/dry-farm/dry-farming-project>

Join the **Dry Farming Collaborative** group on Facebook



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*Co-creating the future of how we manage water on our farms*