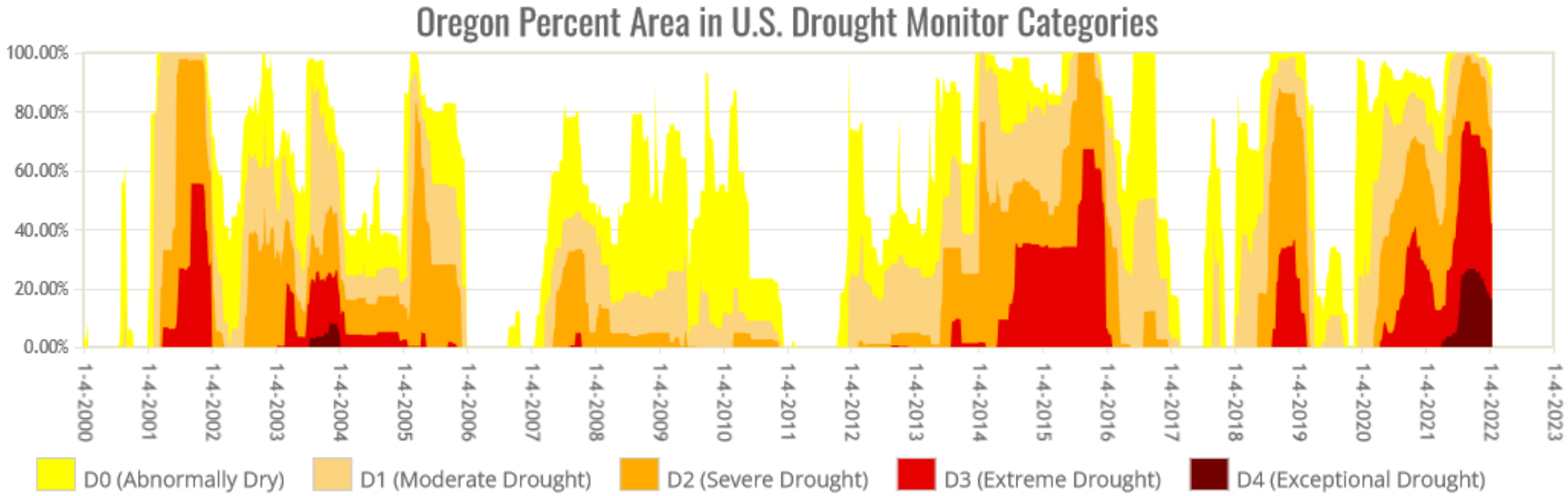
Water use survey, irrigation initiation trial, irrigation scheduling how-to

Dr. Alec Levin, Viticulturist and Assistant Professor

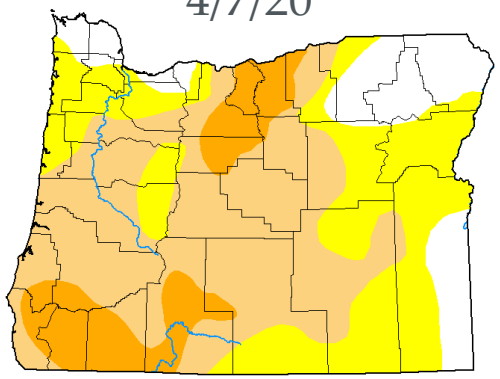
Oregon State University
Southern Oregon Research and Extension Center

Cyclical nature of drought in Oregon

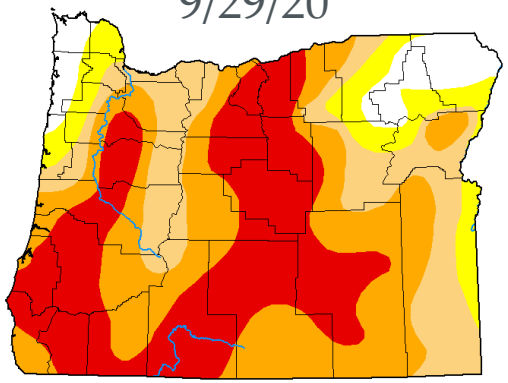


Progression of recent drought in Oregon

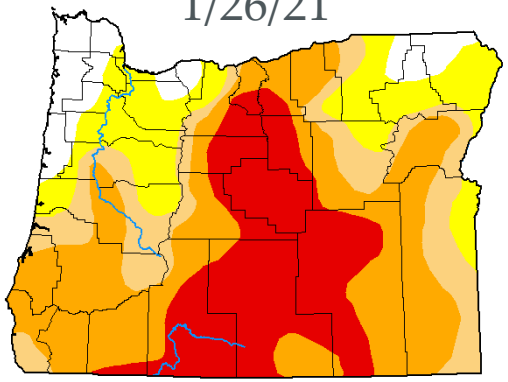
4/7/20



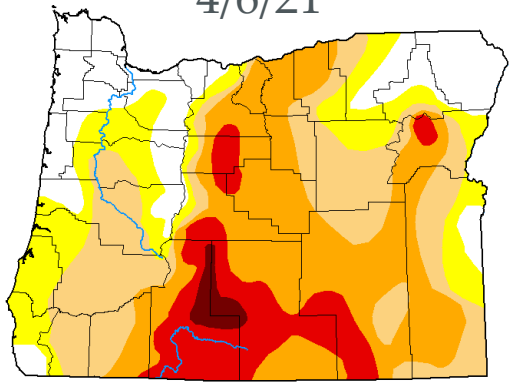
9/29/20



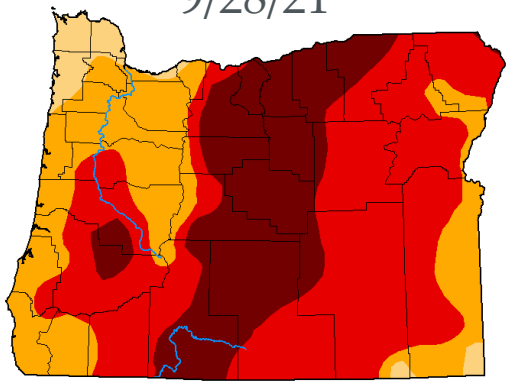
1/26/21



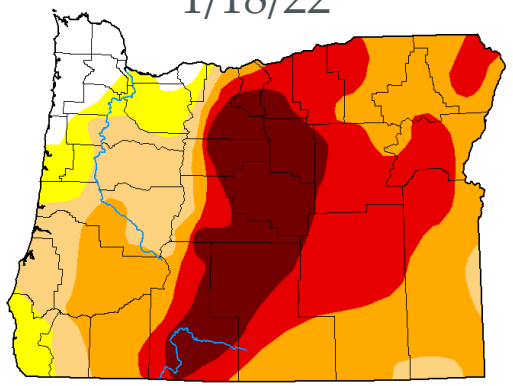
4/6/21



9/28/21



1/18/22



Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

Author:

Brian Fuchs
National Drought Mitigation Center

droughtmonitor.unl.edu

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TALK OUTLINE

- **Oregon Vineyard Water Use**
  - *Preliminary results from 2021 survey*
- **Optimizing irrigation initiation**
  - *Updates on OWB-funded research*
- **Irrigation scheduling 101**
  - *How to write an irrigation schedule*

OREGON VINEYARD WATER USE

Preliminary results from 2021 survey

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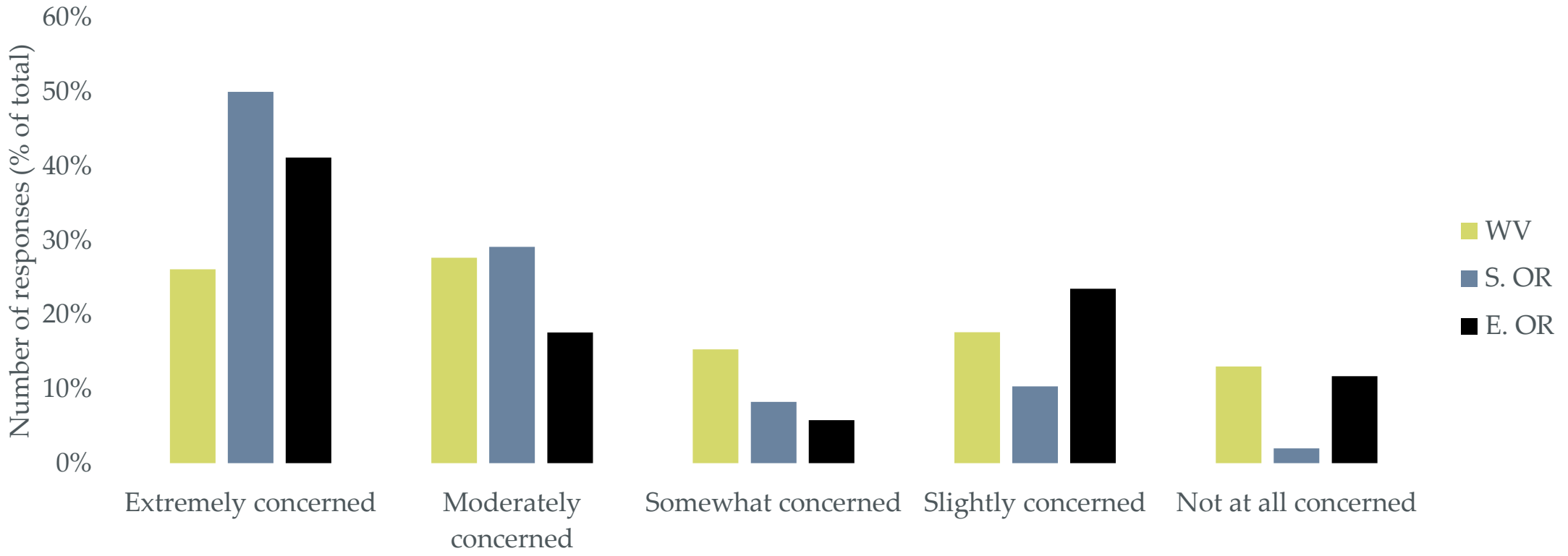
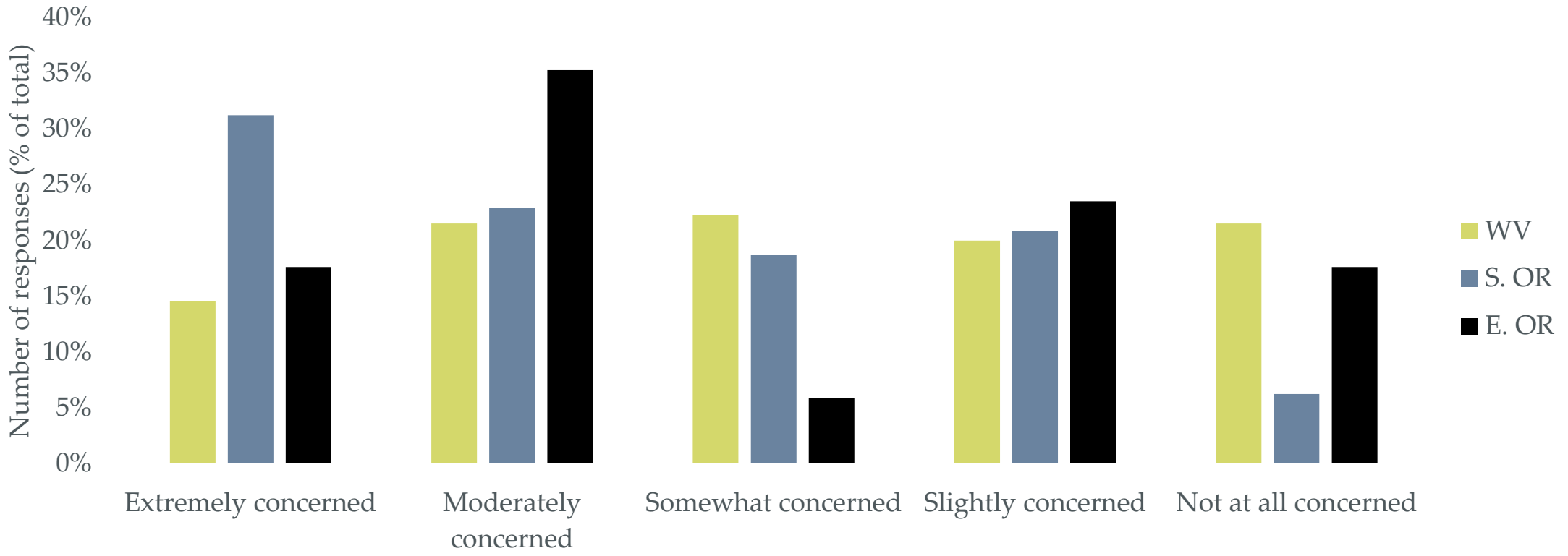
Oregon vineyard water use survey

- Distributed Summer 2021
- Collected 251 responses:
  - WV = 181
  - S. OR = 52
  - E. OR = 18
- Representing 18,923 acres (48%)

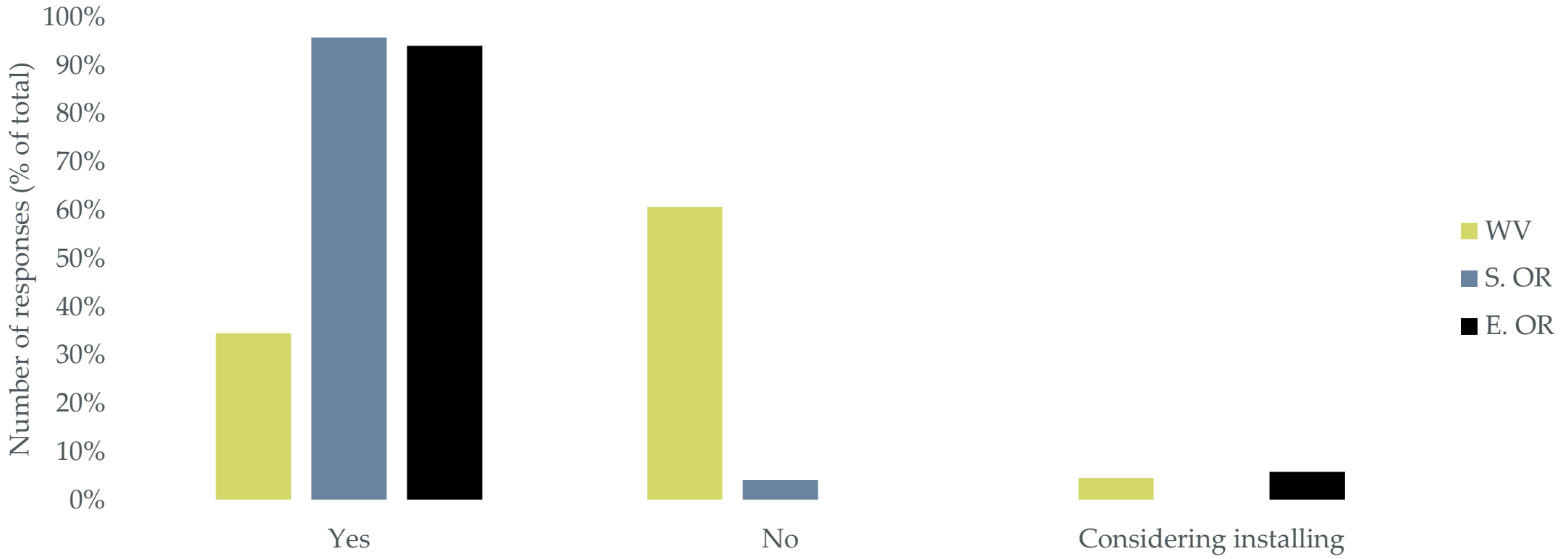
How concerned are you about water mgmt. and availability in your vineyard(s) this season?



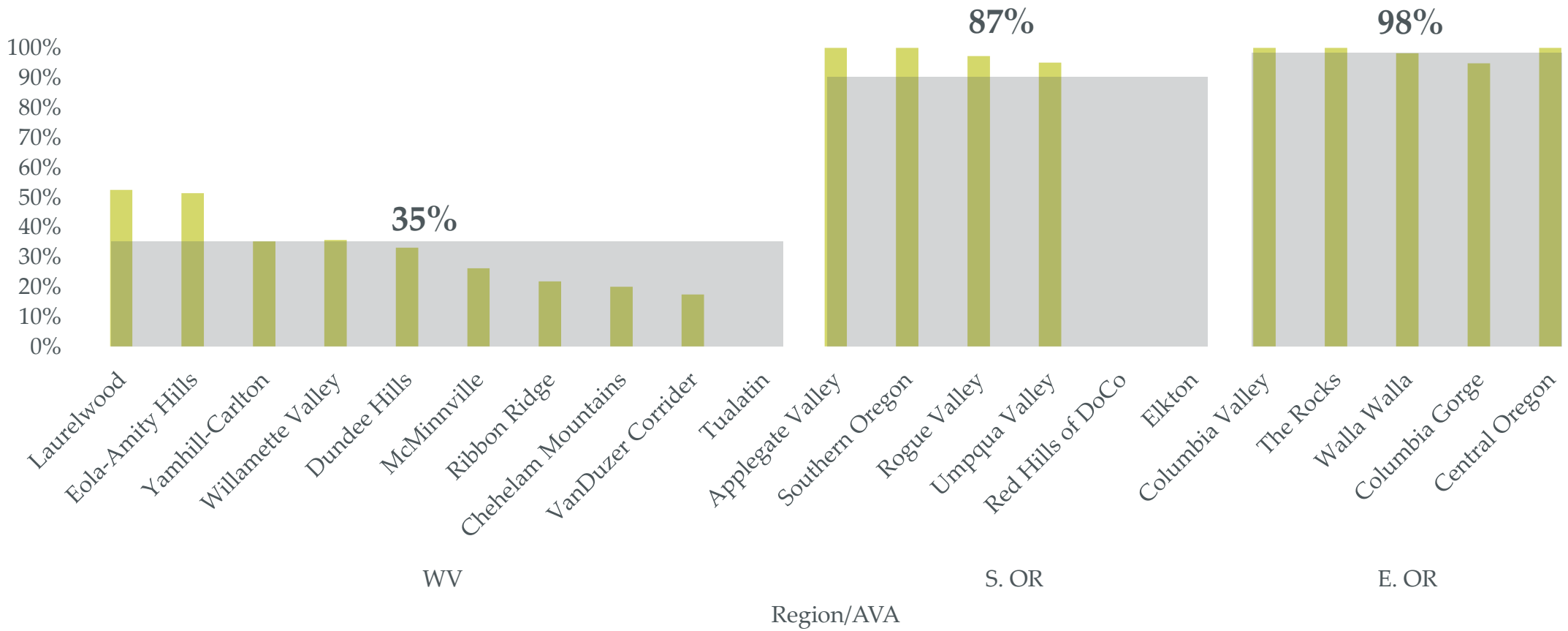
How concerned are you about water mgmt. and availability in your vineyard(s) in general (3-5 yrs.)?



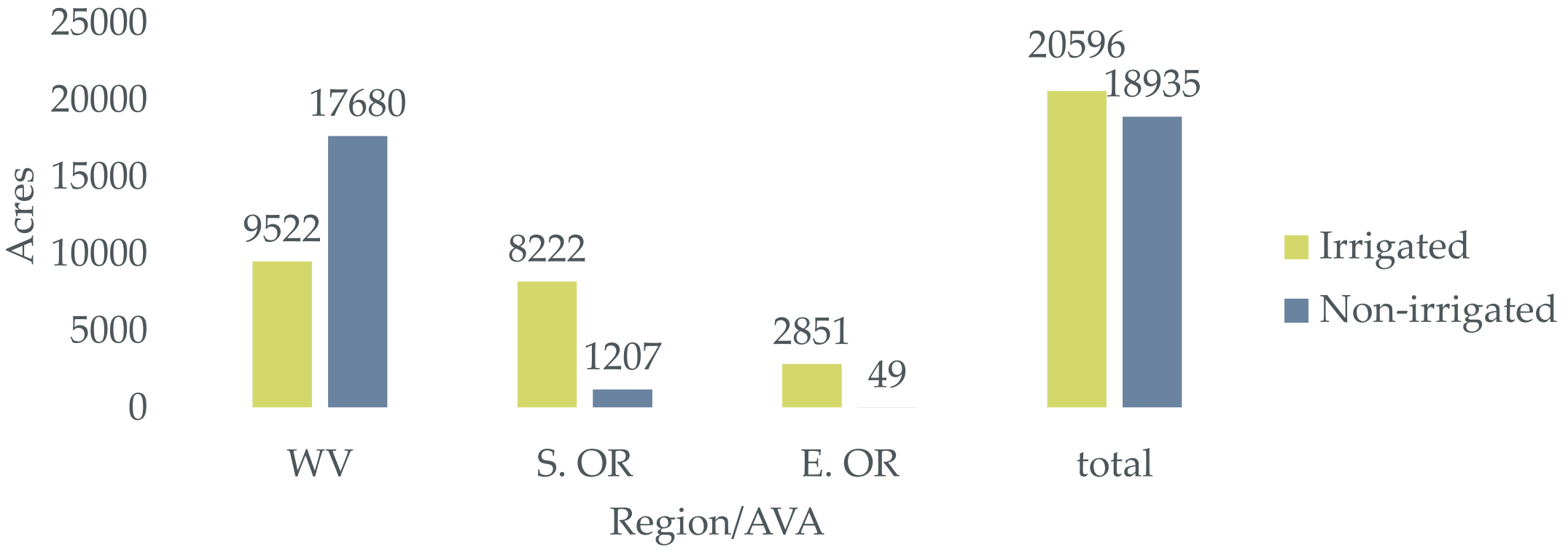
Do you have an irrigation system in your vineyards?



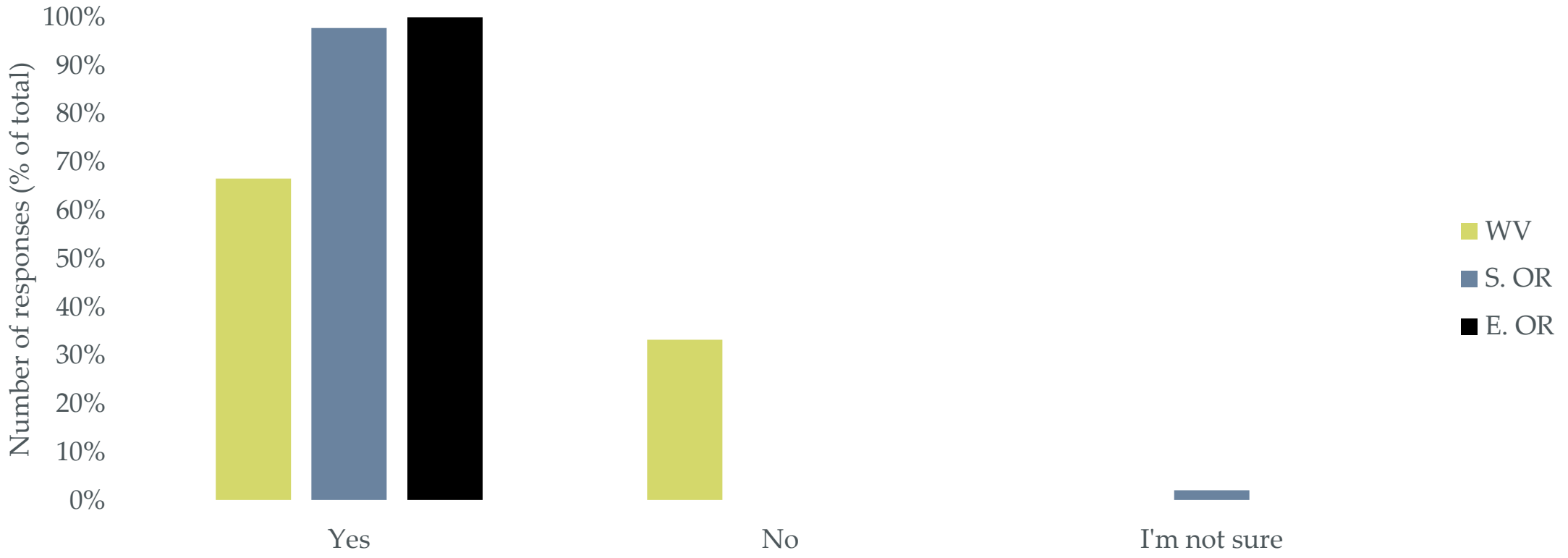
Reported irrigated acreage (% of total)



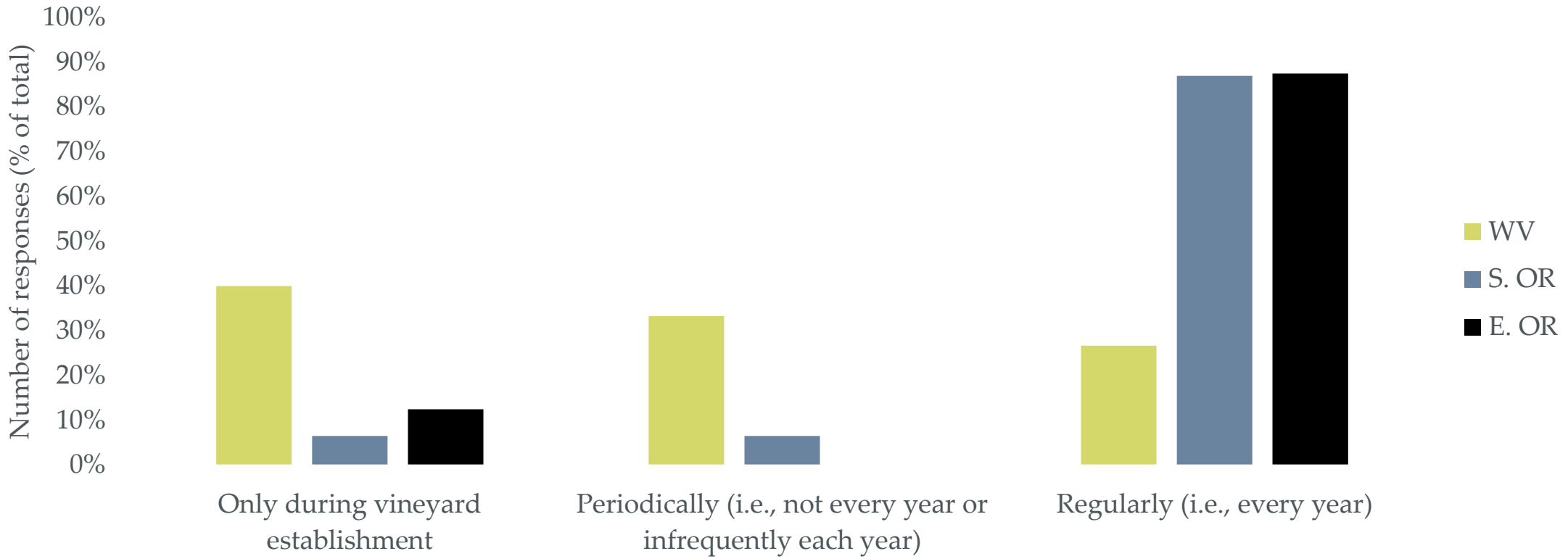
Estimated irrigated vs. non-irrigated acres



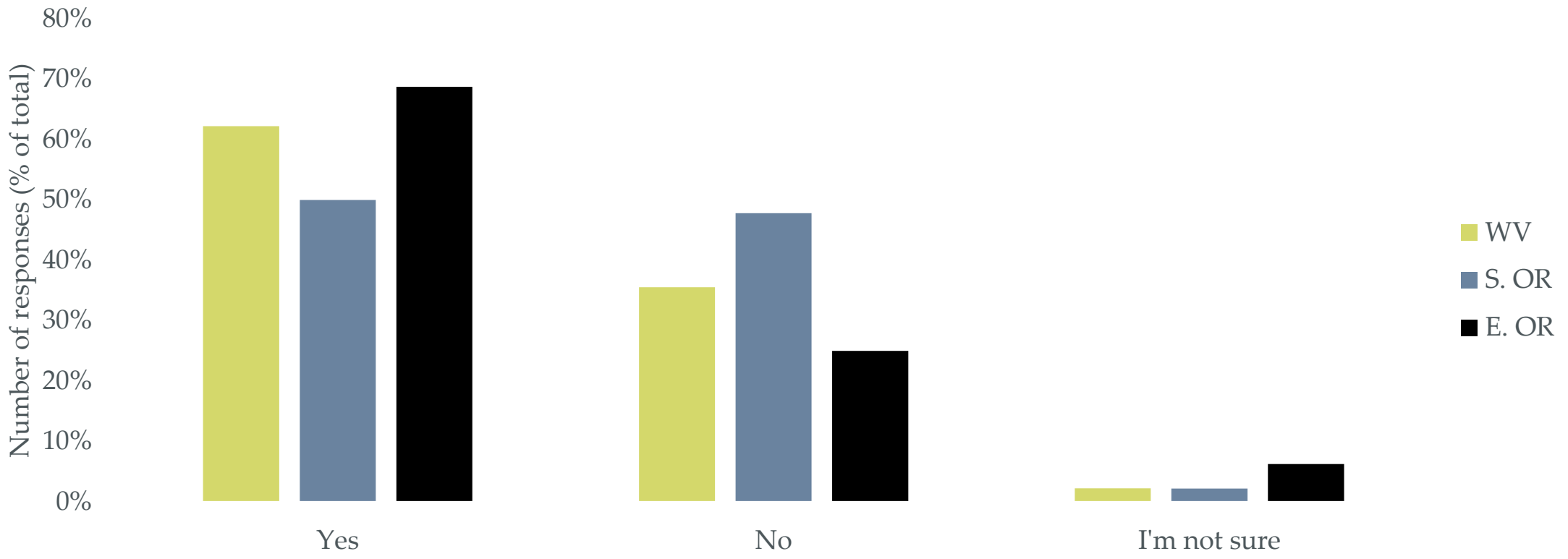
Were the majority of your vineyards established with irrigation?



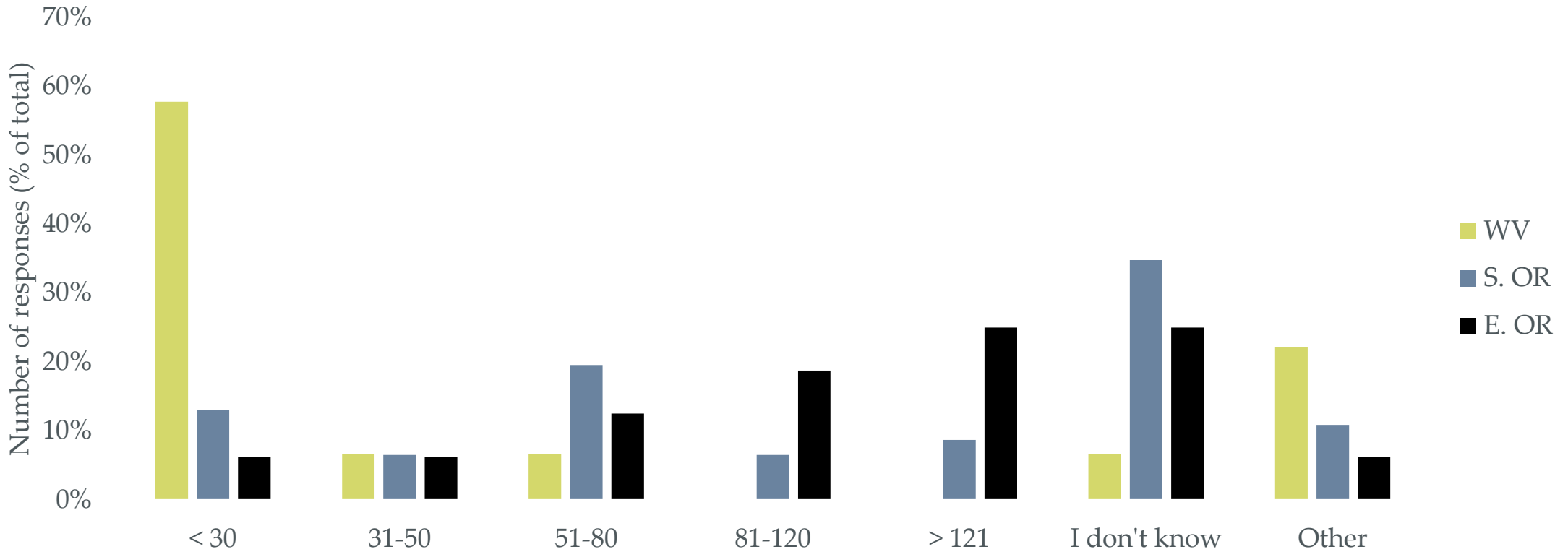
How often is your irrigation system used?



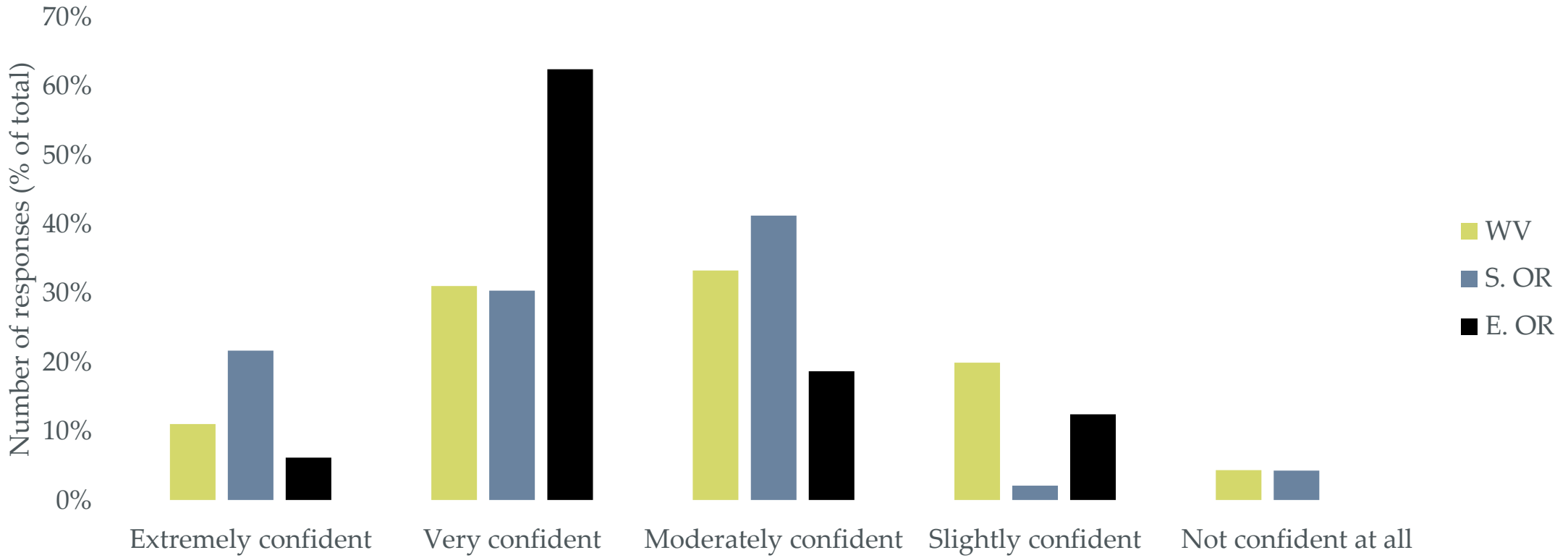
Do you use flow meters to monitor water usage in your vineyard?



How much water do you apply (gallons/vine) per season?



How confident are you that you're applying the correct amount of water at the correct times to meet your vineyard goals?



OPTIMIZING IRRIGAITON INITIATION

Updates on OWB-funded research

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When should irrigation be initiated?

- Initiating irrigation schedule is critical annual decision
- Significant impacts on current and next year's crop
- Delays can be good or bad and are goal-dependent

Vineyard description and management

Site	Elevation (ft.)	Soil Series	Texture Class	Clone	Year planted	Pruning	Management
Eagle Point	1495	Agate-Winlo complex	Loam-gravelly clay loam	UCD 5 (Pommard)	2017	Cane	Conventional
Jacksonville	1675	Ruch	gravelly silt loam	UCD 5 (Pommard)	2014	Spur	Conventional
Ashland	2059	Darow	silty clay loam	UCD 2A (Wadenswil)	2012	Cane	Organic

*All sites planted on 7 x 4 ft. spacing and used 3309C rootstock

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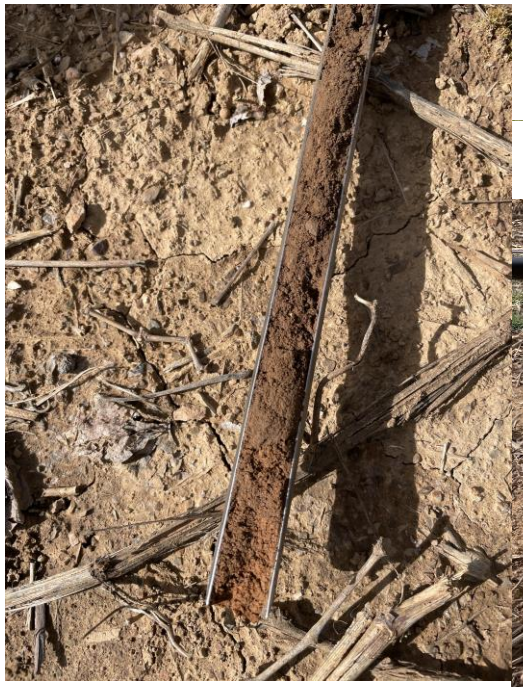
Soil pics

Eagle Point



Jacksonville

Ashland

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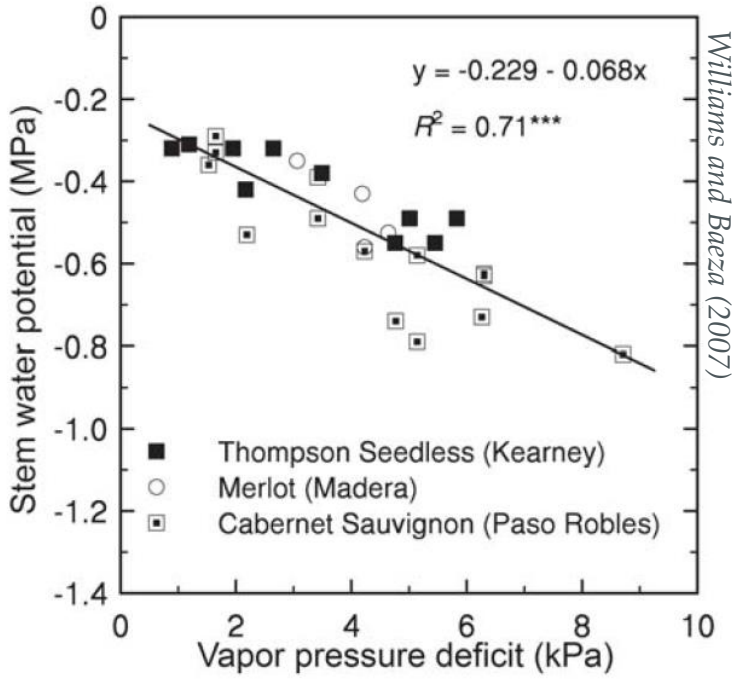
Irrigation treatments

For more info on baseline SWP:
https://bit.ly/3H0XwL4



Calculated from VPD — Measured SWP

$$SWP_{ns} - SWP_{abs} = \Delta SWP$$

Treatment	ΔSWP threshold for irrigation initiation
T1 (control)	-2 bar
T2	-4 bar
T3	-6 bar
T4	-8 bars
T5	-10 bars

Plots irrigated at 70% estimated ET_c after initiation

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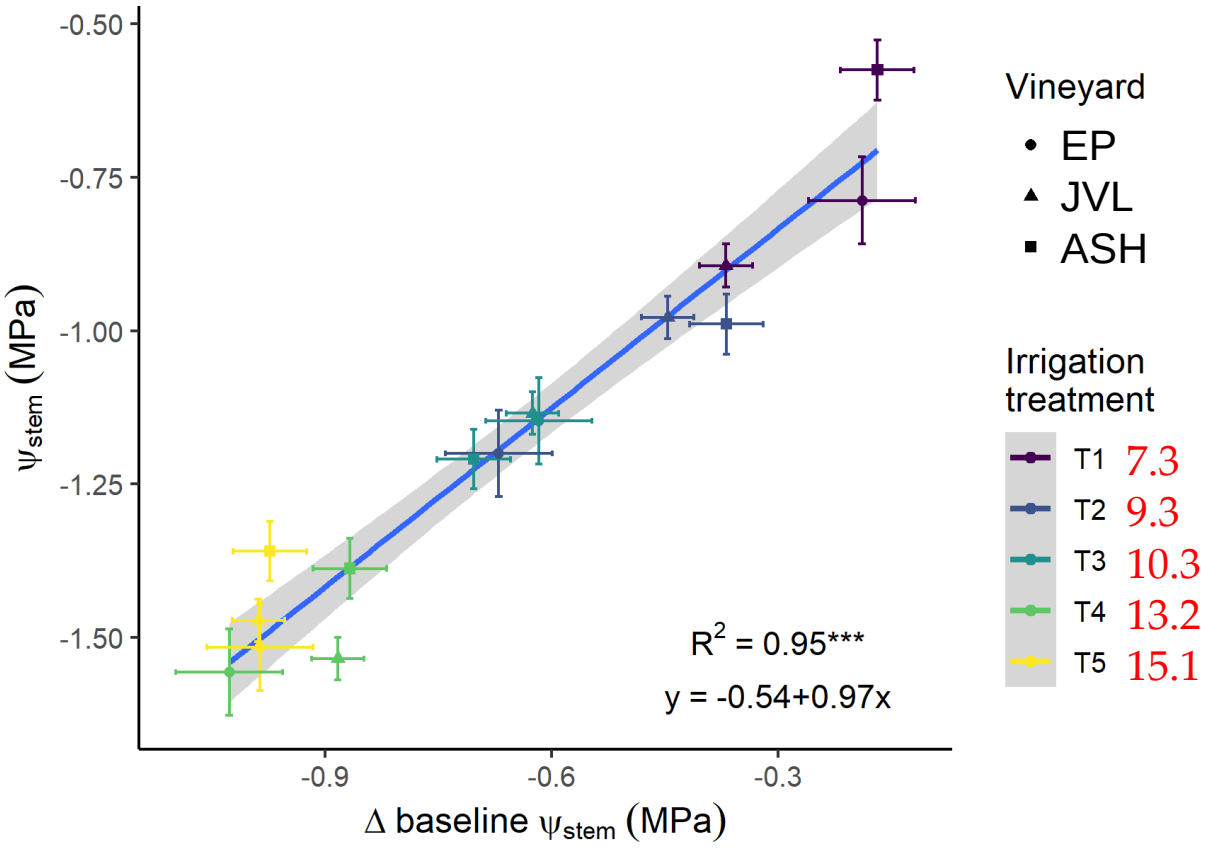
Initiation date, applied water, SWP

Variable	Treatment	Sites			*All*
		EP	JVL	ASH	
Initiation date	T1	6/1	7/5	6/16	*6/17*
	T2	6/22	7/12	6/27	*6/30*
	T3	6/22	7/19	7/4	*7/5*
	T4	7/3	7/29	7/28	*7/20*
	T5	7/3	8/9	8/23	*8/1*
Applied water (gallons/vine*)	T1	149	87	158	*131*
	T2	141	78	141	*120*
	T3	141	69	128	*113*
	T4	123	57	87	*89*
	T5	123	41	47	*70*

*divide by 17.4 to convert to inches



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Canopy size on 11 August 2021

T1

T3

T5

Linear reductions in berry size and yield

Variable	Treatment	Sites				
		Eagle Point	Jacksonville	Ashland	*All*	
Berry weight (g/berry)	T1	0.90	1.15	1.15	*1.06*	
	T2	0.85	1.05*	1.08	*0.99**	-6%
	T3	0.85	1.03**	0.92***	*0.93****	-12%
	T4	0.75**	0.99***	0.83***	*0.86****	-19%
	T5	0.73***	0.84***	0.77***	*0.79****	-25%
Yield (tons/ac)	T1	5.0	6.5	4.3	*5.2*	
	T2	4.0	6.1	3.7	*4.5**	-14%
	T3	4.1	5.8	3.8	*4.4**	-15%
	T4	3.5*	6.0	3.2**	*4.1****	-22%
	T5	3.3*	5.5	2.6***	*3.7****	-29%

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Fruit chemistry at harvest: sugar

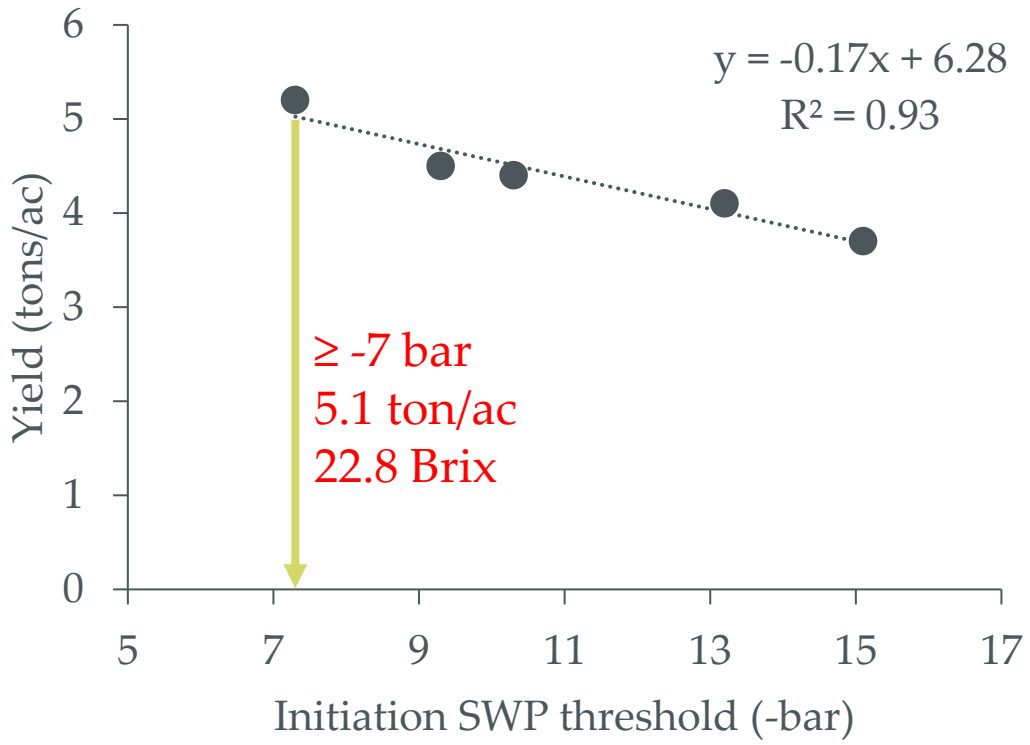
Variable	Treatment	Sites			
		Eagle Point	Jacksonville	Ashland	*All*
Brix	T1	20.9	25.1	22.3	*22.8*
	T2	20.8	26.0	22.3	*23.0* +0.2
	T3	21.0	25.8	21.4	*22.7* -0.1
	T4	22.2**	25.0	20.3***	*22.7* -0.1
	T5	21.2	24.8	20.3***	*22.1* -0.7
Sugar per berry (mg)	T1	187	289	259	*240*
	T2	176	273	242	*230*
	T3	180	265*	197***	*214***
	T4	165	253**	168***	*196****
	T5	155**	207***	165***	*176****

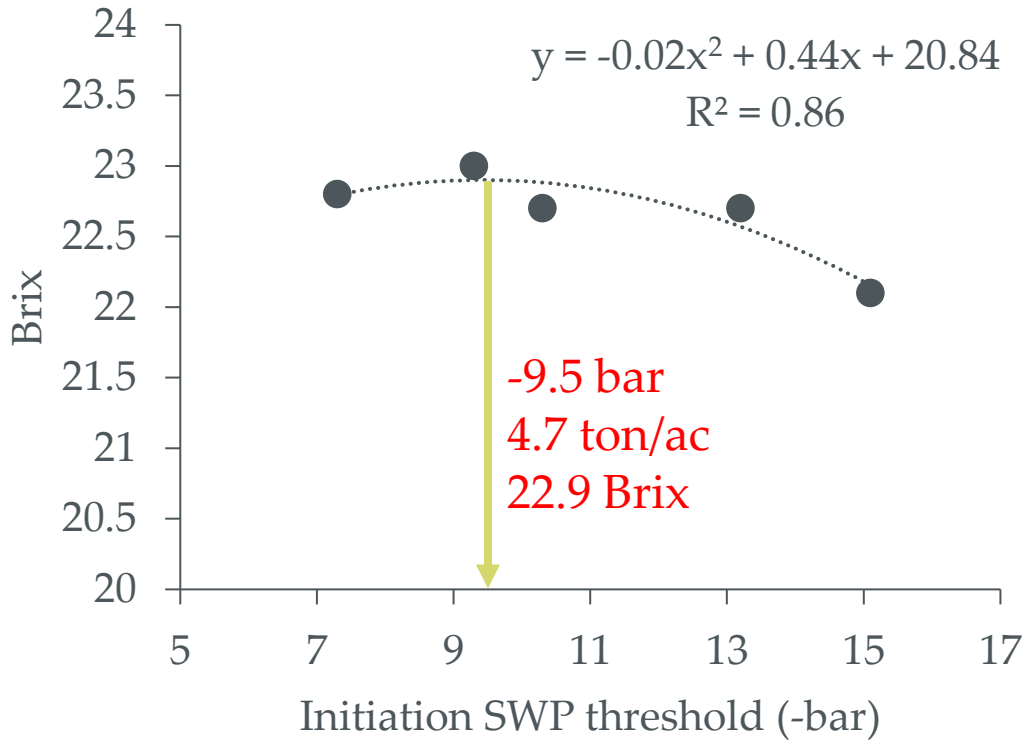
Fruit chemistry at harvest: acid

Variable	Treatment	Sites			All
		Eagle Point	Jacksonville	Ashland	
pH	T1	4.03	3.97	3.51	*3.84*
	T2	4.04	3.99	3.56	*3.86*
	T3	4.15***	4.02	3.46	*3.88*
	T4	4.05	3.95	3.47	*3.82*
	T5	4.04	3.92	3.49	*3.82*
TA (g/L)	T1	5.2	5.9	6.7	*6.0*
	T2	5.1	5.7	6.9	*5.9*
	T3	5.1	5.7	6.6	*5.8*
	T4	4.8*	5.1***	5.6**	*5.2****
	T5	5.1	6.3	6.6	*6.0*

Little to no effect

Can we optimize yield and Brix?





Is 8% yield loss worth 0.1 Brix gain?

To be continued…

Winemaking

Phenolics analyses

For more info on irrigation scheduling:
https://bit.ly/3r4m1BC

IRRIGATION SCHEDULING 101

How to write an irrigation schedule

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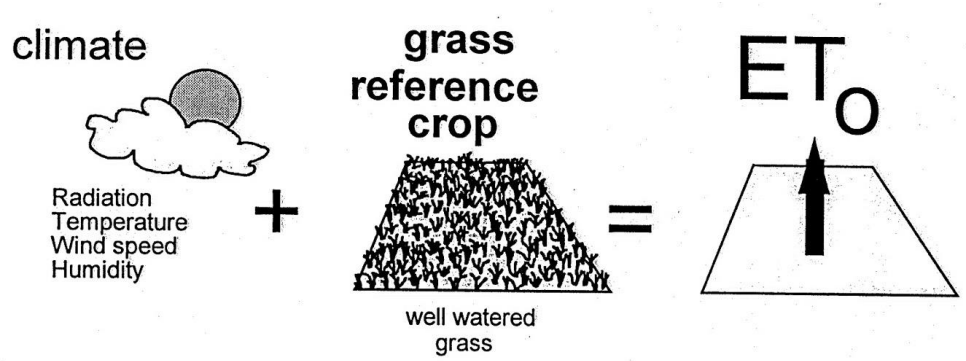
One equation to rule them all

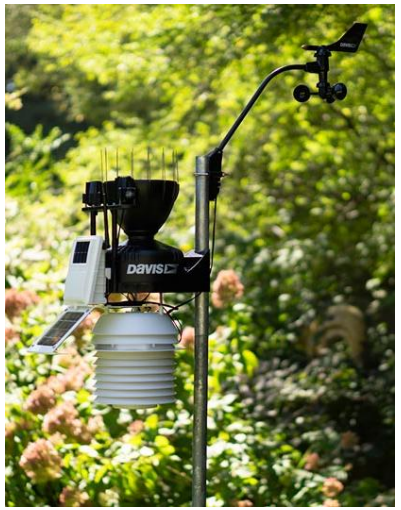
Crop water use =

$ET_o * K_c = ET_c$

- Evaporative demand (i.e., reference evapotranspiration or ET_o)
- Seasonal growth of the vine (i.e., crop coefficient or K_c)
- *Amount of water in the soil profile*

Step 1: determine daily reference ET (ET_o)





Step 2: determine total ET_o between irrigations

BEGIN DATA	Daily ET_o
DATE ,	MDFO ETOS,
07/05/2021,	0.28,
07/06/2021,	0.29,
07/07/2021,	0.27,
07/08/2021,	0.27,
07/09/2021,	0.28,
07/10/2021,	0.28,
07/11/2021,	0.26,
END DATA	1.93

Total ET_o between irrigations =

Sum of daily ET_o (inches/day) =

1.93 inches/week

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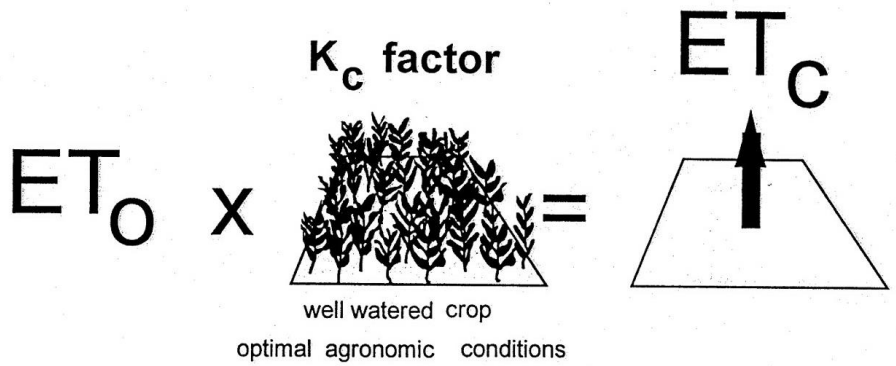
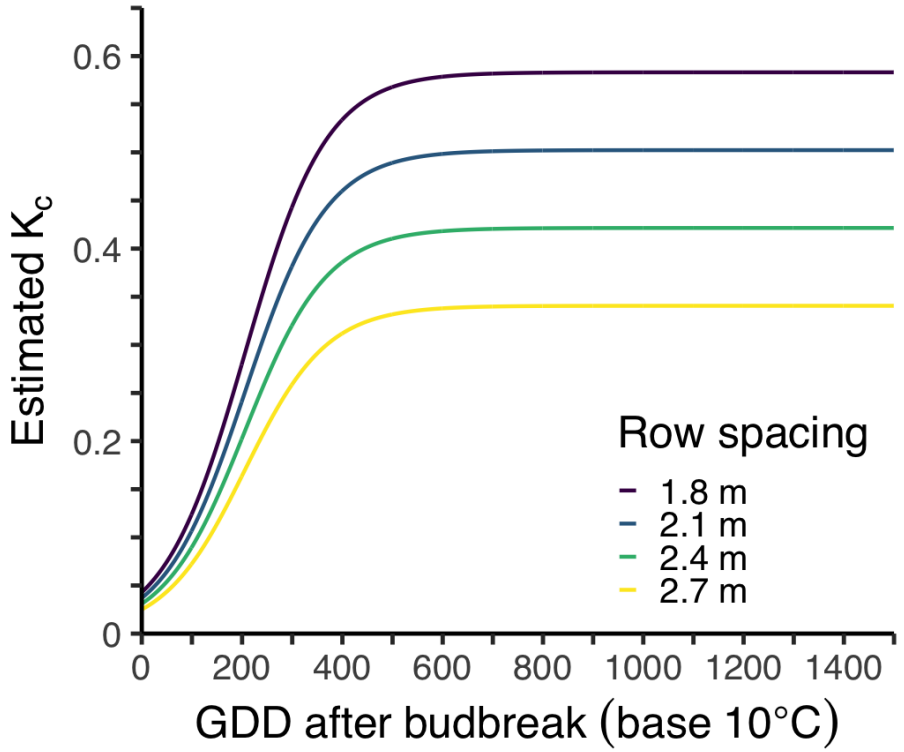
Step 3: determine your K_c





Step 3: determine your K_c using equation

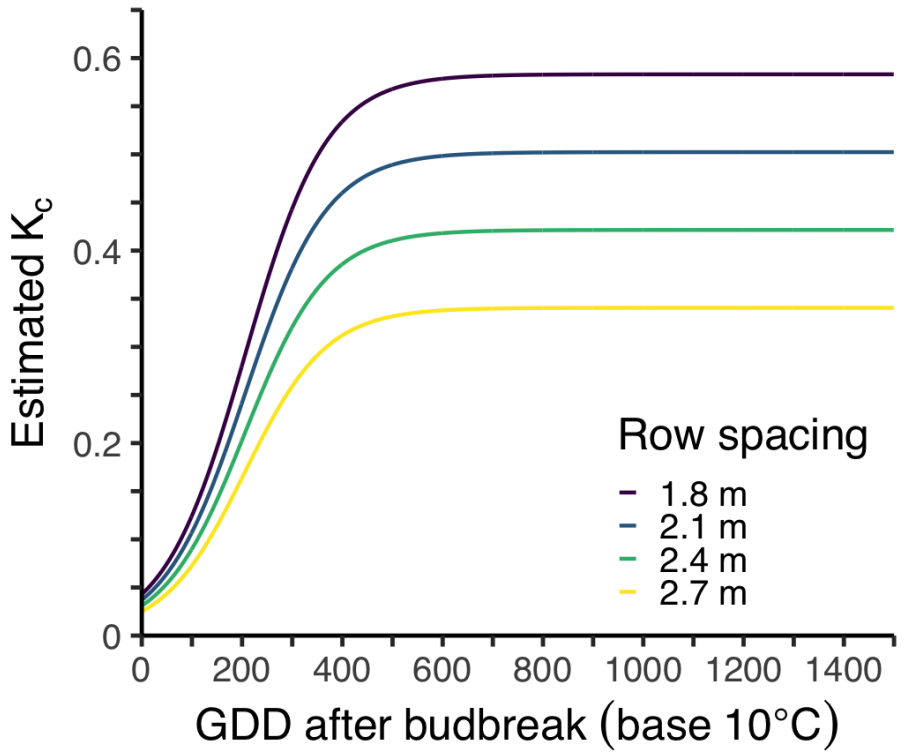
BEGIN DATA

DATE	MDFO TG
07/05/2021,	21.22
07/06/2021,	22.70
07/07/2021,	20.52
07/08/2021,	19.01
07/09/2021,	20.04
07/10/2021,	22.01
07/11/2021,	21.01

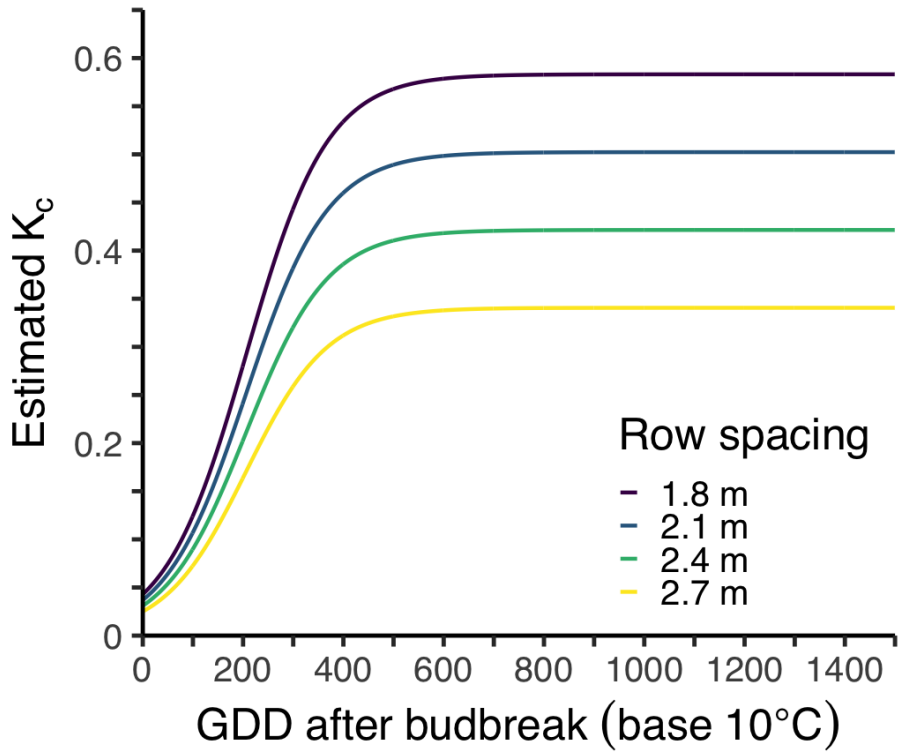
END DATA

Daily DDs

146.51



Step 3: determine your K_c using equation



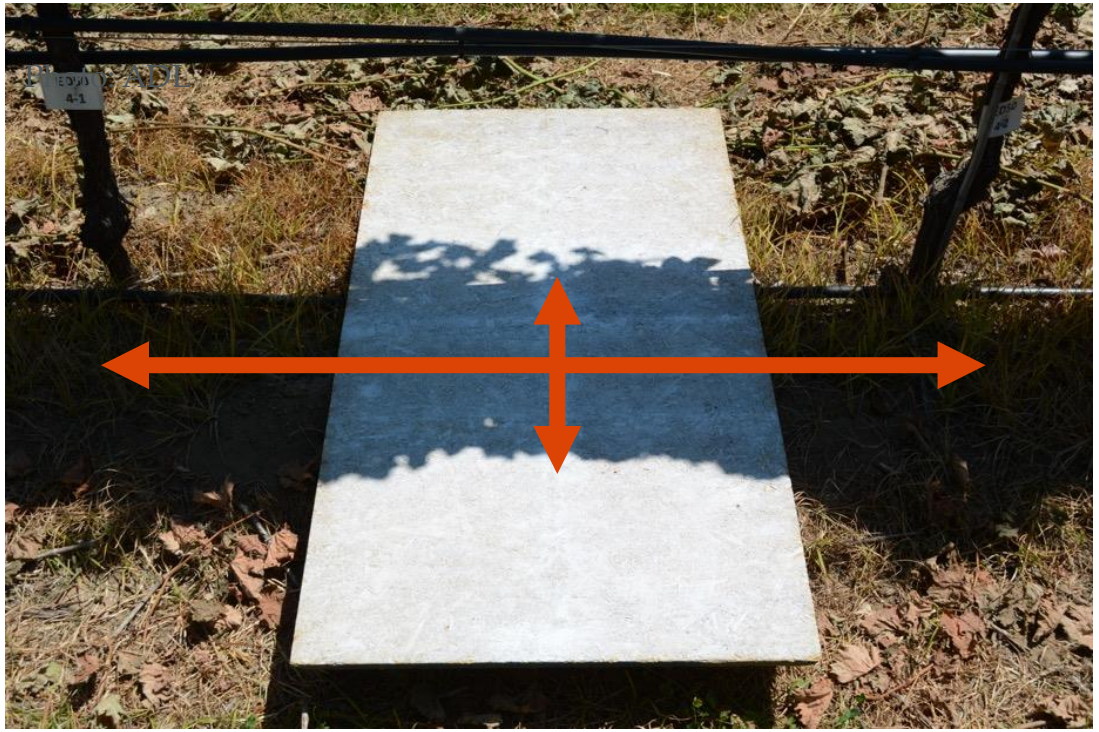
For VSP trellis:

$$K_c = \frac{K_c^{max}}{1 + e^{\left(\frac{(371 - GDD_F)}{146}\right)}}$$

*e is Euler's number: 2.71828

Row spacing (m)	Row spacing (ft.)	K_c^{max}
2.7	9	0.34
2.4	8	0.42
2.1	7	0.50
1.8	6	0.58

Step 3: determine your K_c manually



$$\boldsymbol{Kc = \text{percent shaded area (PSA)} * 0.017}$$

$$PSA = \left(\frac{Total\ area\ of\ shade\ per\ vine}{Total\ land\ area\ per\ vine}\right) * 100$$

$$Kc = \left(\frac{2\ ft.shade\ *\ 5\ ft.bwtn\ vines}{8\ ft.rows\ *\ 5\ ft.bwtn\ vines}\right) * 100 * 0.017$$

$$Kc = \frac{10}{40} * 100 * 0.017$$

$$Kc = 25 * 0.017$$

$$\boldsymbol{Kc = 0.43}$$

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Step 4: determine total ET_c between irrigations

Total ET_c (in.) = Total ET_o (in.) * K_c

Total ET_o = 1.93 in. and K_c = 0.43

Total ET_c = 1.93 in. * 0.43

Total ET_c = 0.83 in.

Step 5: convert inches to gallons

Total ET_c (gallons/vine) = Total ET_c (in.) * ft^2/vine * 0.623

Total ET_c = 0.83 in. and vineyard spacing = 8 x 5 ft.

Total ET_c = 0.83 * 40 ft^2/vine * 0.623

Total ET_c = 20.7 gallons/vine

Step 6: calculate total irrigation run time

Total irrigation run time (T) = Total ET_c / emitter discharge rate per vine (q)

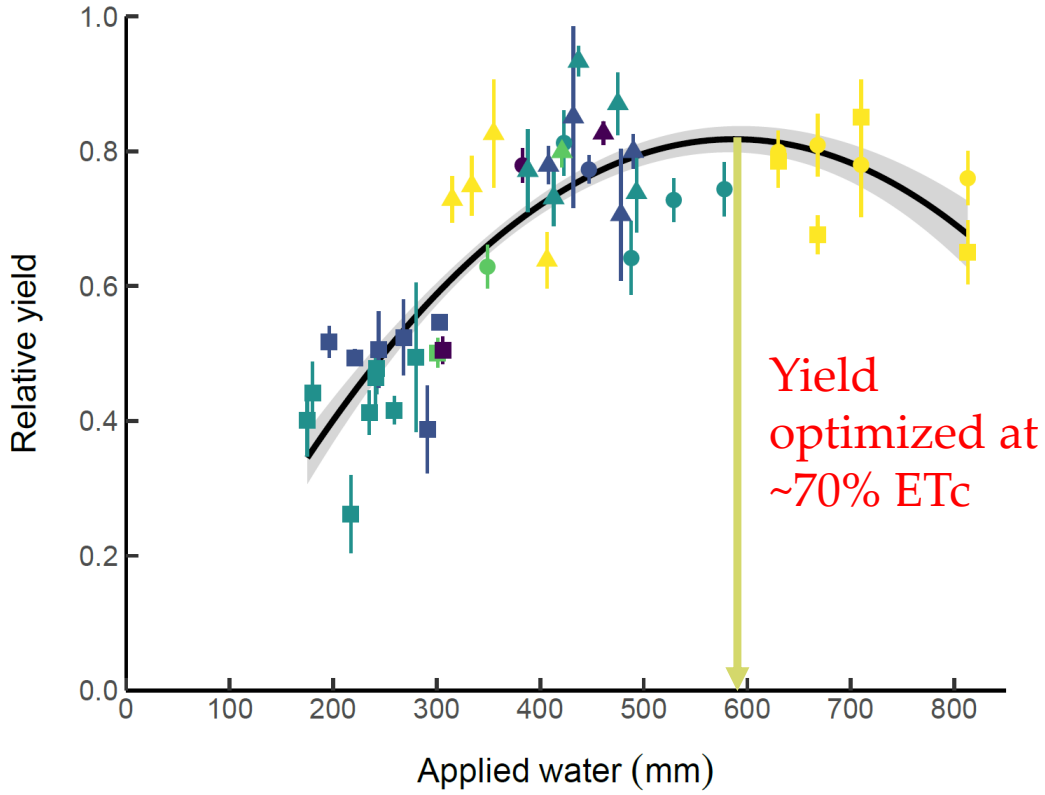
Total ET_c = 20.7 gallons/vine

*q = 3 emitters per vine * 0.26 GPH = 0.78 GPH/vine*

T = 20.7 gallons / 0.78 GPH

T = 26.5 hrs.

Step 7: apply stress coefficient (optional)



Deficit irrigation run time =

Total ET_c run time (T) * stress coefficient (K_s)

$T = 26.5$ hrs. and $K_s = 0.7$

Deficit run time = 26.5 * 0.7

= 18.6 hrs.

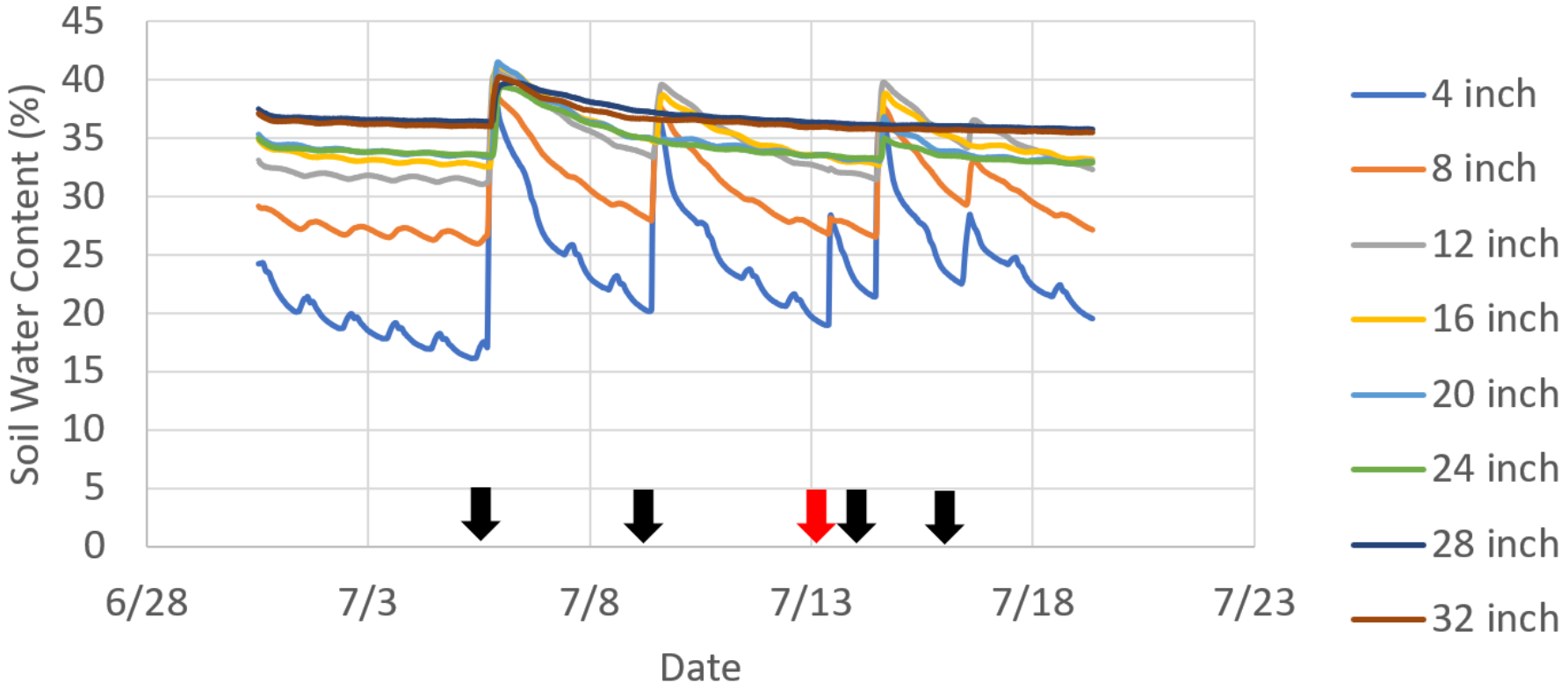
Step 8: determine number of sets

- Goals:
  - Limit runoff
  - Limit nutrient leaching below roots

- Limitations:
  - Soil water infiltration rate
  - System design/capacity
  - Where are the roots?

Evidence of runoff

Step 8: determine number of sets using soil moisture



THANK YOU FOR YOUR ATTENTION!

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