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IQ is dedicated to highlighting innovations that advance quality in ultra-premium and luxury wines

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Recent Research: Research That Will Change the Way You Make Wine

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NO-TOUCH VINEYARD

SENSING AND MANAGEMENT

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Driving Factors for Mechanization and Mechanical Management

- Mechanization
  - Timeliness of cultural practices
  - Willing labor force
  - Cost of labor ($15/h)
  - Quality of life socioeconomic factors
  - Proximity to population centers
  - Land availability and cost
  - Foreign competition

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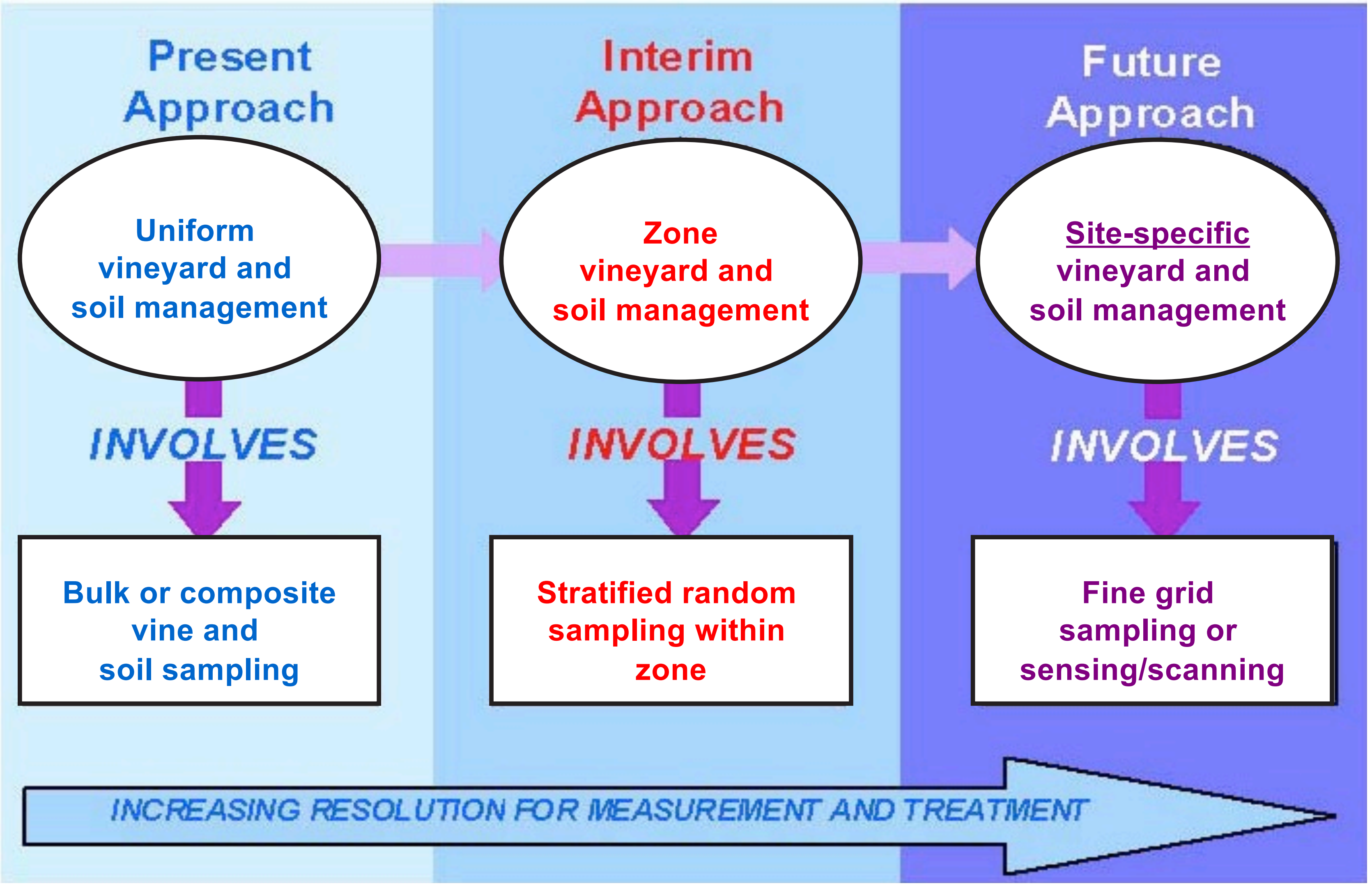
Evolution towards spatio-temporal management of vineyards



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What can we do in vineyards mechanically?

- Dormant pruning *
- Suckering
- Shoot thinning *
- Leaf removal *
- Berry/cluster thinning *
- Harvest

	Wine	Raisin	Table
Harvesting	90	35	-
Pruning			
Pre-prune	65	5	30
Box-hedge	12	-	-
Canopy Mgt			
Leaf removal	45	-	10
Shoot thinning	7	-	-
Hedging	100	100	100
Shoot positioning	2	-	-
Crop load Mgt			
Fruit removal	7	-	-

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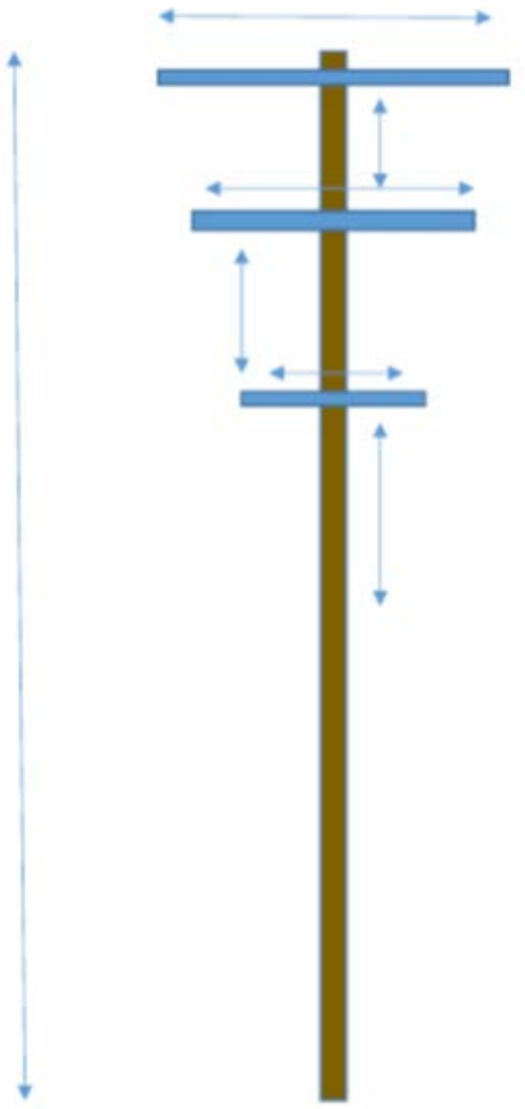
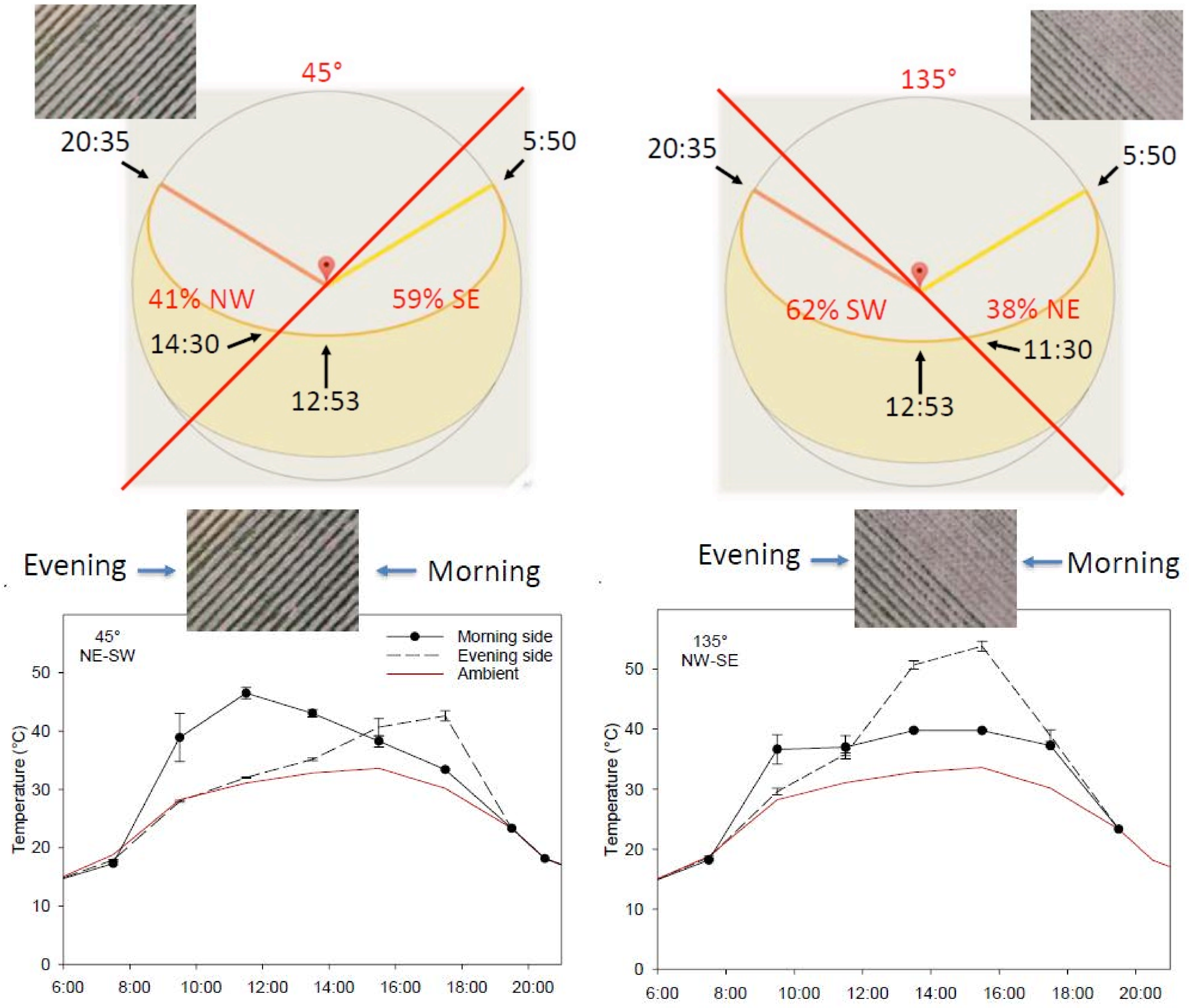
Shift towards non-positioned conduction systems

The UCDavis60 Trellis





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Mechanical cultural practices and trellis type adaptability

	California sprawl	VSP	Quadrilateral	Single high wire	Head-trained
Pre-pruning	+++	++++	+++	++++	-
Final pruning	++	++	+++	++++	-
Shoot thinning	++	++	++	++++	-
Leaf removal	++	++++	++	++++	++
Berry/cluster thinning	++	++	+	++++	+
Trunk suckering	+++	+++	++	++++	+
Harvest	+++	++++	+++	++++	-

Trellis Systems used in California for High Efficiency Mechanical Production

- Singlr high wire system
- 62 to 66 inch tall
- Single canopy
- Non-shoot positioned
- ~35% exposed leaf area
- Production in 18 months
- 11 to 24 t/A in 7 ft x 10 ft plant density

- High Quadrilateral System
- 68 inch tall
- Divided canopy
    - 36 to 48 inch cross-arm
- Non-shoot positioned
- ~70% exposed leaf area
- Production in 18 months
- 14 to 32 t/A in 6 ft x 11 ft plant density

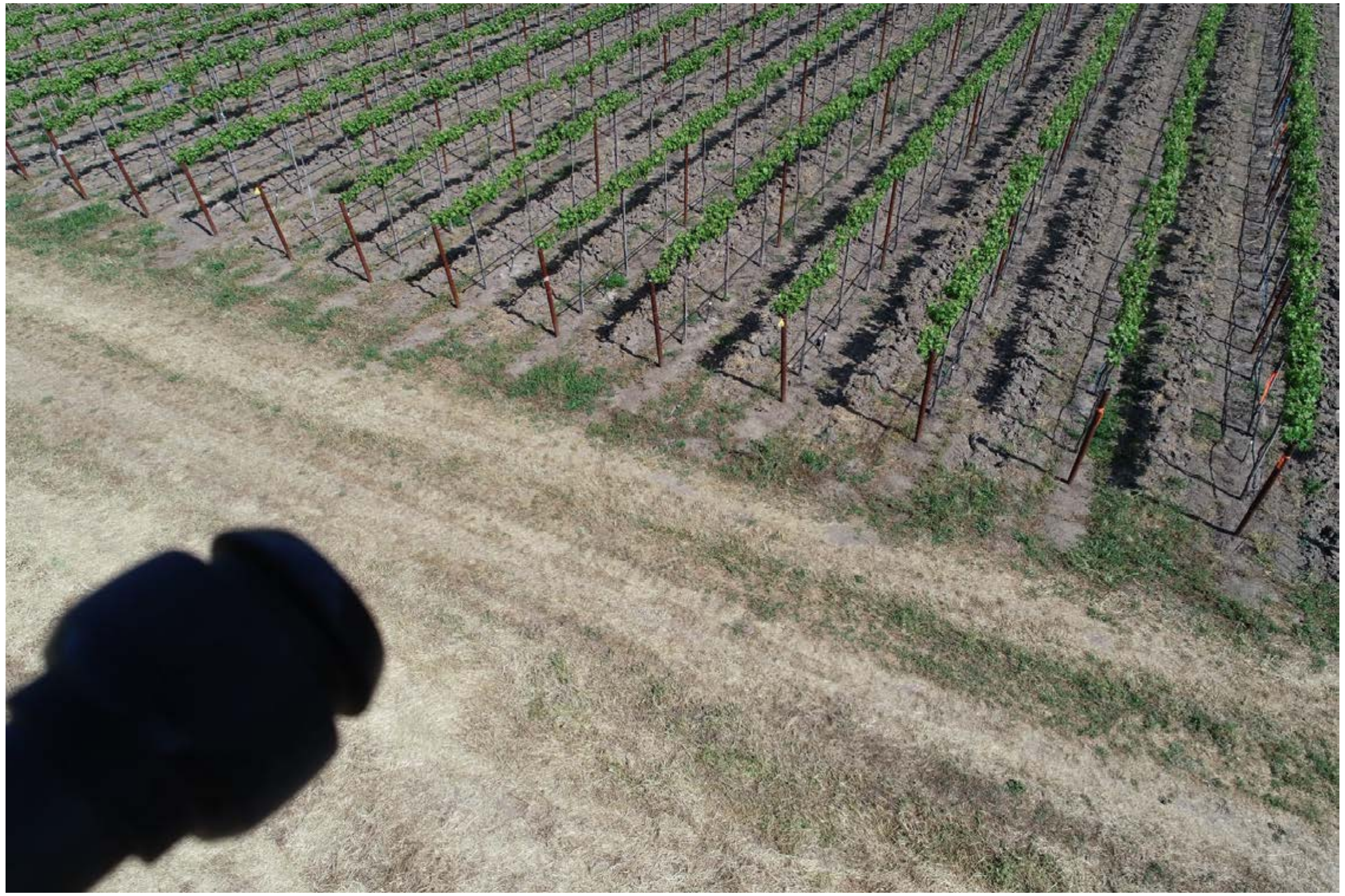
High efficiency production systems

- Single high-wire

- High quadrilateral

No-touch vineyard at Oakville

- Planted 2016
- First crop in 2018
- Single high wire system
- 100% mechanically managed
- 5 ft x 6 ft 4” spacing
- Cabernet Sauvignon/C3309



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Dormant Pruning

- Achieved mechanically
- 4-inch hedge
- One-pass, final pruning
- Bearing height based on previous year crop load (~ 8 lbs fruit/1lbs pruning wt)

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Shoot removal

- Achieved mechanically
- Applied at 6 inch to 8 inch stage
- Main goal to control cropping
- About 30% of shoots removed mechanically

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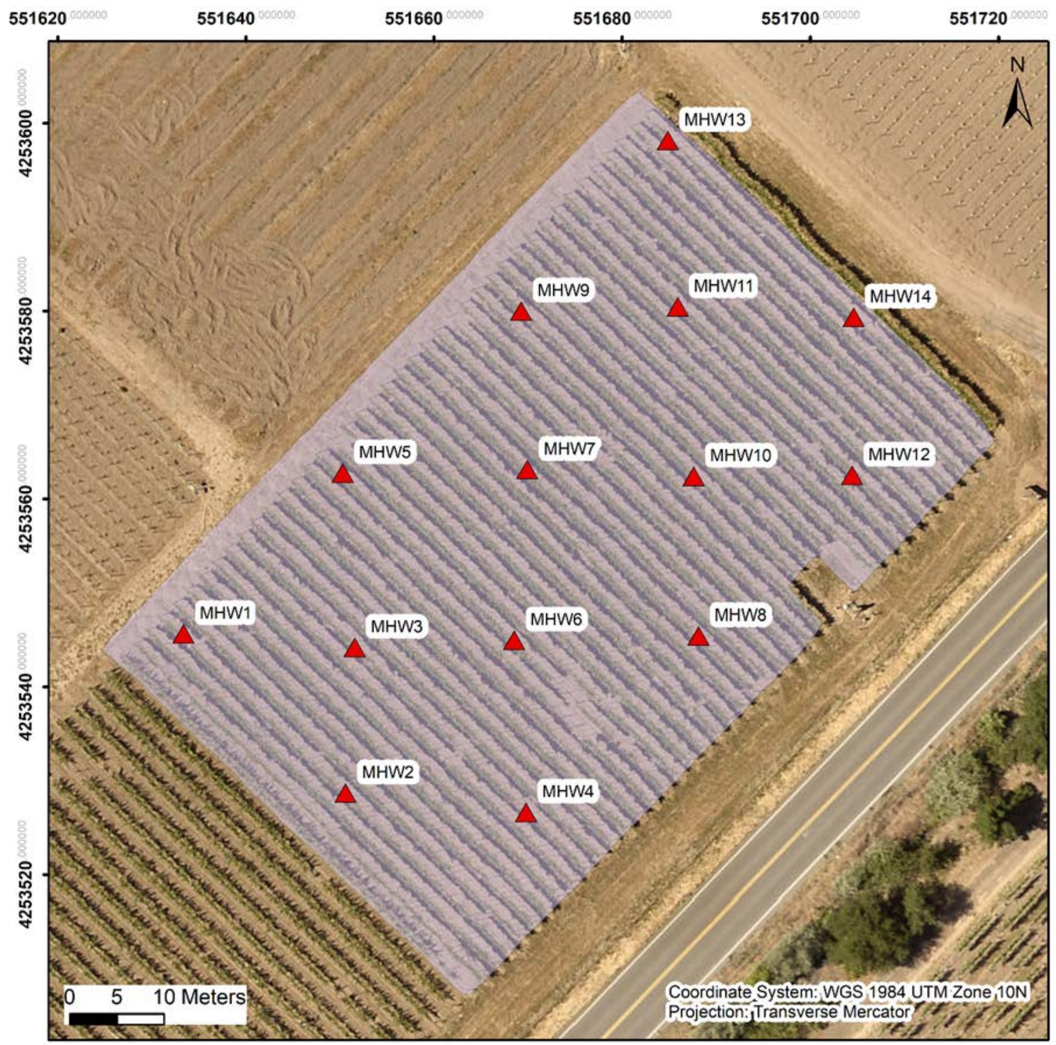
Materials and methods – Experimental design and on-site measurements

- An equidistant 30 m × 30 m grid to sample and collect on-site measurements (14 experimental units, and 3 vines in each unit).
- Soil pedology
- Plant physiology
  - Plant water status by Ψ_{stem}
  - Leaf gas exchange
  - Yield components at harvest
- Berry primary metabolism
  - Total soluble solids, titratable acidity, pH
- Berry secondary metabolism
  - Berry skin flavonoids



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Materials and methods - Soil spatial variability assessment

- Geonics EM38 was used in both **vertical dipole mode** and **horizontal dipole mode** to assess two depths:
  - 0.75 - 1.50 m - Deep EC
  - 0 - 0.75 m - Shallow EC
- Geospatial analysis in R, including packages:
  - gstat 1.1-6
  - automap package 1.0-14
  - NbClust, v3.0

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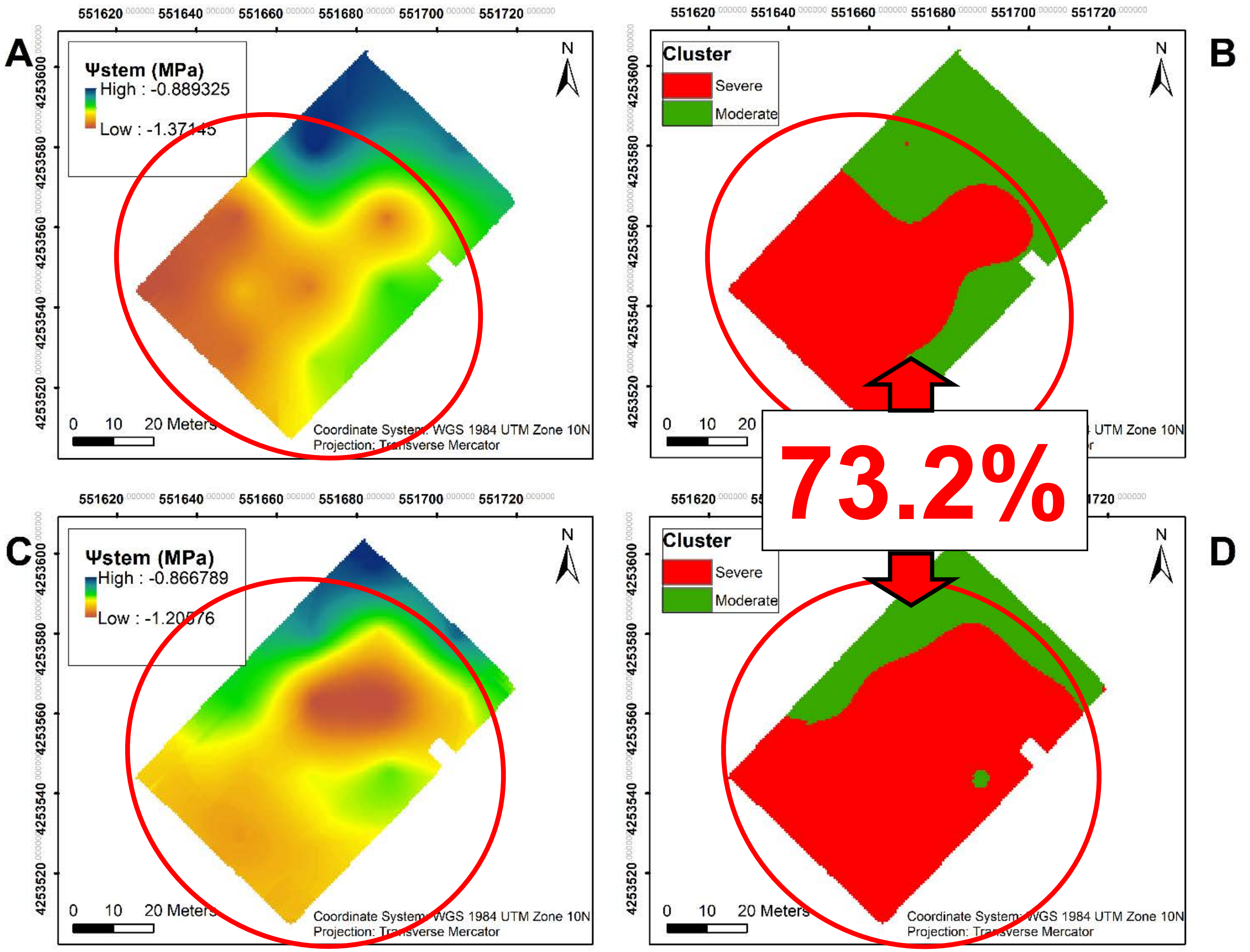
Results - Vineyard zoning by plant water status

- The vineyard was delineated into two clusters by *k*-means clustering based on Ψ_{stem} integrals, including a **severely water stressed zone** and a **moderately water stressed zone**.
- The separation described **70.8%** in 2018 and **67.8%** in 2019 of **the variability in the plant water status** according to the result of **between sum of squares/total sum of squares**.



(A) Ψstem kriging map in 2018; (B) k-means clustering of stem water potential integrals in 2018; (C) Ψstem kriging map in 2019; (D) k-means clustering of stem water potential integrals in 2019.

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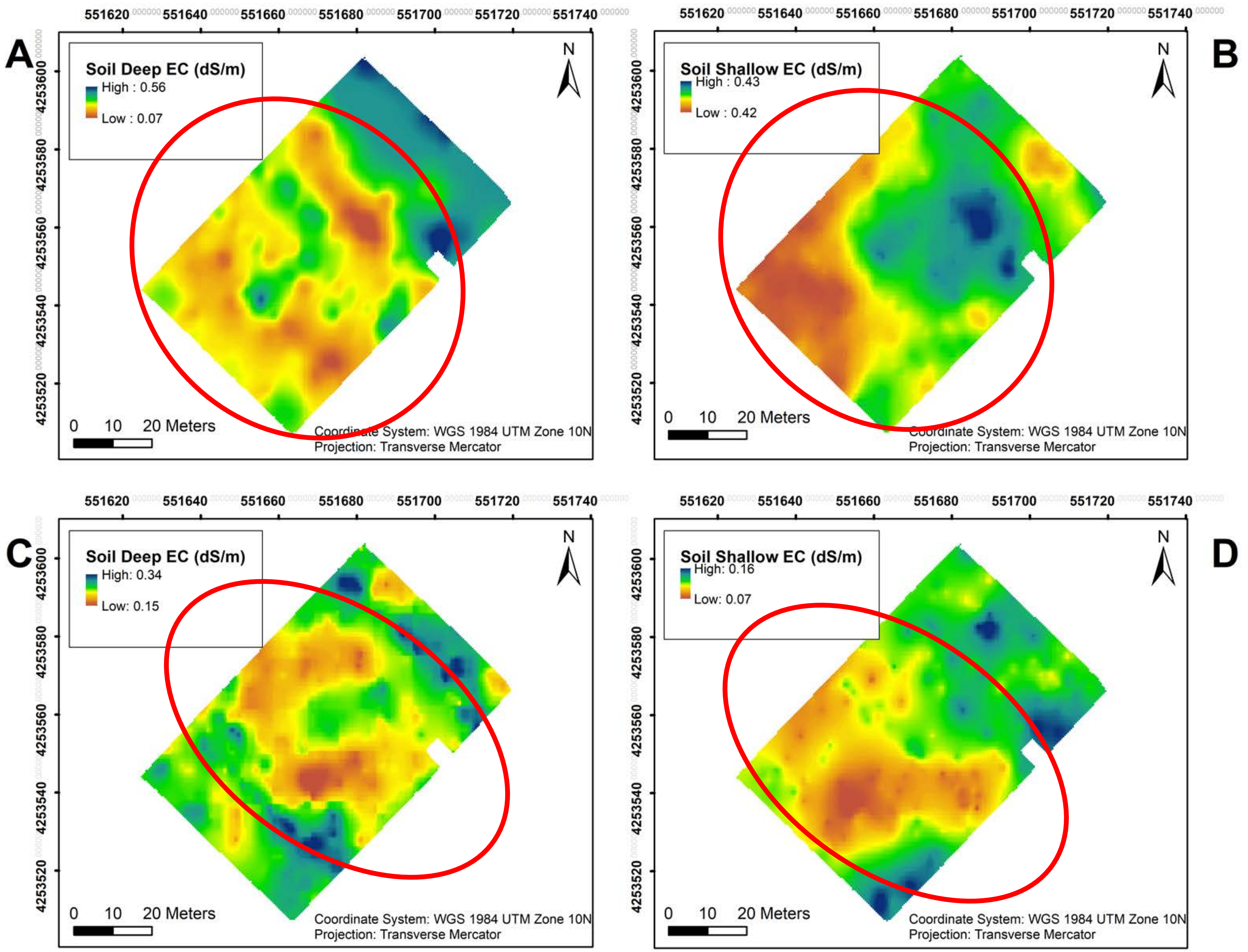
Results - Soil EC

- In 2018
  - **Deep soil:** EC values in were lower in the southwestern section as well as the central section of the vineyard.
  - **Shallow soil:** lower EC values in the southwestern section of the vineyard .
- In 2019
  - **Deep soil:** EC values were lower only in the central section of the vineyard.
  - **Shallow soil:** lower EC values were observed in the southwestern section of the vineyard.



(A) Deep EC in 2018, (B) shallow EC in 2018, (C) deep EC in 2019, (D) shallow EC in 2019.

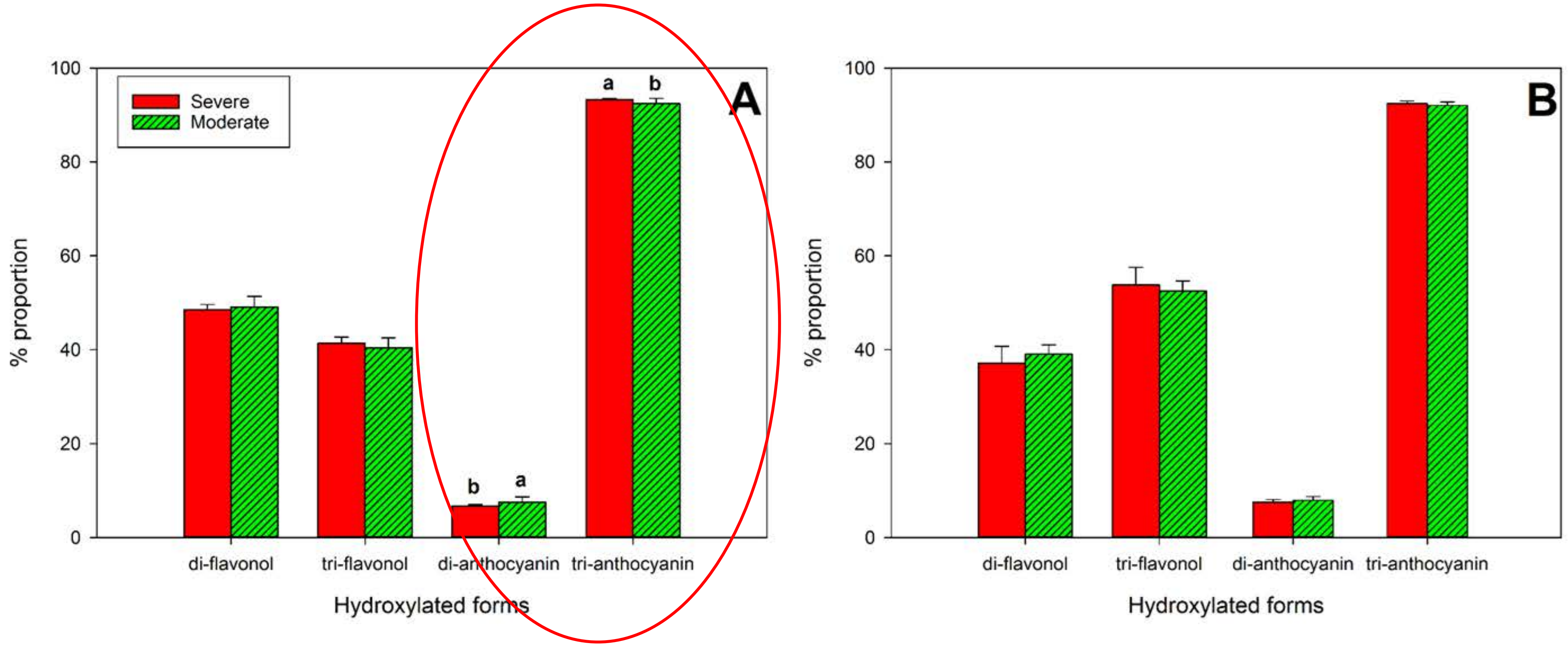
Results - Yield components

Table 2. Yield components at harvest of Cabernet Sauvignon as separated by plant water status zoning in Oakville, CA in 2018 and 2019 [a]

		Cluster no. per vine	Cluster weight (g)	Yield per vine (kg)	Berry weight (g)	Skin weight (g)	Berry no.	Leaf area (m^2)	Leaf area/fruit (m^2/kg)
2018	Severe Water Stress ± SD	110.22 ± 19.32	80.03 ± 16.69	8.45 ± 1.08	1.14 ± 0.07 **b**	0.05 ± 0.00 **b**	7387.6 ± 894.48	4.51 ± 1.09	0.55 ± 0.19
	Moderate Water Stress ± SD	98.57 ±26.78	90.71 ± 9.88	8.82 ± 2.15	1.29 ± 0.05 **a**	0.06 ± 0.01 **a**	6930.9 ± 1783.45	4.33 ± 0.59	0.51 ± 0.10
	p value	ns	ns	ns	0.001	0.014	ns	ns	ns
2019	Severe Water Stress ± SD	78.19 ± 17.02	61.35 ± 9.04	4.77 ± 1.18	0.98 ± 0.09	0.07 ± 0.01	5058.34 ± 1304.35	5.72 ± 0.93	1.26 ± 0.36
	Moderate Water Stress ± SD	89.53 ± 21.95	67.01 ± 5.45	5.96 ± 1.31	1.03 ± 0.06	0.07 ± 0.01	5825.56 ± 1549.39	5.86 ± 0.62	1.01 ± 0.14
	p value	ns	ns	ns	ns	ns	ns	ns	ns
Year		0.01571	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	ns	< 0.0001
Year × Zoning		ns	ns	ns	ns	ns	ns	ns	ns

[a] ANOVA to compare data (*p* value indicated); Letters within columns indicate significant mean separation according to Tukey's HSD test.

Flavonol and anthocyanins



A. 2018
B. 2019

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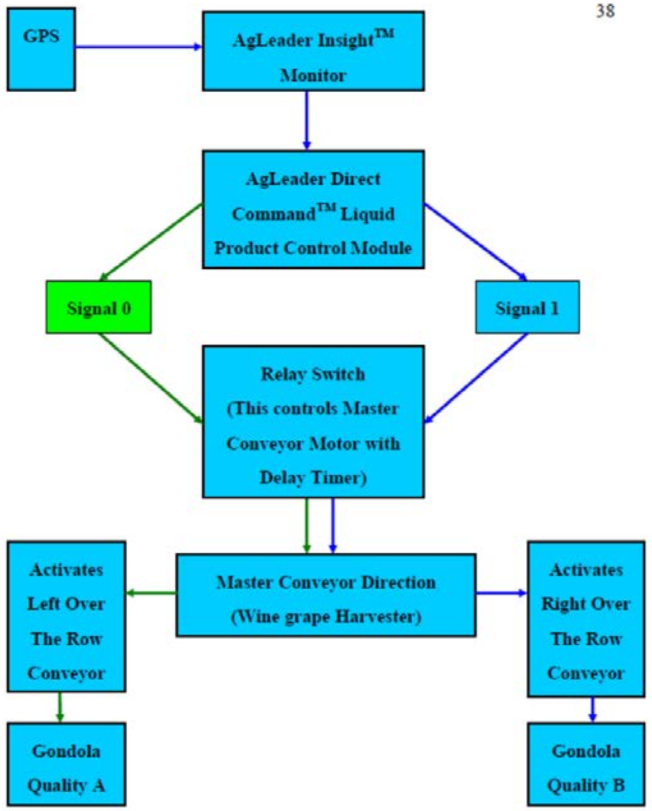
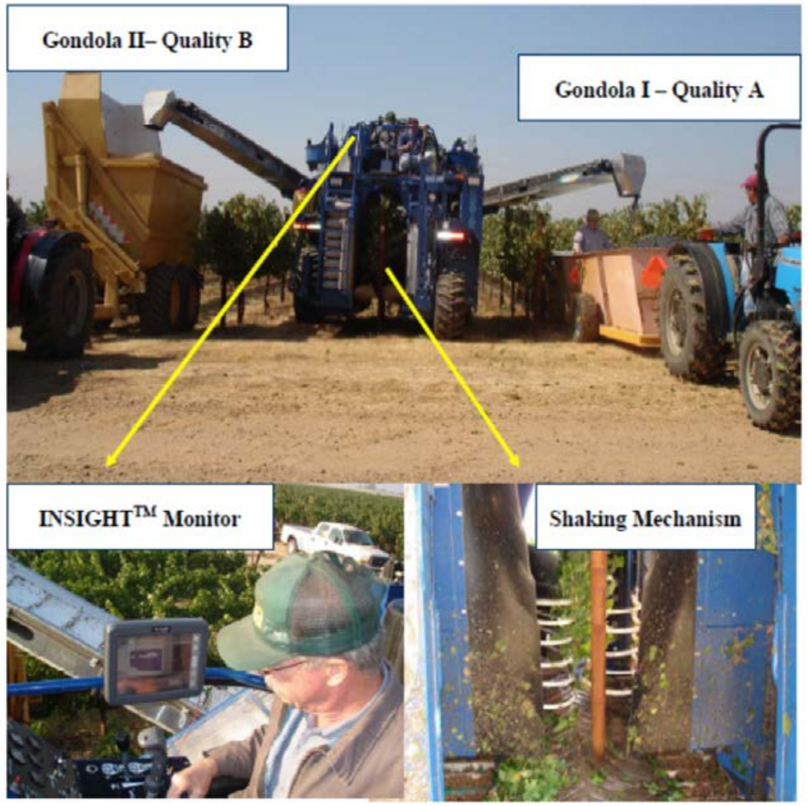
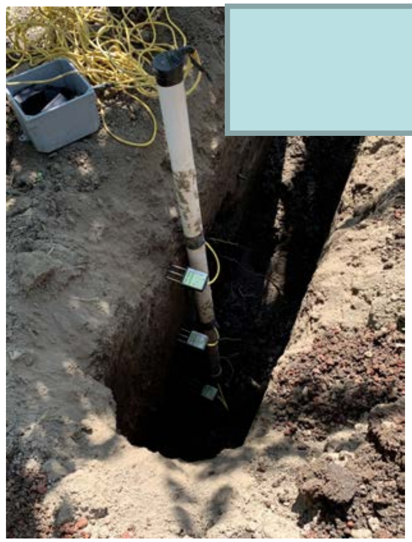
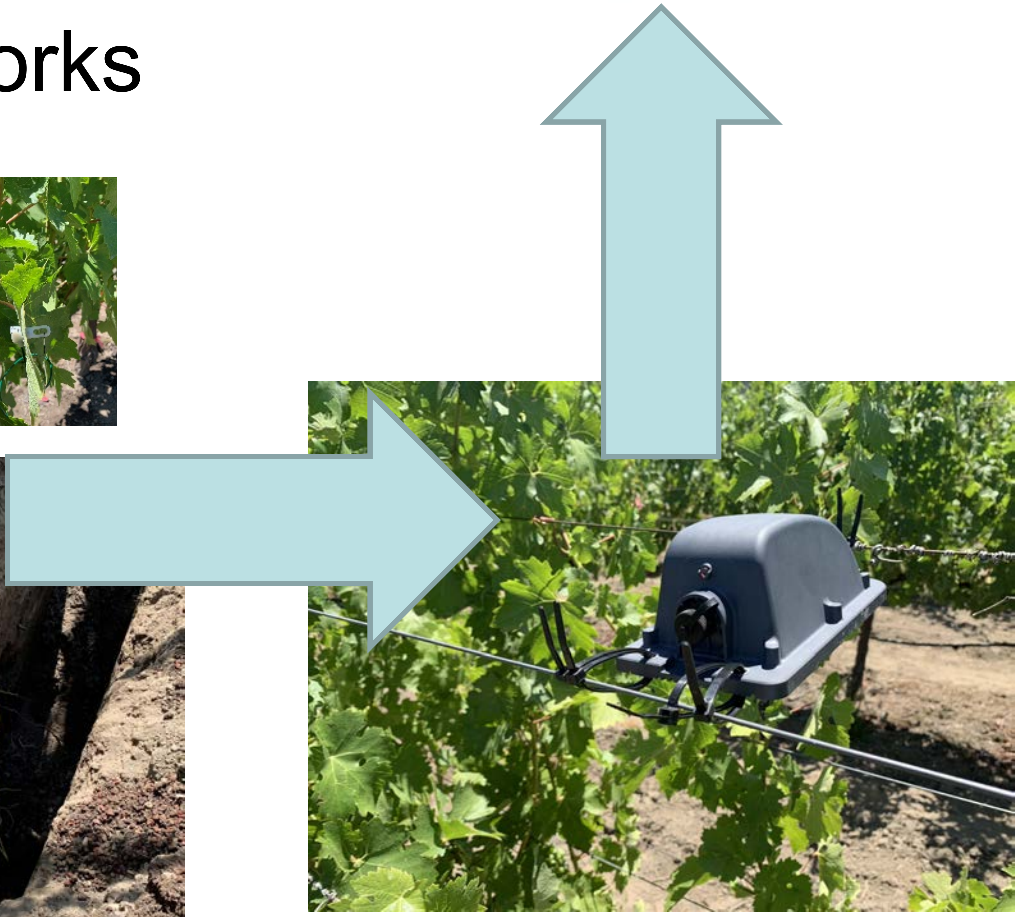
Perspective and future work

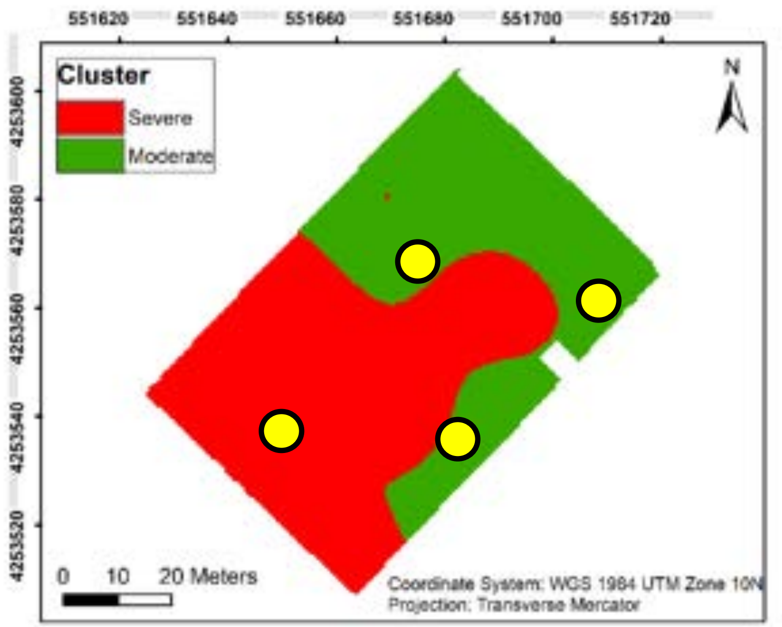
- Selective harvest by mechanical means
- Variable irrigation delivery
- Continuously monitoring soil water/salinity by TDR sensors
- Smart point monitoring via wireless mesh networks











Thank you for your attention

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