"Leveraging the potential microclimatic differences created by trellis systems to investigate the metabolic potential of Vitis vinifera cv. Chenin Blanc in a model vineyard."

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Lessons learnt about the adaptability of Chenin blanc grapevine performance and fruit quality from a trellis-system experiment.

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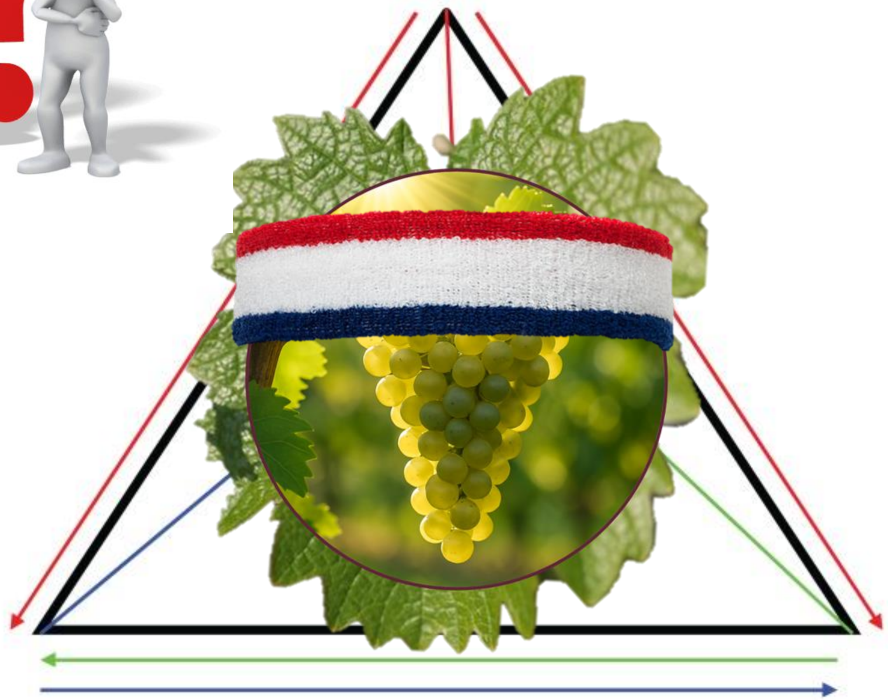
NRF National Research Foundation
SOUTH AFRICA WINE discover diversity in a glass
CHENIN BLANC ASSOCIATION

‘The vineyard- *A high-performance athlete*’

Genetics, Climate, and the *Human Touch*-

- Key Question: How do these three factors interact to determine grapevine performance and wine characteristics?

Environment (E): Sunlight, temperature, and humidity (the invisible forces shaping quality).



Genetics (G): Chenin Blanc – versatile, adaptable, and South Africa's signature white grape.

Management Practices (M): Trellis systems—our way of controlling chaos.

What is a Grapevine Trellis System?

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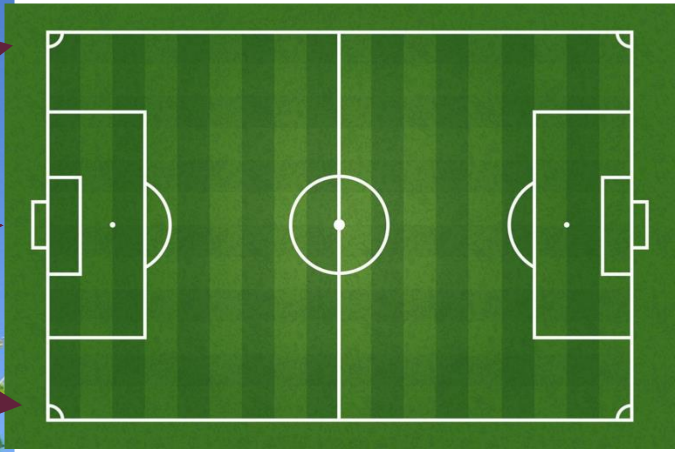

- Controls canopy architecture – directs growth, like tactics dictate player positioning.
- Regulates microclimate – manages light interception, temperature, and humidity around the fruit zone.
- Impacts performance – influences yield, berry composition, disease incidence, and wine quality.
- Trellis = The 'game plan' that coaches the vine’s growth and fruit quality.

Importance of training systems:

Impact of Trellis systems

Yield and Photosynthetic Efficiency

Larger trellis systems increase canopy size and improve light interception, which enhances photosynthetic activity and ultimately increases grape yield (Swanepoel et al., 1990).

Canopy microclimate and Disease management

Trellis design influences canopy architecture, which affects air circulation and humidity levels around the fruit zone. Proper trellising can reduce the incidence of fungal diseases such as downy mildew and gray mold by improving ventilation and reducing humidity (Yin et al., 2022)

Fruit quality and Ripening

Effective trellis systems optimize sunlight exposure to clusters, promoting better sugar accumulation, ripeness, and color development in grapes(Yin et al., 2022)

Labor efficiency and Vineyard management

Trellises support vines structurally, making tasks such as pruning, spraying, weeding, and harvesting easier and less labor-intensive(Yin et al., 2022)

Vine balance and Growth Regulation

Trellis systems help balance vegetative and reproductive growth by controlling vine vigor and shoot positioning (Yin et al., 2022)

How does Trellis design shape Chenin blanc?

Study Area:
Welgevallen Experimental Farm- Block 6

Model Vineyard:

- Established: 2020
- 1.11 ha (66 rows)
- NE-SW row orientation
- Rootstock: Richter 99
- Vine spacing: 2.4 m x 1.5 m (majority)
- Panel length: 7.5m with 5 vines/ panel
- Soil: homogenous Oakleaf with small patches of Tukulu and Hutton

Trellis system characteristic:	System:
Free-standing vines	Bush vines and posted vines
Single canopy (VSP)	3 & 4 strand hedge trellis, 5 & 7
Single cano	mechanical pruning- small box), 2 strand hedge (simulated mechanical pruning- large box)
Horizontally divided single canopy	Double lengthened double Perold
Horizontally divided double canopy	Tramlines (5 strand double lengthened Perold), Geneva Double Curtain, Lyre
Vertically divided single canopy	Ballerina
Vertically divided double canopy	Scott Henry, Smart Dysan, Smart Henry, 2K2T

Analyse *vine vigour variability* across 19 trellis systems.

Google Earth

Airbus

Larger canopies=more leaves=more ripening power

Trellis system	Divided canopy?	Fresh mass (kg)	Leaf number	Total Leaf area (cm^2)
2K2T	Vertically divided/ double canopy	**0.97 ± 0.51 ***	**735.33 ± 225.48 ***	**52498.9 ± 29252.9 *****
Lyre	Horizontally divided/ Double canopy	0.71 ± 0.17	587.33 ± 112.77	**39647.7 ± 10716.6 ***
GDC	Horizontally divided/ Double canopy	0.36 ± 0.10	408.33 ± 38.48	23525.8 ± 2920.35
T-Kap	Horizontally divided/ Double canopy	0.42 ± 0.12	437.33 ± 18.50	[illegible]
Ballerina	Vertically divided/ single canopy	0.71 ± 0.31	627.67 ± 300.32	[illegible]
Scott Henry	Vertically divided/ double canopy	0.67 ± 0.20	622.33 ± 127.29	[illegible]
Smart Henry	Vertically divided/ double canopy	0.43 ± 0.22	392.00 ± 168.68	22597.4 ± 12073.9
Smart Dysan	Vertically divided/ double canopy	0.89 ± 0.42	**757.33 ± [illegible]2.36 ***	**51267.0 ± 23857.5 *****
High Wire Perold	No	**0.95 ± 0.07 ***	**1018.00 ± 242.03 *****	**51844.9 ± 6475.31 *****
2-Strand Hedge (Small box)	No	0.57 ± 0.14	**777.67 ± 112.10 ***	33467.0 ± 5409.7
2-Strand Hedge (Big Box)	No	0.76 ± 0.07	**890.33 ± 63.91 ****	**44016.2 ± 2587.35 ****
1-Strand hedge	No	0.50 ± 0.15	513.67 ± 90.29	29325 ± 9564.39
5-Strand double lengthened	No	0.48 ± 0.16	467.00 ± 135.69	25922.6 ± 8044.94
Perold fixed	No	0.48 ± 0.05	495.67 ± 57.01	29209.1 ± 3326.59
7-Strand double lengthened	No	0.46 ± 0.11	426.00 ± 110.04	24080 ± 4416.94
5-strand double lengthened (Tramlines)	No	0.38 ± 0.10	383.00 ± 82.18	20112.5 ± 4762.22
4-strand hedge fixed	No	**0.21 ± 0.04 ***	229.67 ± 64.93	12650 ± 2643.73
4 strand hedge	No	**0.19 ± 0.04 ***	250.00 ± 57.11	12261.5 ± 3474.53
Posted vine	No	0.59 ± 0.05	457.67 ± 67.89	16371 ± 2831.68
Bush vine	No	0.32 ± 0.13	380.33 ± 111.70	18179.7 ± 7254.05
P-value	-	0.000	<0.0001	0.000

↑ Ripening power

Differences observed in phenology: smaller system, slower development

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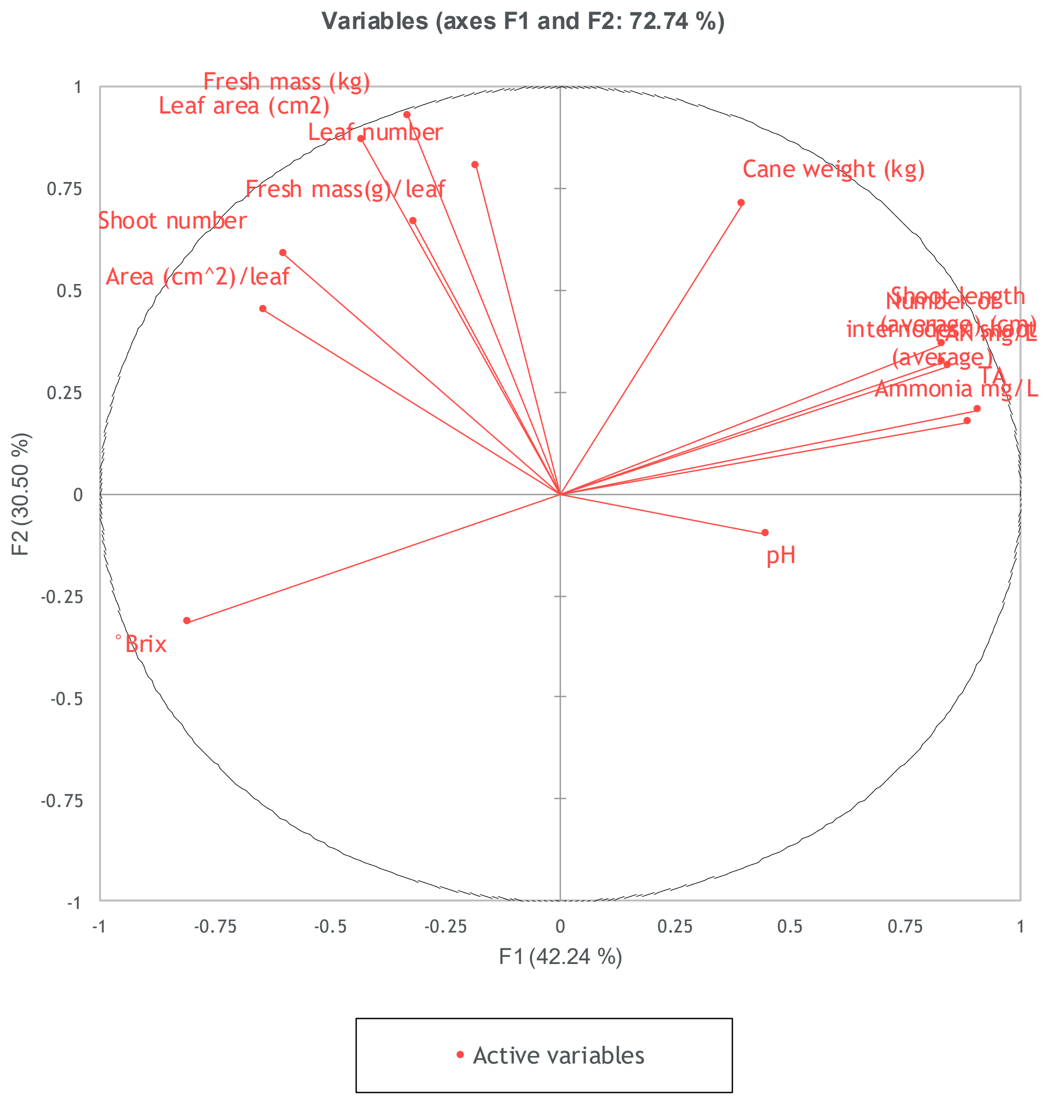
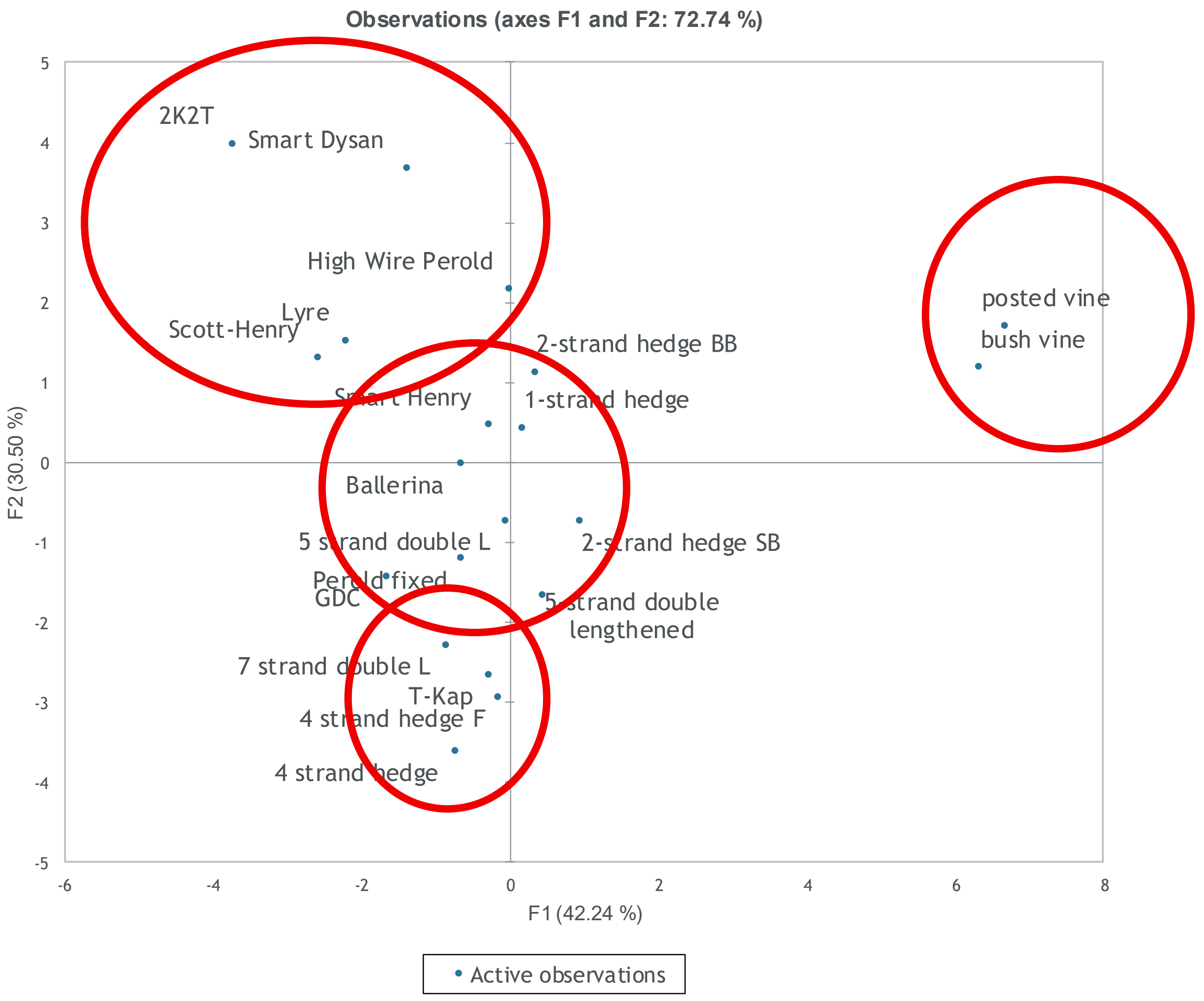
Trellis system	Yield 2024 (kg/vine)	Harvest date (2024)	Trunk circumference (cm)	Shoot number	Shoot length (cm)	Pruning weight (kg/vine)
2K2T	1.80	24 January	9.23 ± 2.17^{cde}	66.33 ± 0.58^{g}	34.161^{a}	0.467 ab
Lyre	0.56	24 January	9.60 ± 1.94^{e}	48.67 ± 11.85^{efg}	37.630^{a}	0.450 ab
GDC	1.33	24 January	8.13 ± 1.41^{bcd}	30.00 ± 4.36^{abcde}	39.320^{a}	0.217 ab
T-Kap	1.17	24 January	8.69 ± 1.38^{abc}	41.67 ± 7.02^{cdef}	39.532^{a}	0.333 ab
Ballerina	1.17	24 January	8.78 ± 1.50^{ab}	22.00 ± 2.65^{abc}	70.316^{bc}	0.533 ab
Scott Henry	1.04	24 January	8.83 ± 1.63^{bcde}	54.00 ± 5.00^{fg}	40.683^{a}	0.317 ab
Smart Henry	1.45	24 January	8.93 ± 1.16^{bcde}	27.67 ± 1.53^{abcd}	48.367^{ab}	0.333 ab
Smart Dysan	1.51	24 January	8.47 ± 1.27^{bcde}	43.67 ± 4.16^{def}	50.260^{ab}	0.550 ab
High Wire Perold	0.77	24 January	9.38 ± 1.31^{bcde}	42.67 ± 8.02^{def}	60.675^{abc}	0.483 ab
2-Strand Hedge (Small box)	2.3	24 January	9.07 ± 1.39^{abcd}	37.67 ± 3.79^{bcdef}	52.696^{ab}	0.383 ab
2-Strand Hedge (Big Box)	1.92	24 January	8.71 ± 1.55^{bcde}	46.00 ± 11.53^{def}	41.958^{ab}	0.583 ab
1-Strand hedge	1.94	24 January	8.85 ± 1.60^{cde}	31.67 ± 14.47^{abcde}	42.315^{ab}	0.367 ab
5-Strand double lengthened	3.15	24 January	9.38 ± 1.52^{de}	28.67 ± 2.89^{ab}	53.768^{ab}	0.427 ab
Perold fixed	0.96	24 January	9.07 ± 1.41^{bcde}	27.33 ± 2.52^{abcd}	42.679^{ab}	0.450 ab
7-Strand double lengthened	1.22	24 January	8.71 ± 1.12^{bcde}	26.33 ± 4.04^{abcd}	49.068^{ab}	0.250 ab
5-strand double lengthened	1.09	24 January	8.85 ± 1.07^{bcde}	20.67 ± 3.21^{abcd}	47.346^{ab}	0.427 ab
4-strand hedge fixed	0.42	24 January	9.65 ± 1.48^{e}	33.67 ± 7.51^{abcde}	34.056^{a}	0.233 ab
4 strand hedge movable	0.17	24 January	7.56 ± 1.47^{a}	21.33 ± 5.77^{ab}	34.903^{a}	0.150 b
Posted vine	NA	12 February	17.16 ± 3.02^{f}	16.33 ± 2.08^{a}	121.713^{d}	0.633 ab
Bush vine	NA	12 February	18.63 ± 3.12^{f}	19.33 ± 2.08^{ab}	83.708^{c}	0.783 a
P-value			<0.0001	<0.0001	<0.0001	**0.023**

Summary of baseline analysis

More dense canopies (e.g., 2-Strand Hedge systems): ↓ Brix, ↓ pH, and ↑ acidity, = slower ripening and higher acid retention	**Divided canopies** ↑ higher total leaf area and ↑ leaf number ↑ fresh mass = shading
Exposed canopies (e.g., Smart Dysan, Perold Fixed, 4-Strand Hedge Fixed): ↑ Brix, ↑ pH, and ↓acidity , = better sugar accumulation and faster acid degradation	**VSP, hedge and single vine canopies** ↓ moderate-low total leaf area ↓ leaf number ↓ fresh mass = increased light interception.

Selection of Representative Trellis Systems





Selection of Representative Trellis Systems

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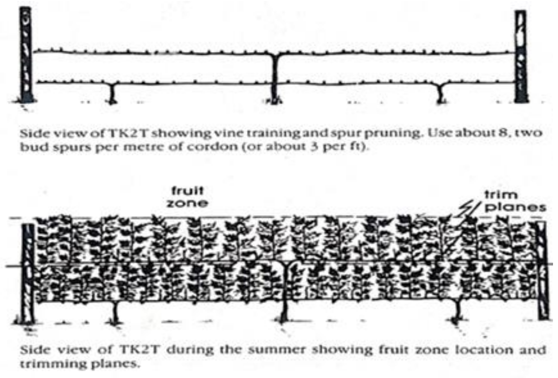
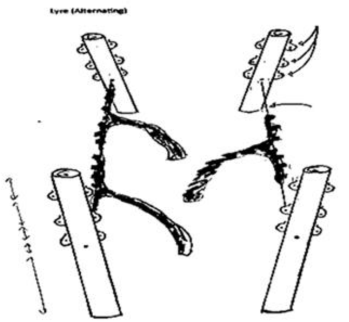
Following the 'lay-of-the-land' investigation we selected the following trellis systems:

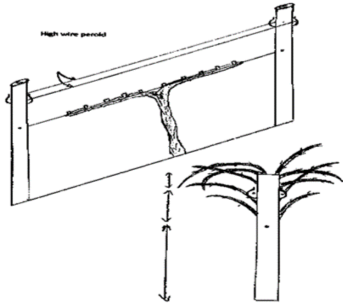
- **We chose 6 trellis systems** representing different yield and quality scenarios.
  - 2K2T (Vertically divided canopy)
  - LYRE (LY) (Horizontally divided canopy)
  - HIGH WIRE PEROLD (HWP) (VSP)
  - 7-STRAND DOUBLE LENGTHENED (7SDL) (Industry standard) (VSP)
  - POSTED VINES (PV) (Single vine)
  - BUSH VINES (BV) (Un-trellised)



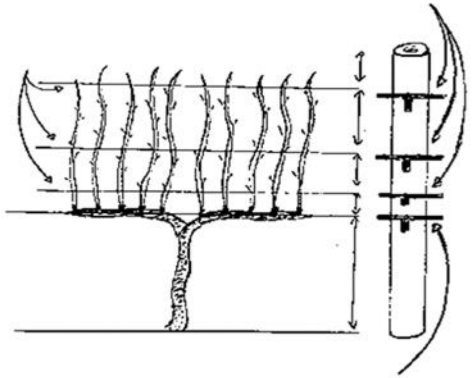
2K2T



LYRE



HWP



7SDL

PV

BV

How do trellis systems impact canopy and bunch microclimate?

@ 06:00 bush vines are the coolest

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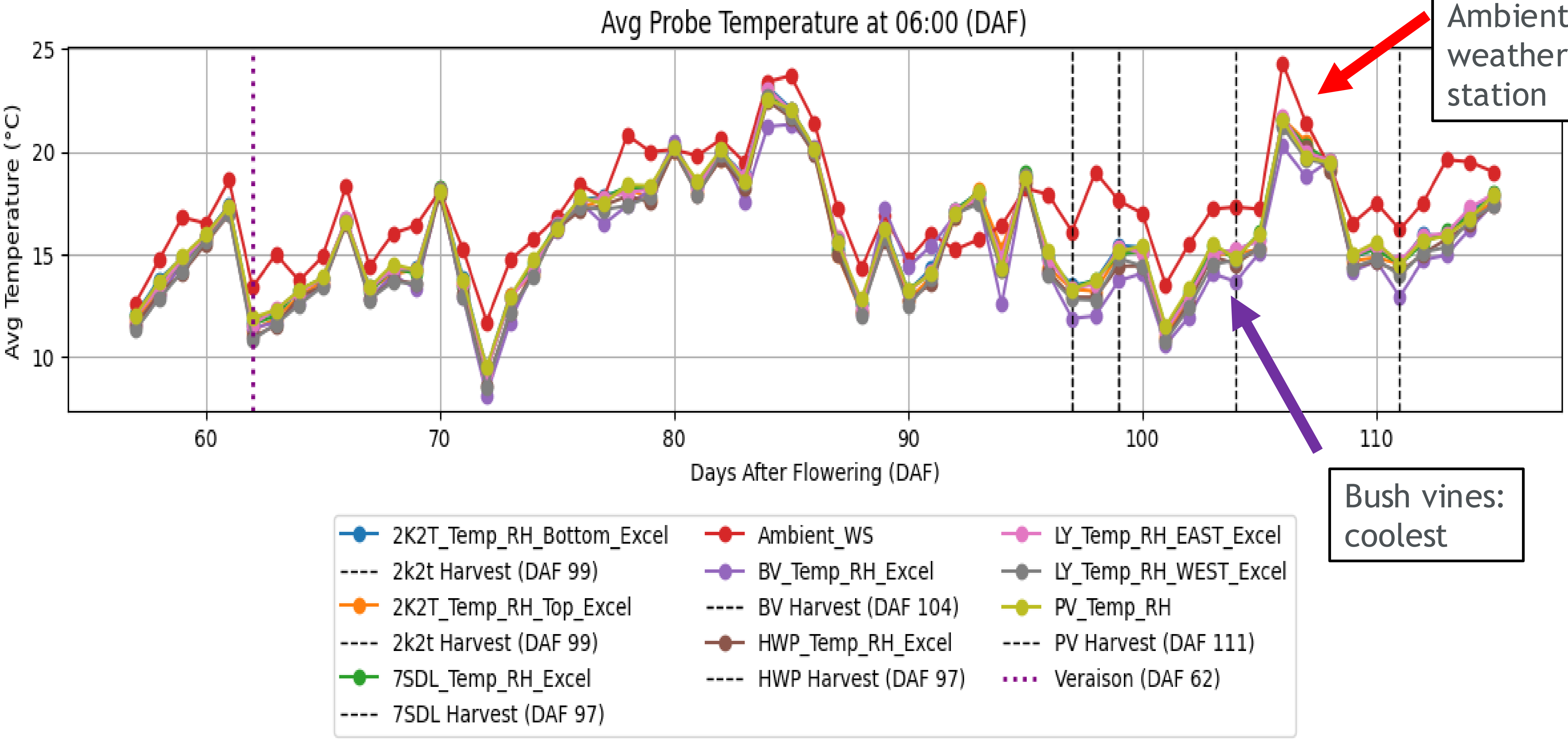
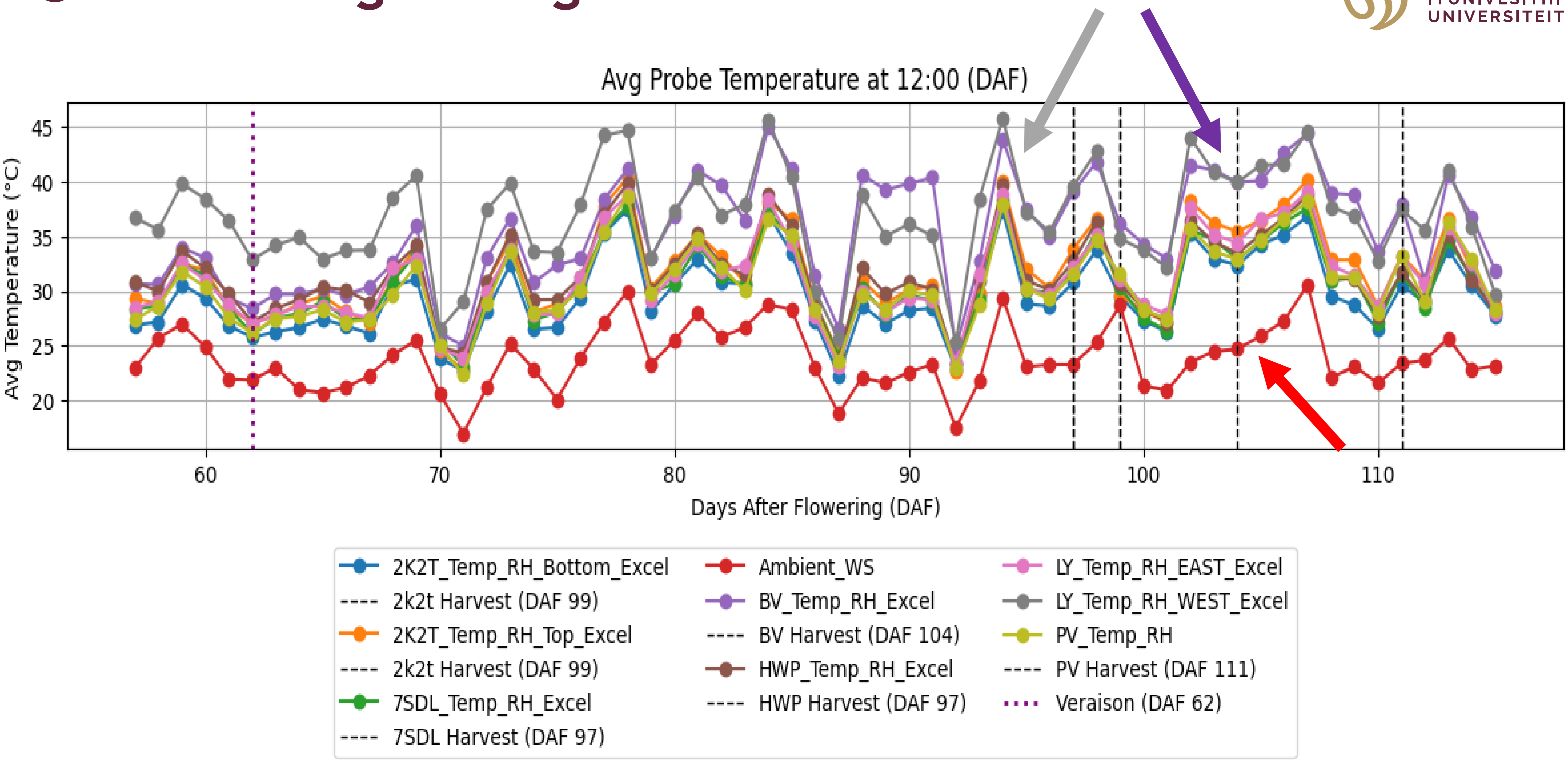


Ambient weather station

Bush vines: coolest

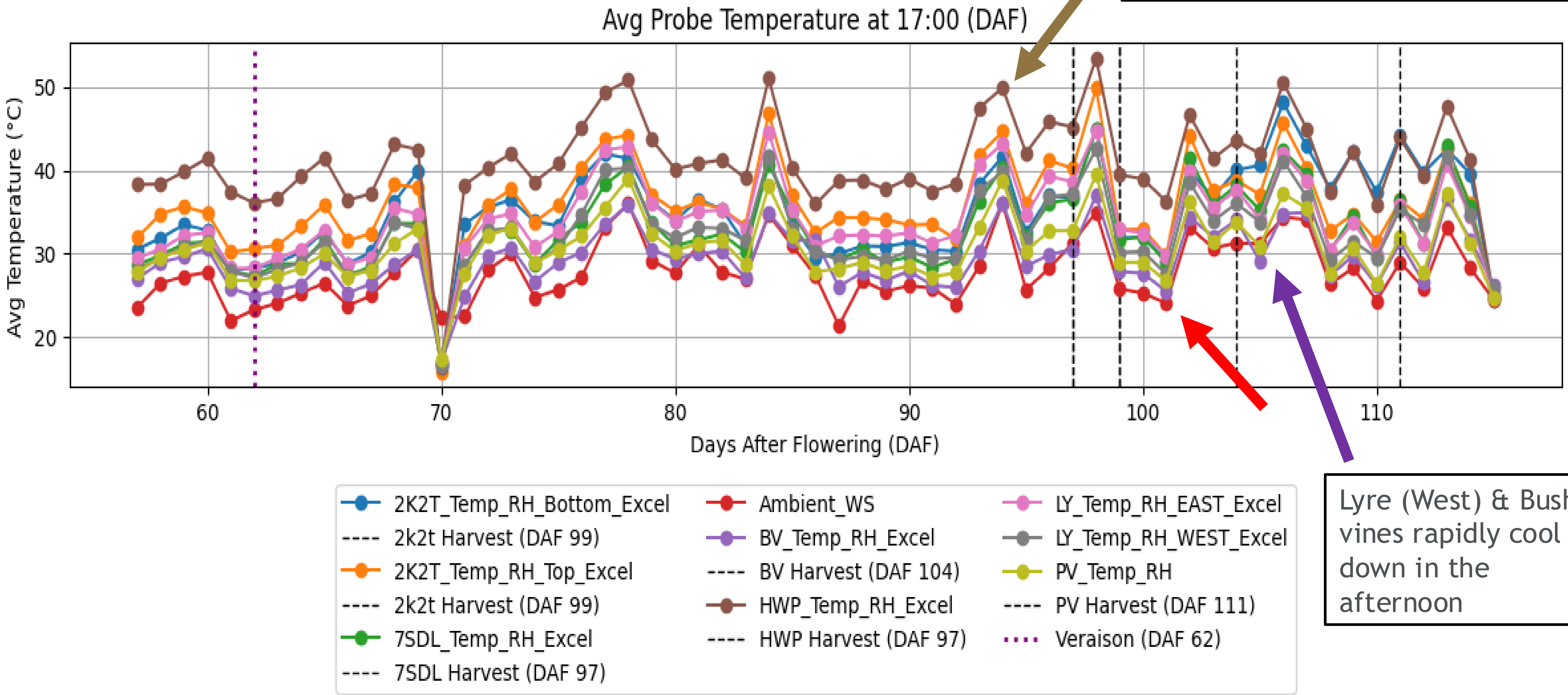
@12:00 things change…

Lyre (West) & Bush vines rapidly warm-up, stay warm



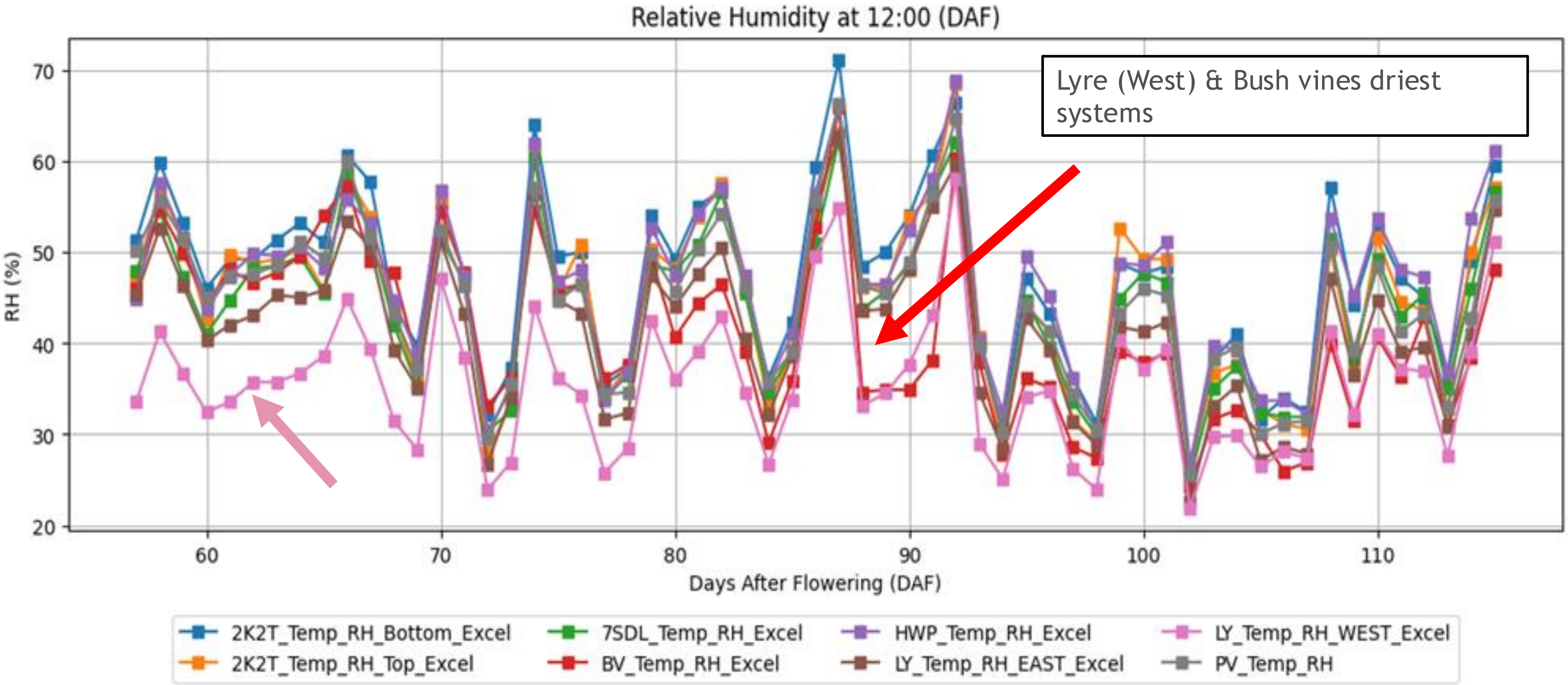
@17:00

HWP systems maintain (trap heat) staying warm throughout mid-late afternoon

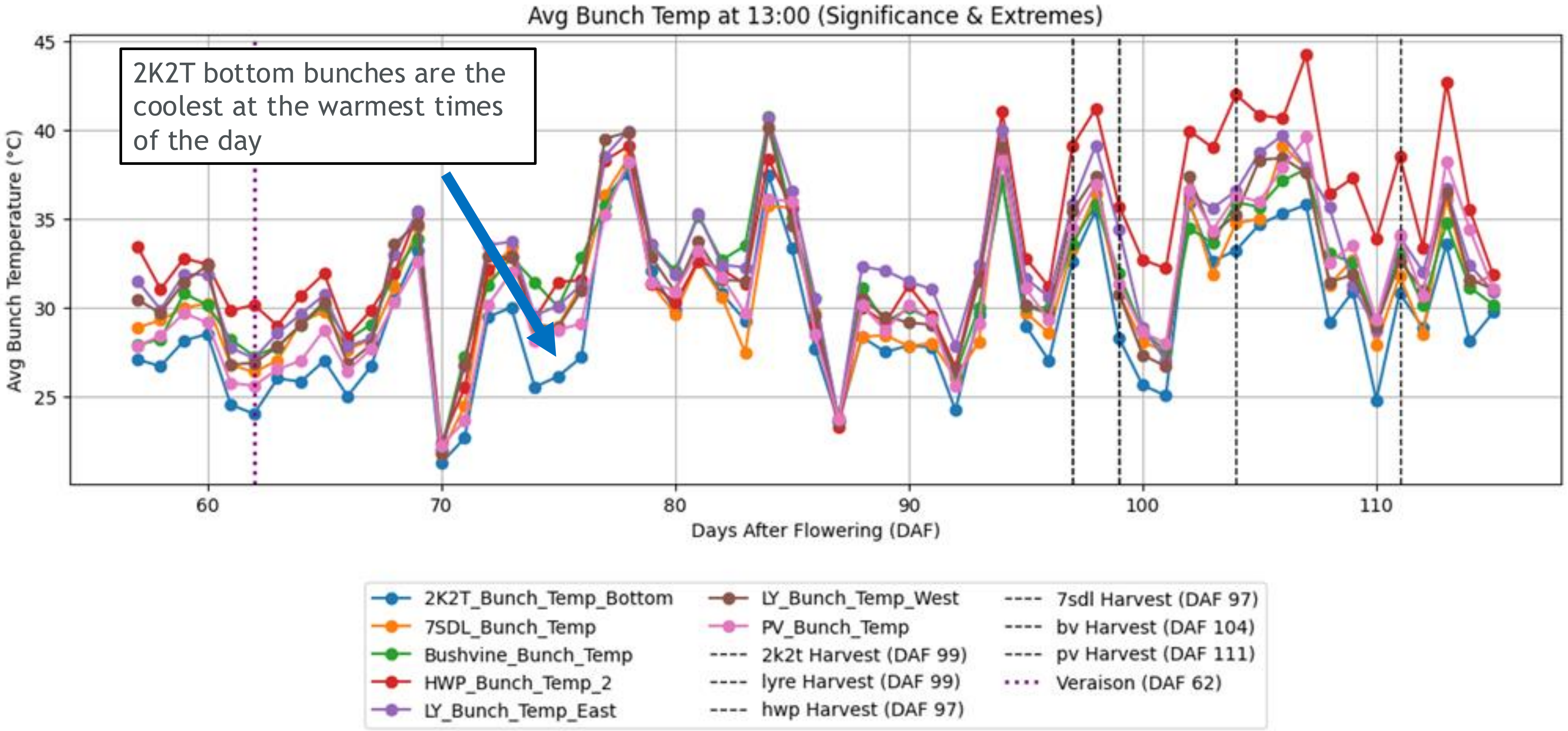


Lyre (West) & Bush vines rapidly cool down in the afternoon

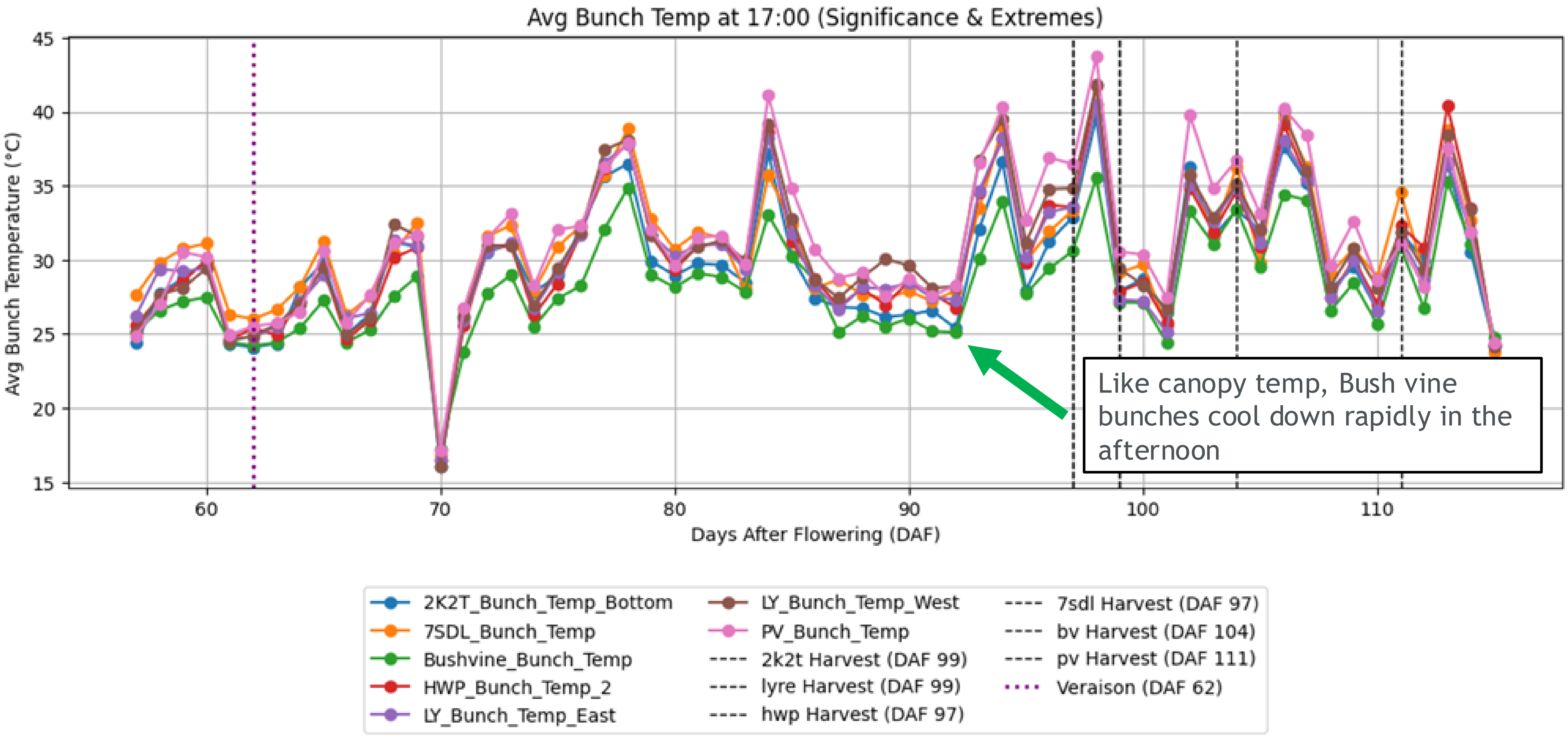
Canopy Relative Humidity: warmest system = driest system



Bunch Temperature @13:00



@17:00



Avg Bunch Temp at 17:00 (Significance & Extremes)
Avg Bunch Temperature (°C)
Days After Flowering (DAF)
15
20
25
30
35
40
45
60
70
80
90
100
110
Like canopy temp, Bush vine bunches cool down rapidly in the afternoon
2K2T_Bunch_Temp_Bottom
7SDL_Bunch_Temp
Bushvine_Bunch_Temp
HWP_Bunch_Temp_2
LY_Bunch_Temp_East
LY_Bunch_Temp_West
PV_Bunch_Temp
2k2t Harvest (DAF 99)
lyre Harvest (DAF 99)
hwp Harvest (DAF 97)
7sdl Harvest (DAF 97)
bv Harvest (DAF 104)
pv Harvest (DAF 111)
Veraison (DAF 62)

How do trellis systems impact vine balance?

Vegetative measurements at Leaf fall (2025): Plant canopy architecture

(n=25 shoots/system)

Category	Lateral Leaf area (cm2)	Leaf number (Lateral)	Main Leaf area (cm2)	Leaf number Main	Shoot length (cm)	Cane diameter (mm)	Area/leaf (Lateral)	Area/leaf (Main)
HWP	497.960	14.440	894.366	12.360	89.040	7.359	23.915	79.425
LY_E	421.517	12.400	797.821	13.867	111.067	7.004	27.223	58.986
7SDL	523.521	16.600	529.628	9.400	120.720	6.662	29.443	56.254
PV	665.511	20.280	264.878	8.120	123.600	13.319	36.90	23.692
2K2T_T	442.633	12.133	463.747	6.000	70.667	7.225	29.875	55.396
BV	538.198	21.750	248.867	6.625	67.583	8.563	21.101	36.973
LY_W	163.942	5.200	538.100	10.267	89.667	6.165	20.070	53.185
2K2T_B	305.229	8.133	463.173	7.133	64.000	6.537	20.940	56.650
Pr > F(Model) Significant	0.078 No	0.005 Yes	<0.0001 Yes	0.001 Yes	<0.0001 Yes	<0.0001 Yes	0.621 No	<0.0001 Yes

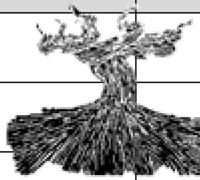
Dense canopies = higher disease pressure, more labor.

Balanced

Open canopies = easier spray coverage, better light balance.

Trellis design influences long-term vine development: Trunk Circumferences

Trellis	2024	2025	Increase in diameter (cm)
Year of Production	1st	2nd	
BV	18.628 a	25.105 a	+6.477
PV	17.163 b	23.458 a	+6.295
LYRE	9.604 c	14.252 bc	+4.648
2K2T	9.233 cd	15.48 b	+6.247
HWP	8.831 cd	12.631 cd	+3.800
7SDL	8.711 d	12.074 d	+3.363
Pr > F(Model)	**<0.0001**	**<0.0001**	-
Significant	Yes	Yes	-



Trunk growth differs significantly across trellis systems, with **BV and PV** driving the largest increases in diameter.

Yield data (2024/25)

Eno-carpological Characterization

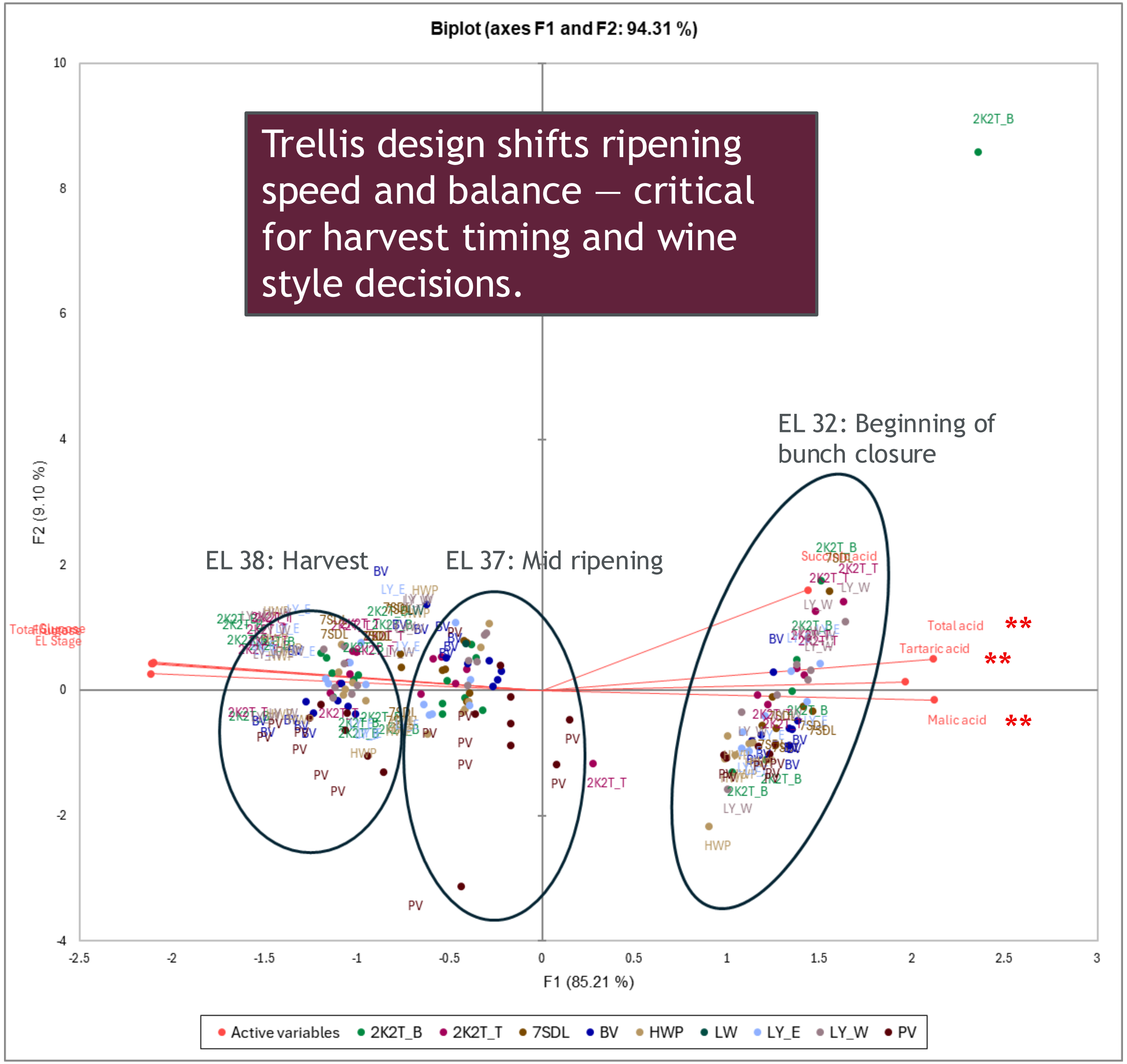
Trellis system	Yield/panel (kg)	Yield/vine (kg)	Number of berries/bunches	Brix	pH
HWP	11.738 ± 1.35ab	2.935 ± 0.34ab	119.200 ± 28.608a	22.8	3.41
2K2T_TOP	10.800 ± 1.24a	2.700 ± 0.31ab	95.000 ± 60.191a	23.2	3.28
BV	12.134 ± 3.87a	3.034 ± 0.97a	97.200 ± 53.719a	22.7	3.44
7SDL	10.140 ± 1.90ab	2.028 ± 0.38ab	94.300 ± 22.351a	23.2	3.49
2K2T_BOTTOM	7.980 ± 1.04b	1.995 ± 0.26b	120.600 ± 45.651a	23.2	3.28
PV	8.802 ± 2.59ab	2.201 ± 0.65ab	84.100 ± 33.884a	22.2	3.93
LY_EAST	11.320 ± 1.61ab	2.580 ± 0.29ab	93.900 ± 52.519a	23.2	3.33
LY_WEST	12.760 ± 0.32a	2.929 ± 0.29ab	72.000 ± 21.644a	23.4	3.50
Pr > F(Model)	**0.008**	**0.005**	0.185	-	-
Significant	**Yes**	**Yes**	No	-	-

Eno-Carpological Characterization

Category	Berry weight (g)	Seed weight (g)	%Seed of Berry	%Skin & Pulp of Berry
BV	2.193 ± 0.381a	0.061± 0.021a	2.756 ± 0.7ab	97.244 ± 0.7ab
2K2T_TOP	1.915 ± 0.333bc	0.047 ± 0.019ab	2.492 ± 0.931b	97.508 ± 0.931a
HWP	2.076 ± 0.338ab	0.053 ± 0.02ab	2.507 ± 0.660b	97.493 ± 0.660a
LY_WEST	1.908 ± 0.392bc	0.056 ± 0.018ab	3.010 ± 0.995ab	96.990 ± 0.995ab
7SDL	1.873 ± 0.455bc	0.055 ± 0.025ab	2.922 ± 0.998ab	97.085 ± 0.997ab
LY_EAST	1.543 ± 0.308d	0.055 ± 0.054ab	3.599 ± 0.382a	96.401 ± 0.382b
PV	1.808 ± 0.412c	0.053 ± 0.0207ab	2.879 ± 0.728ab	97.121 ± 0.728ab
2K2T_BOTTOM	1.453 ± 0.276d	0.041 ± 0.031b	2.920 ± 1.37ab	97.080 ± 1.374ab
Pr > F(Model)	**<0.0001**	**0.016**	**0.025**	**0.025**
Significant	Yes	Yes	Yes	Yes

How do you trellis systems impact grape primary metabolism?

PCA- organic acids and sugars



Case Study Objective: Perform an economic/ analysis of the production scenarios over two seasons (2024/2025 and 2025/2026).

- The purpose will be to **identify a uniform production** unit and then do a production analysis for each of the scenarios by focusing on the inputs and outputs of each system (financial input and quality of crop as an output).
  - Establishment costs (*Vinpro Cost Guide*)
  - Seasonal labor cost
    - Canopy management practices etc.
  - Cost of fruit/value of crop produced

Canopy management costs per trellis system (seconds/panel):

-includes Pruning, Suckering, Tying up shoots, Vertical shoot positioning , Canopy Trimming , Clean Sucker/ Canopy Trimming, Clean Legs, Harvest.

Trellis system	Total time taken for canopy management/season (seconds/panel)	Cost/season/panel	Establishment cost per ha (poles and wires etc.)	Cost/ha/season
2K2T	1 857	R11.98	R110 025.00	**R 8,319.33**
LYRE	1 461.5	R9.80	R157 522.00	**R 6,803.19**
HWP	1 374	R6.77	R 85 149.00	**R 4,703.92**
7SDL	1 041.5	R5.59	R190 036.00	**R 3,105.59**
POSTED VINES	3 767	R15.87	-	**R 15,874.49**
BUSH VINES	1 488.5	R9.96	-	**R 8,214.15**

Summary

Canopy					Yield			Cost	
Trellis system	Shoots/vine	Lateral Leaf area (cm2)	Main Leaf area (cm2)	Lateral:Main leaf area	Yield/vine (kg)	Yield/panel (kg)	Yield/panel (kg) industry	Establishment cost per ha (poles and wires etc.)	Cost/ha/season
2K2T_TOP	40.1	17749.60	18596.27	1:1.05	2.7	10.8	19.32	R110 025.00	R 8,319.33
2K2T_BOT	41.9	12789.11	19406.96	1:1.52	2.0	8.0			
LYRE_EAST	35	14753.11	27923.72	1:1.89	2.6	11.3	-	R157 522.00	R 6,803.19
LYRE_WEST	33.81	5544.19	18197.47	1:3.28	2.9	12.8			
HWP	30.5	15187.77	27278.15	1:1.80	2.9	11.7	3.09	R 85 149.00	R 4,703.92
7SDL	24	12564.51	12711.08	1:1.01	2.0	10.1	16.94	R190 036.00	R 3,105.59
POSTED VINES	17.1	11380.24	4529.41	1:0.40	2.2	8.8	3.21	-	R 15,874.49
BUSH VINES	25.8	13885.52	6420.76	1:0.46	3.0	12.1	8.29	-	R 8,214.15

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	Trellis	Vine spacing (m)	Cordon runs/vine	Cordon length/vine (m)	Yield per Vine (kg)	No. of Bearers	Pruning weight/vine (kg)	Leaf Area (m^2)	mass (kg)/vine/bearer	kg/m cordon	Leaf Area : Yield (cm2/g)	Yield: Pruning Weight (kg)
Divided Canopies	2K2T_B	1.5	2	3	2.00	20.95	0.69	32.20	0.10	0.67	6.20	2.89
	2K2T_T	1.5	2	3	2.70	20.05	0.41	36.35	0.13	0.90	7.43	6.59
	LY_E	1.5	2	3	2.58	17.50	0.63	42.68	0.15	0.86	6.05	4.10
	LY_W	1.5	2	3	2.93	16.91	0.58	23.74	0.17	0.98	12.34	5.05
VSP	HWP_	1.5	1	1.5	2.94	15.25	0.92	42.47	0.19	1.96	6.91	3.19
	7SDL_	1.2	1	1.2	2.03	12.00	0.80	25.28	0.17	1.69	14.91	2.54
Single Vine	BV_	1.5	1	1.5	3.03	12.93	0.84	20.35	0.23	2.02	8.02	3.61
	PV_	1.5	1	1.5	2.20	8.55	1.45	15.91	0.26	1.47	13.83	1.52

LA:FRUIT

- **7–14 cm²/g** → Widely accepted optimum for ripening wine grapes- *Kliewer & Dokoozlian (2005)*
- **8–12 cm²/g** → Balanced range for premium wine production- *Smart & Robinson (1991), "Sunlight into Wine"*
- **10–12 cm²/g** → Higher requirement in cool climates or late ripening cultivars *Howell (2001)*
- **6–8 cm²/g** → Adequate under warm, high-light condition- Studies in Australia & California (e.g., *Poni et al., 2018*)

RAVAZ INDEX

- **< 5** → Overly Vegetative, under-cropped, high disease risk, diluted fruit
- **5–10** → Optimal balance (wine quality focused)
- **10–12** → Acceptable in warm climates
- **> 12** → Over-cropped, poor ripening risk, compromised fruit quality

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Thank You!

SAGWRI
South African Grape and
Wine Research Institute

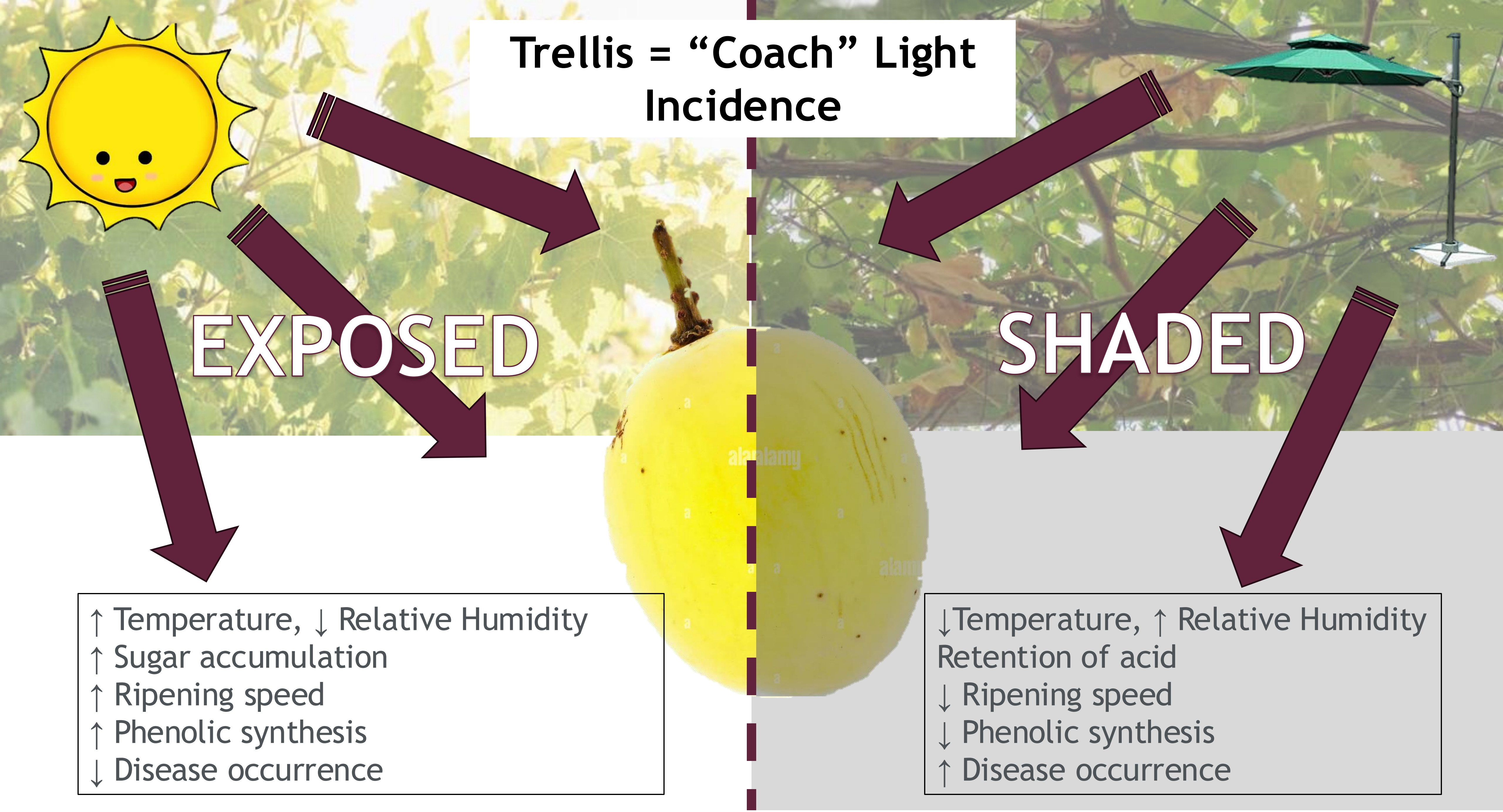
- God Almighty
- My Supervisors: Prof. Melane Vivier and Dr. Etienne Terblanche and Academic Mentors
- National Research Foundation (NRF) for Financial Support
- SAWGRI Institutional Support, Administrative and Technical support
- Collaborators and Industry Partners
- Colleagues and Lab Peers
- International Interns: Theophile Brault, Armand Lapie
- Family and Personal Support

NRF National Research Foundation

SOUTH AFRICA WINE
discover diversity in a glass

CHENIN BLANC ASSOCIATION

Trellis = “Coach” Light Incidence



↑ Temperature, ↓ Relative Humidity
↑ Sugar accumulation
↑ Ripening speed
↑ Phenolic synthesis
↓ Disease occurrence

↓Temperature, ↑ Relative Humidity
Retention of acid
↓ Ripening speed
↓ Phenolic synthesis
↑ Disease occurrence

(Sanchez-Rodriguez & Spósito, 2020)

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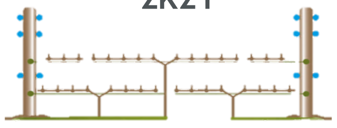
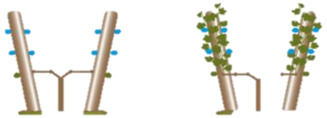
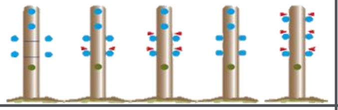
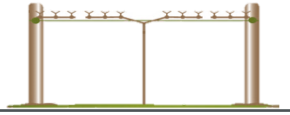
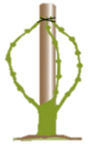
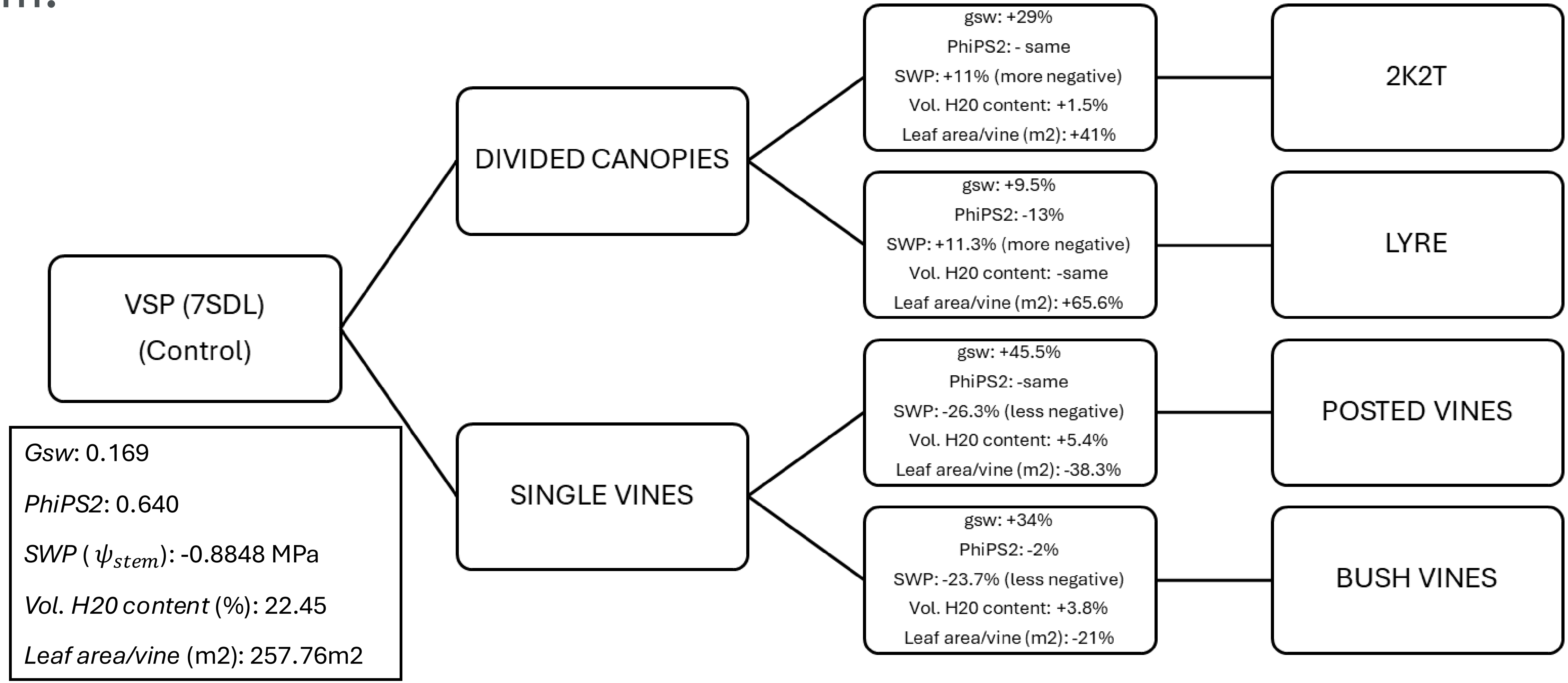
	DIVIDED CANOPY SYSTEMS (Horizontally and Vertically divided)		VERTICAL SHOOT POSITIONED SYSTEMS (VSP)		SINGLE VINE SYSTEMS	
TRELLIS SYSTEM	2K2T 	LYRE 	7-STRAND DOUBLE LENGTHENED 	HIGH WIRE PEROLD 	 POSTED VINE	 BUSH VINE
Microclimate: PAR ☀️ RH 💧 Canopy temp 🌡️ Bunch Temp 📈	☀️: ↔ moderate 💧: ↑ highest 🌡️: ↓ low 📈:↓ (Bottom)	☀️:↑ highest (W)*** 💧: ↔ moderate 🌡️: ↑ highest (W) 📈: ↔ moderate	☀️: ↔ moderate 💧: ↔ moderate 🌡️: ↔ moderate 📈: ↔ moderate	☀️:↓ lowest 💧: ↔ moderate 🌡️: ↔ moderate 📈:↑ highest	☀️: ↔ moderate 💧: ↔ moderate 🌡️: ↔ moderate 📈: ↑ highest (17:00)	☀️: ↔ moderate 💧: ↓ lowest* 🌡️: ↑ highest 📈: ↔ moderate
Vegetative: Lateral Leaf area Main Leaf area	Balanced	Favours main leaves	Balanced	Favours main leaf production	Favours lateral leaf production	Favours lateral leaves
Reproductive: Yield Brix Ph Bunch Weight Berry weight Berry number	🍇: 8.5 kg/panel 🧪: 23.2 🍇: 3.28 🍇: 162.32 g 🍇: 1.91 g 🍇: 120	🍇: 11.2 kg/panel 🧪: 23.2 🍇: 3.33 🍇: 126.81 g* 🍇: 1.7 g 🍇: 83	🍇: 10.14 kg/panel 🧪: 22.9 🍇: 3.49 🍇: 167.16 g 🍇: 1.8 g 🍇: 95	🍇: 11.4 kg/panel 🧪: 22.8 🍇: 3.41 🍇: 232.7 g* 🍇: 2.0 g 🍇: 119.2	🍇: 8.8 kg/panel 🧪: 22.2 🍇: 3.93 🍇: 143.06 g 🍇: 1.8 g 🍇: 120	🍇: 12.1 kg/panel 🧪: 22.7 🍇: 3.44 🍇: 170.73 g*** 🍇: 2.19 g 🍇: 97

How do our systems compare to the industry norm?

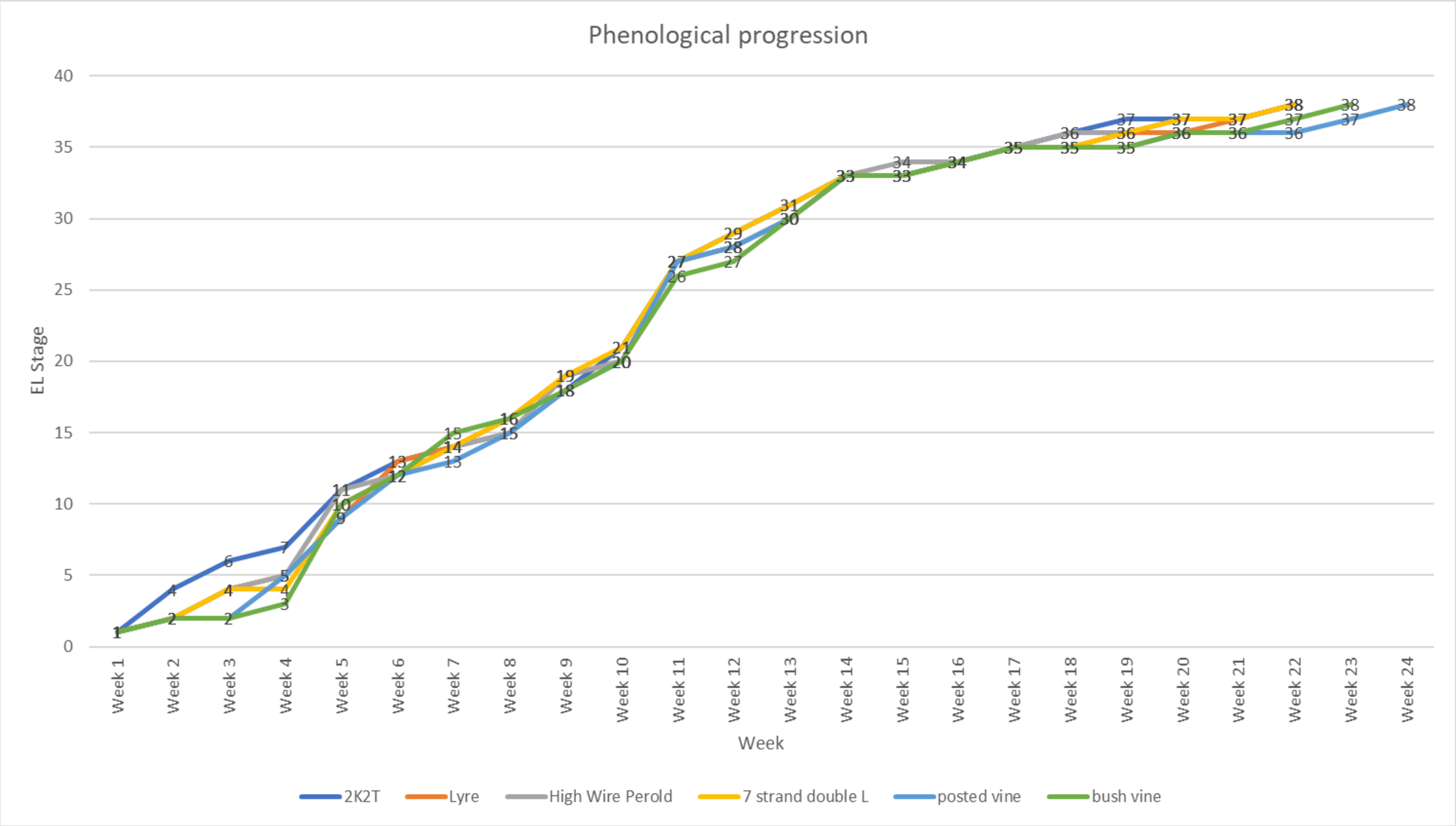


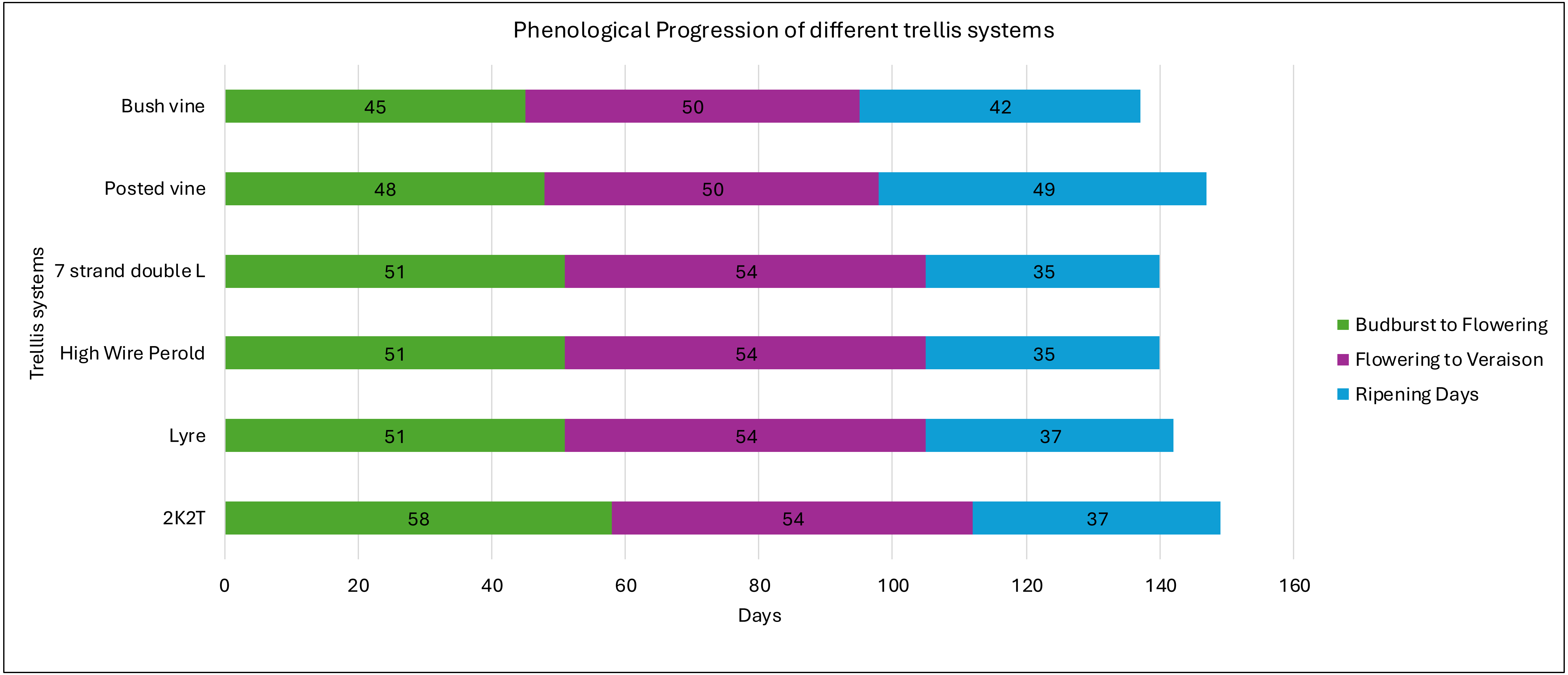
Leaf Petiole analysis (Flowering)

Elements	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	B (mg/kg)
PV	3.757 a	0.390 a	1.203 a	1.467 abc	0.200 a	154.000 d	263.667 ab	148.667 ab	12.000 a	23.767 a	42.900 abc
BV	3.427 cd	0.237 b	0.643 c	1.250 c	0.237 a	177.667 bcd	337.333 a	211.667 a	9.567 b	26.000 a	47.567 a
7SDL	3.613 ab	0.250 b	1.207 a	1.303 bc	0.237 a	188.333 bc	143.000 c	113.667 b	7.000 cd	25.167 a	44.667 ab
HWP	3.537 bc	0.257 b	0.993 b	1.537 ab	0.230 a	195.333 b	188.667 bc	132.667 b	8.233 bc	22.100 a	43.400 abc
2K2T	3.027 e	0.193 b	1.127 ab	1.440 abc	0.193 a	240.333 a	193.000 bc	165.333 ab	5.733 d	23.900 a	35.233 c
LY	3.330 d	0.247 b	1.110 ab	1.567 a	0.193 a	165.000 cd	187.000 bc	141.333 ab	6.733 cd	23.367 a	38.100 bc
Pr > F(Model)	**<0.0001**	**0.001**	**<0.0001**	**0.007**	0.063	**<0.0001**	**0.001**	**0.017**	**<0.0001**	0.484	**0.006**
Significant	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**

Phenological development

Trellis system	Harvest date (2024)	Harvest date (2025)
2K2T	24 January	12 February
Lyre	24 January	12 February
GDC	24 January	-
T-Kap	24 January	-
Ballerina	24 January	-
Scott Henry	24 January	-
Smart Henry	24 January	-
Smart Dysan	24 January	-
High Wire Perold	24 January	10 February
2-Strand Hedge (Small box)	24 January	-
2-Strand Hedge (Big Box)	24 January	-
1-Strand hedge	24 January	-
5-Strand double lengthened	24 January	-
Perold fixed	24 January	-
7-Strand double lengthened	24 January	10 February
5-strand double lengthened	24 January	-
4-strand hedge fixed	24 January	-
4 strand hedge movable	24 January	-
Posted vine	12 February	24 February
Bush vine	12 February	17 February




Phenological Progression of different trellis systems
Bush vine
Posted vine
7 strand double L
High Wire Perold
Lyre
2K2T
45
50
42
48
50
49
51
54
35
51
54
35
51
54
37
58
54
37
0
20
40
60
80
100
120
140
160
Days
Trellis systems
Budburst to Flowering
Flowering to Veraison
Ripening Days

Weekly Irrigation Scheduling Methodology

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Purpose:

To determine optimal irrigation amounts for grapevines based on phenological development and environmental conditions.

- Key Components:
- Crop Coefficient (Kc):
  - Initiated 6 November 2024 at **Kc = 0.5102**
  - Increased to **Kc = 0.75** during vegetative growth (where plant water requirements are greater)
  - Gradually decreased **post-veraison** to support ripening
- Reference Information (Fixed Inputs):
  - Plant, row, and vine spacing
  - Area per meter of vine
  - Vines per panel
  - Total area under panel
  - Dripper spacing
  - Dripper discharge (L/hr)
- Variable Inputs (Weekly):
  - Crop coefficient (Kc)
  - **ETo (reference evapotranspiration) (iLeaf)**
  - **Rainfall data (iLeaf)**
- Method:
  - Data input into **R code** weekly
  - Code calculates, ***water requirement per vine*** and converts to ***minutes to irrigate***
  - Output communicated to vineyard manager **every Friday**

Irrigation Scheduling: based on *Kc*, *Eto* and Rainfall

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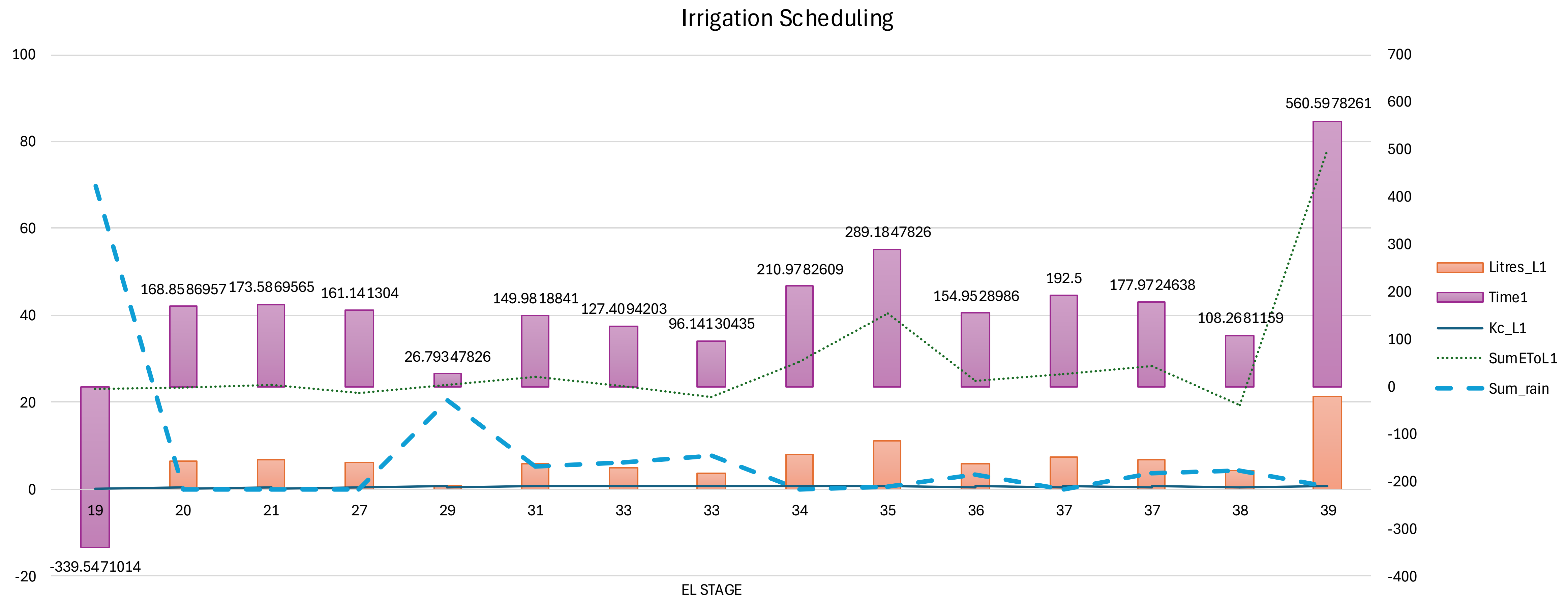
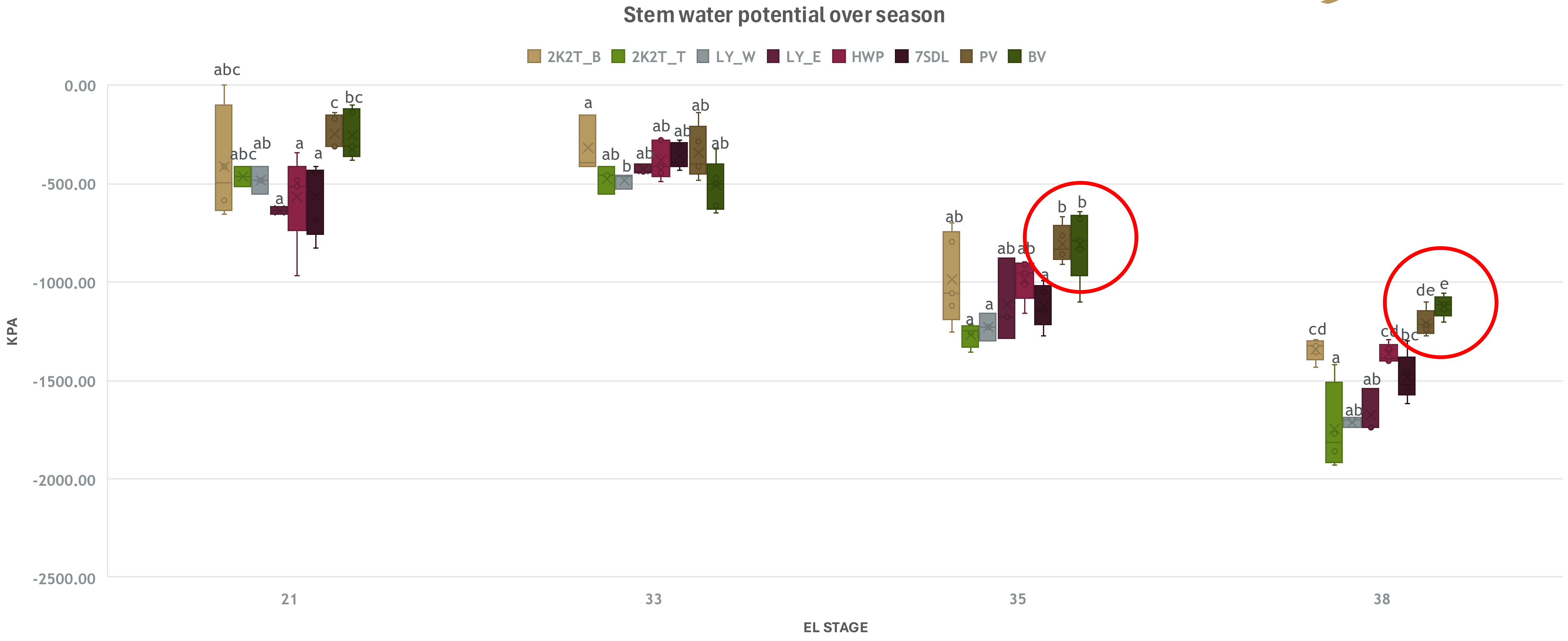
- Irrigation was carried out weekly, on the basis of maintenance of a Kc value for phenological development as determined for wine grape production





Stem water potential over season
2K2T_B
2K2T_T
LY_W
LY_E
HWP
7SDL
PV
BV
KPA
0.00
-500.00
-1000.00
-1500.00
-2000.00
-2500.00
21
33
35
38
EL STAGE
abc
abc
ab
a
a
a
c
bc
a
ab
b
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ab
ab
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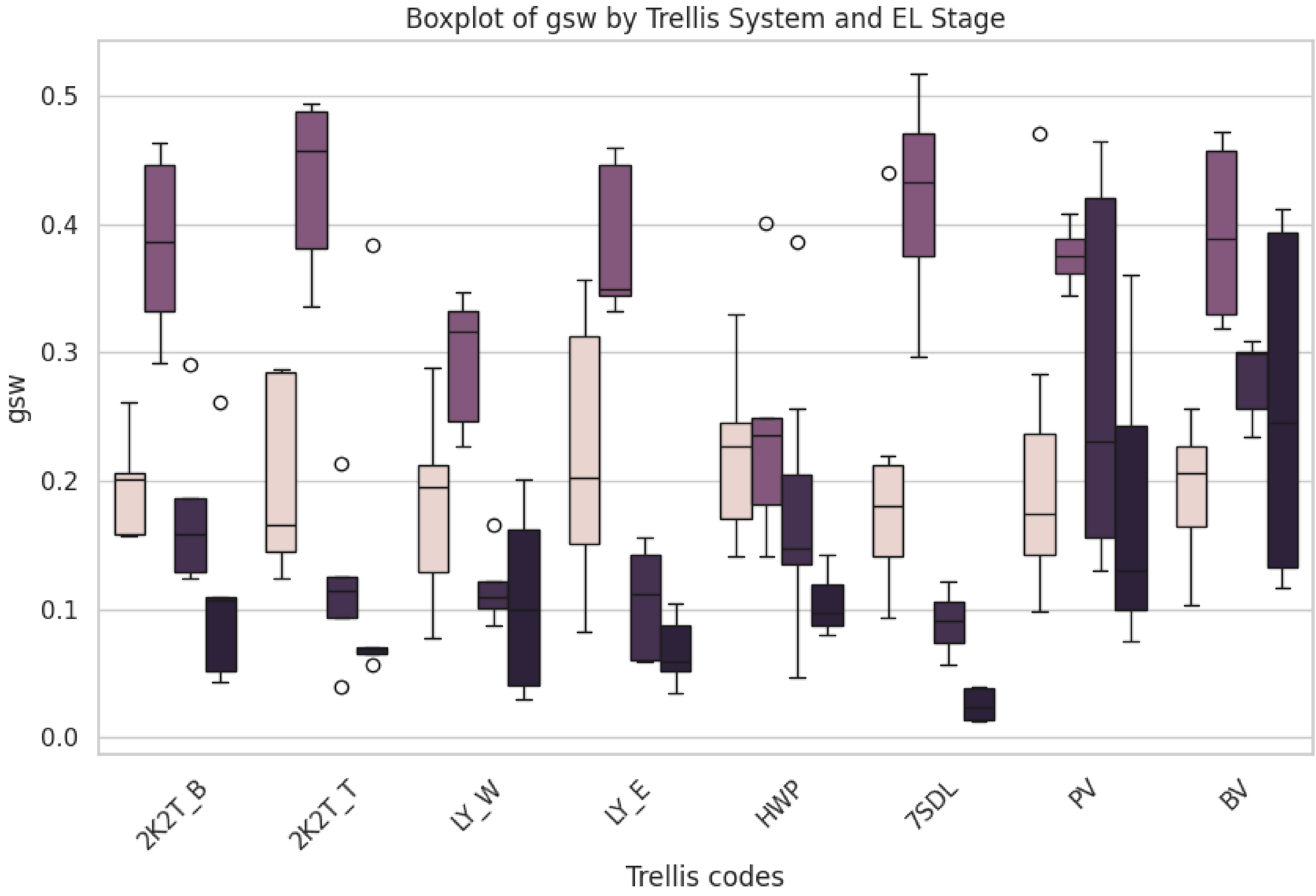
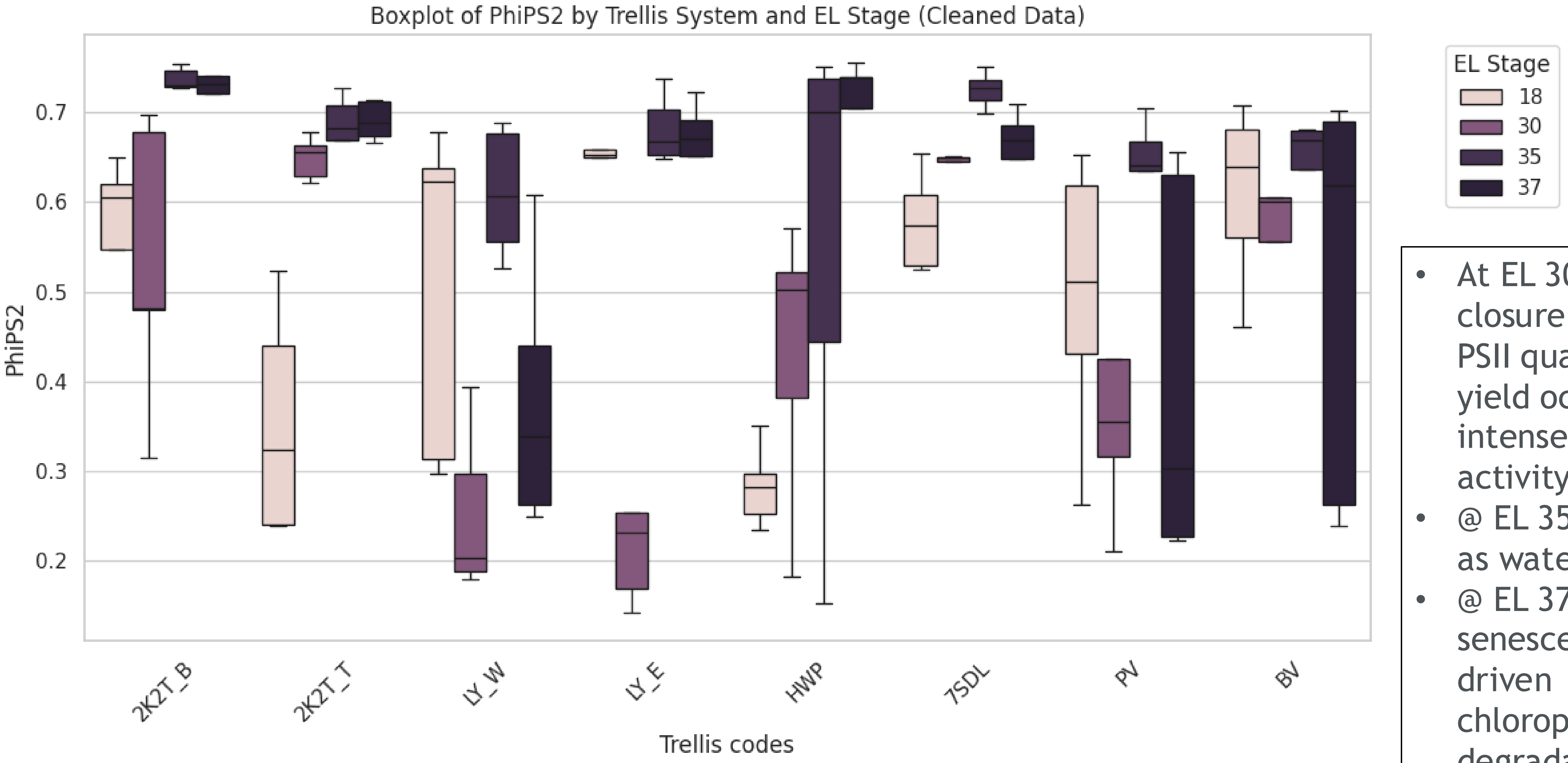
ab
ab
cd
bc
de
e



- Peak at bunch closure(where active growth is greatest), decrease as water becomes limited.
- Vegetative demand, based on trellis canopy size, can trigger a significant reduction in gsw.



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- At EL 30: (bunch closure) highest PSII quantum yield occurs → intense *Pn* activity.
- @ EL 35: declines as water stress ↑
- @ EL 37: senescence driven chlorophyll degradation ↓ PSII efficiency.

Yield data (2024/25)

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Category	Yield/panel (kg)	Yield/vine (kg)	Bunch Weight Ave (g)	Brix	pH
LY	24.080 ± 1.34a	5.509 ± 1.39a	139.488 ± 59.85a	23.2	3.33
2K2T	18.780 ± 2.16b	4.695 ± 1.41a	148.170 ± 55.32a	23.2	3.28
BV	12.134 ± 3.87c	3.034 ± 0.97b	162.717 ± 7.62a	22.7	3.44
HWP	11.738 ± 1.35c	2.935 ± 0.75b	177.963 ± 64.68a	22.8	3.41
PV	8.802 ± 2.58c	2.201 ± 0.89b	173.521 ± 91.57a	22.2	3.93
7SDL	10.140 ± 1.90c	2.028 ± 0.80b	155.552 ± 73.72a	22.9	3.49
Pr > F(Model)	**<0.0001**	**<0.0001**	0.899	-	-
Significant	**Yes**	**Yes**	No		

Eno-carpological Characterization

Trellis system	Yield/panel (kg)	Yield/vine (kg)	Bunch weight (g)	Bunch Volume (ml)	Number of berries/bunches	Bunch Length (cm)	Bunch width (cm)
HWP	11.738 ± 1.35ab	2.935 ± 0.34ab	232.701 ± 60.888a	226.000 ± 31.955a	119.200 ± 28.608a	13.930 ± 2.755a	6.860 ± 0.973ab
2K2T_TOP	10.800 ± 1.24a	2.700 ± 0.31ab	162.319 ± 64.354ab	151.000 ± 43.576abc	95.000 ± 60.191a	12.518 ± 2.426a	8.260 ± 2.539a
BV	12.134 ± 3.87a	3.034 ± 0.97a	170.763 ± 91.375ab	177.000 ± 88.575ab	97.200 ± 53.719a	11.780 ± 2.847a	6.151 ± 1.176ab
7SDL	10.140 ± 1.90ab	2.028 ± 0.38ab	167.157 ± 44.847ab	147.000 ± 67.831abc	94.300 ± 22.351a	11.210 ± 2.920a	7.430 ± 1.721ab
2K2T_BOTTOM	7.980 ± 1.04b	1.995 ± 0.26b	161.495 ± 66.185ab	118.000 ± 63.386bc	120.600 ± 45.651a	13.460 ± 2.410a	5.930 ± 1.489b
PV	8.802 ± 2.59ab	2.201 ± 0.65ab	143.059 ± 61.271ab	125.000 ± 69.162bc	84.100 ± 33.884a	12.390 ± 2.365a	6.820 ± 1.263ab
LY_EAST	11.320 ± 1.61ab	2.580 ± 0.29ab	136.259 ± 82.586b	78.000 ± 49.677c	93.900 ± 52.519a	11.970 ± 2.661a	5.520 ± 1.302b
LY_WEST	12.760 ± 0.32a	2.929 ± 0.29ab	126.814 ± 46.388b	106.000 ± 40.879bc	72.000 ± 21.644a	11.300 ± 2.556a	5.500 ± 1.246b
Pr > F(Model)	**0.008**	**0.005**	**0.030**	**<0.0001**	0.185	0.114	**0.001**
Significant	**Yes**	**Yes**	**Yes**	**Yes**	No	No	**Yes**

Eno-Carpological Characterization

Category	Berry weight (g)	Berry width (mm)	Berry length (mm)	Seed number	Seed weight (g)	%Seed of Berry	%Skin & Pulp of Berry
BV	2.193 ± 0.381a	13.920 ± 1.577a	15.440 ± 1.197a	1.300 ± 0.505a	0.061± 0.021a	2.756 ± 0.7ab	97.244 ± 0.7ab
2K2T_TOP	1.915 ± 0.333bc	15.198 ± 0.978a	15.383 ± 1.114a	1.320 ± 0.513a	0.047 ± 0.019ab	2.492 ± 0.931b	97.508 ± 0.931a
HWP	2.076 ± 0.338ab	13.125 ± 0.951a	14.611 ± 1.134a	1.300 ± 0.544a	0.053 ± 0.02ab	2.507 ± 0.660b	97.493 ± 0.660a
LY_WEST	1.908 ± 0.392bc	13.037 ± 1.160a	14.988 ± 1.254a	1.280 ± 0.454a	0.056 ± 0.018ab	3.010 ± 0.995ab	96.990 ± 0.995ab
7SDL	1.873 ± 0.455bc	12.567 ± 1.574a	14.651 ± 1.959a	1.320 ± 0.551a	0.055 ± 0.025ab	2.922 ± 0.998ab	97.085 ± 0.997ab
LY_EAST	1.543 ± 0.308d	11.879 ± 1.142a	13.930 ± 1.19a	1.360 ± 0.598a	0.055 ± 0.054ab	3.599 ± 3.82a	96.401 ± 3.82b
PV	1.808 ± 0.412c	12.622 ± 1.303a	14.445 ± 1.261a	1.300 ± 0.544a	0.053 ± 0.0207ab	2.879 ± 0.728ab	97.121 ± 0.728ab
2K2T_BOTTOM	1.453 ± 0.276d	11.992 ± 1.022a	13.444 ± 1.095a	1.240 ± 0.476a	0.041 ± 0.031b	2.920 ± 1.37ab	97.080 ± 1.374ab
Pr > F(Model)	**<0.0001**	0.365	0.373	0.982	**0.016**	**0.025**	**0.025**
Significant	**Yes**	No	No	No	**Yes**	**Yes**	**Yes**