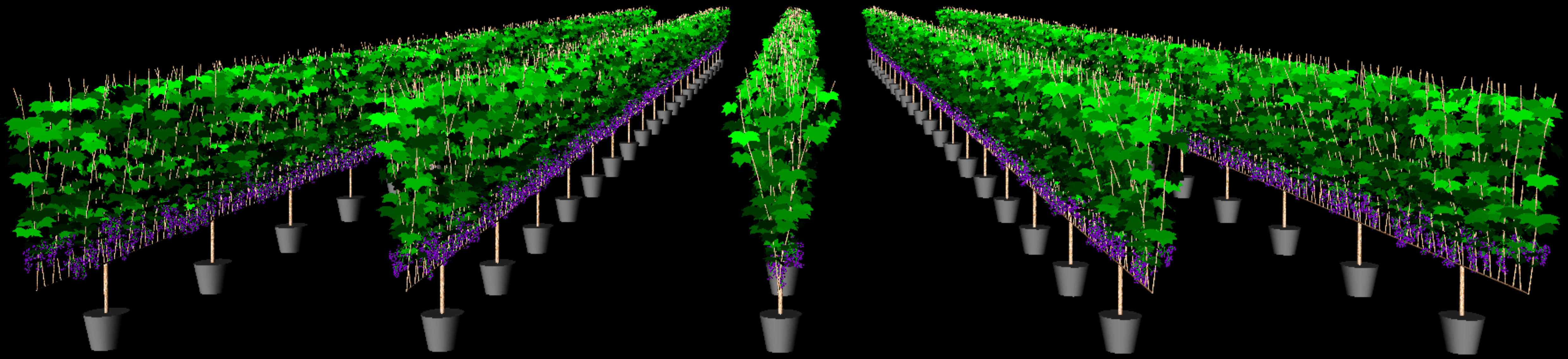
Growing grapes on a virtual plant



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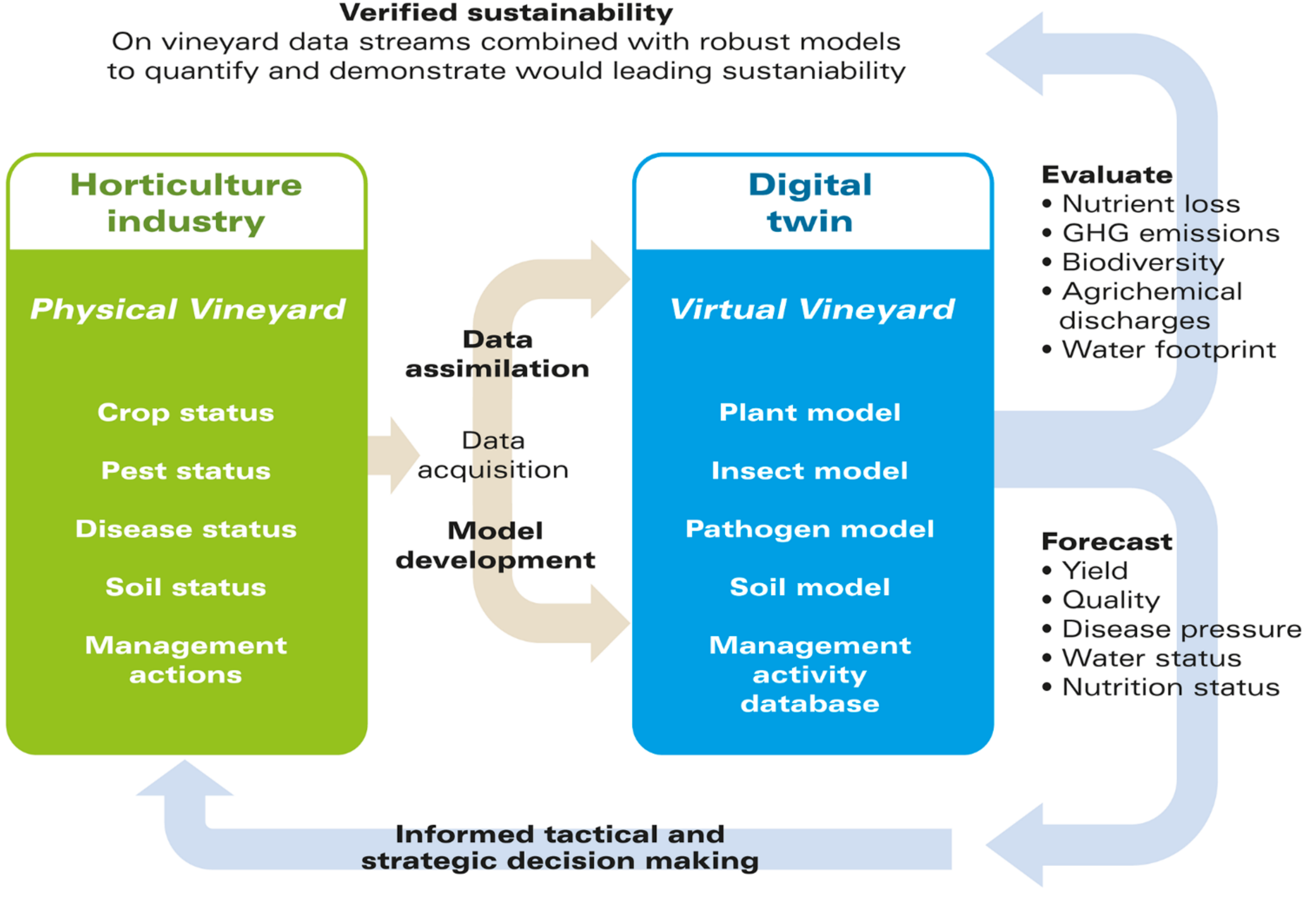
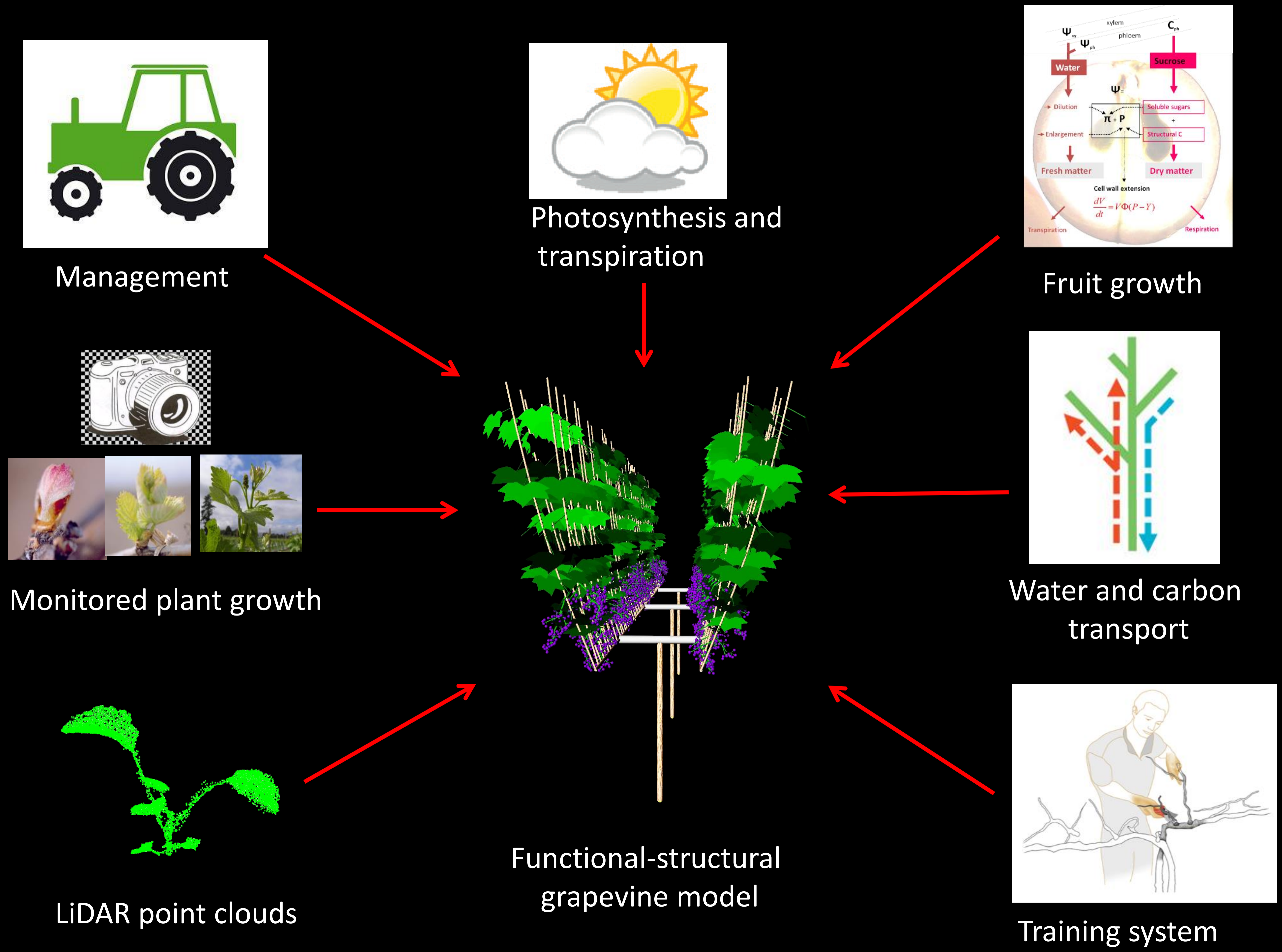
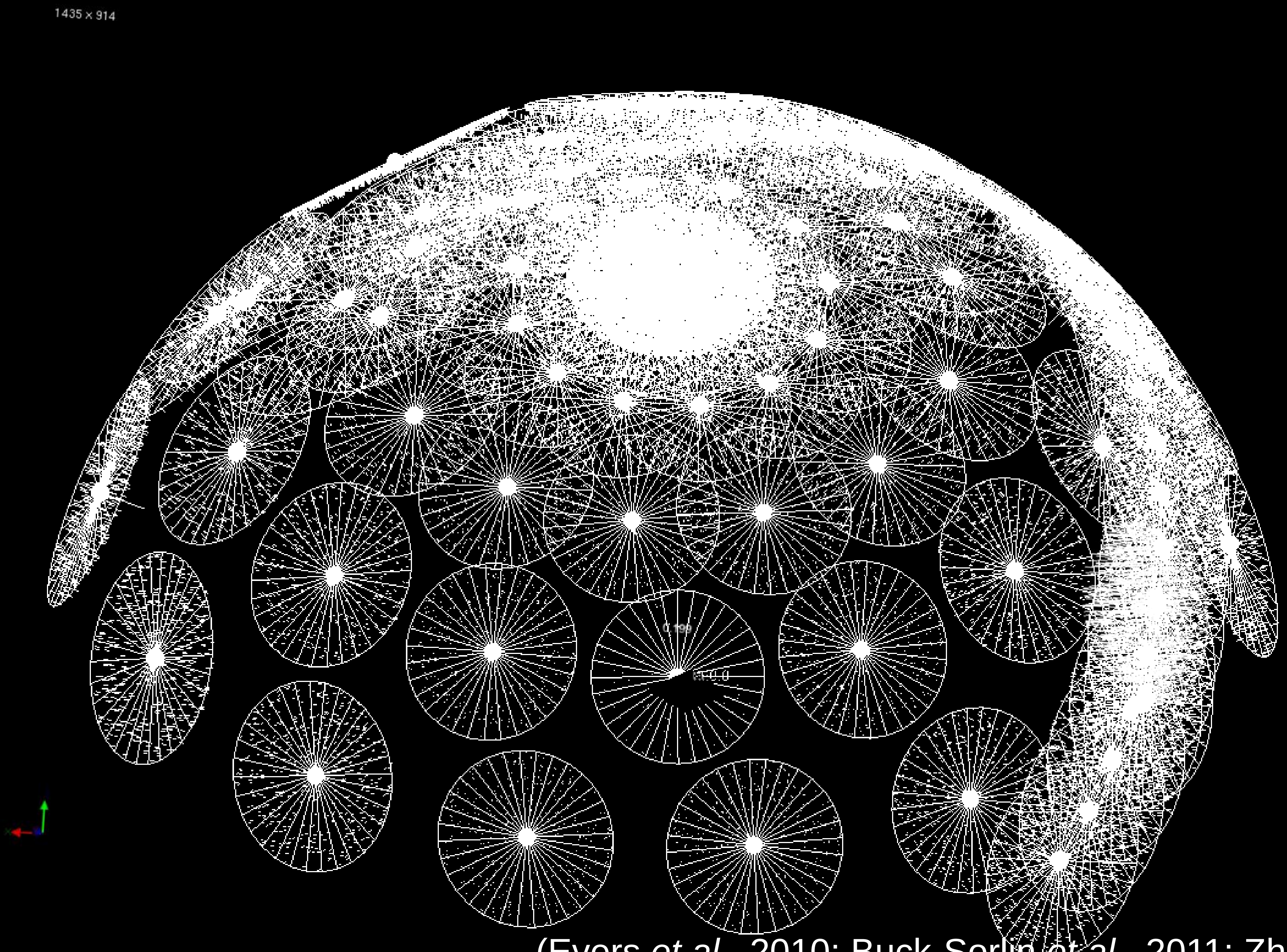


Verified sustainability
On vineyard data streams combined with robust models to quantify and demonstrate would leading sustainability
Horticulture industry
Physical Vineyard
Crop status
Pest status
Disease status
Soil status
Management actions
Data assimilation
Data acquisition
Model development
Digital twin
Virtual Vineyard
Plant model
Insect model
Pathogen model
Soil model
Management activity database
Evaluate
• Nutrient loss
• GHG emissions
• Biodiversity
• Agrichemical discharges
• Water footprint
Forecast
• Yield
• Quality
• Disease pressure
• Water status
• Nutrition status
Informed tactical and strategic decision making

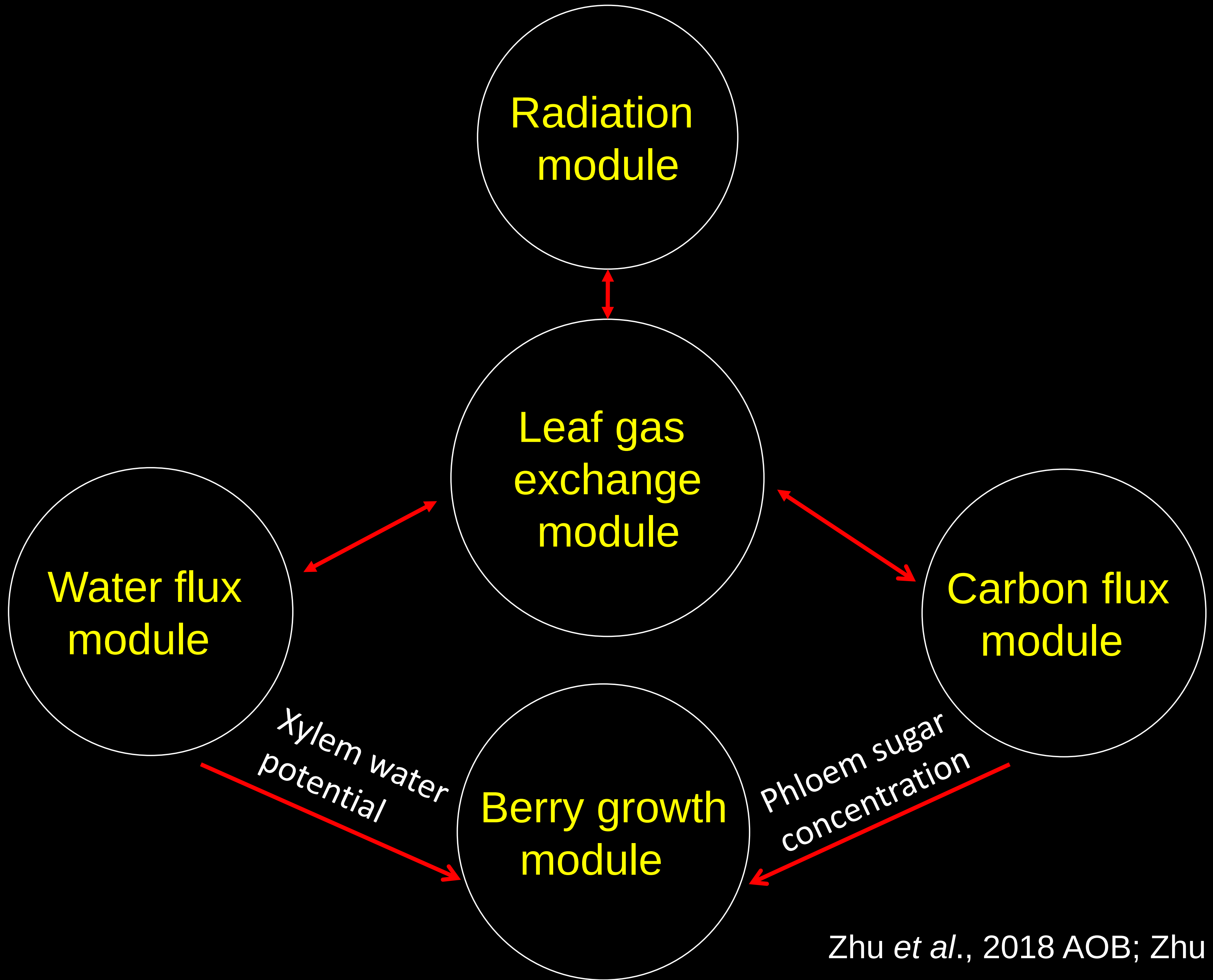


Management
Photosynthesis and transpiration
xylem
phloem
Water
Sucrose
Dilution
Enlargement
Soluble sugars
Structural C
Fresh matter
Dry matter
Cell wall extension
Transpiration
Respiration
Fruit growth
Monitored plant growth
Water and carbon transport
LiDAR point clouds
Functional-structural grapevine model
Training system

Radiation module

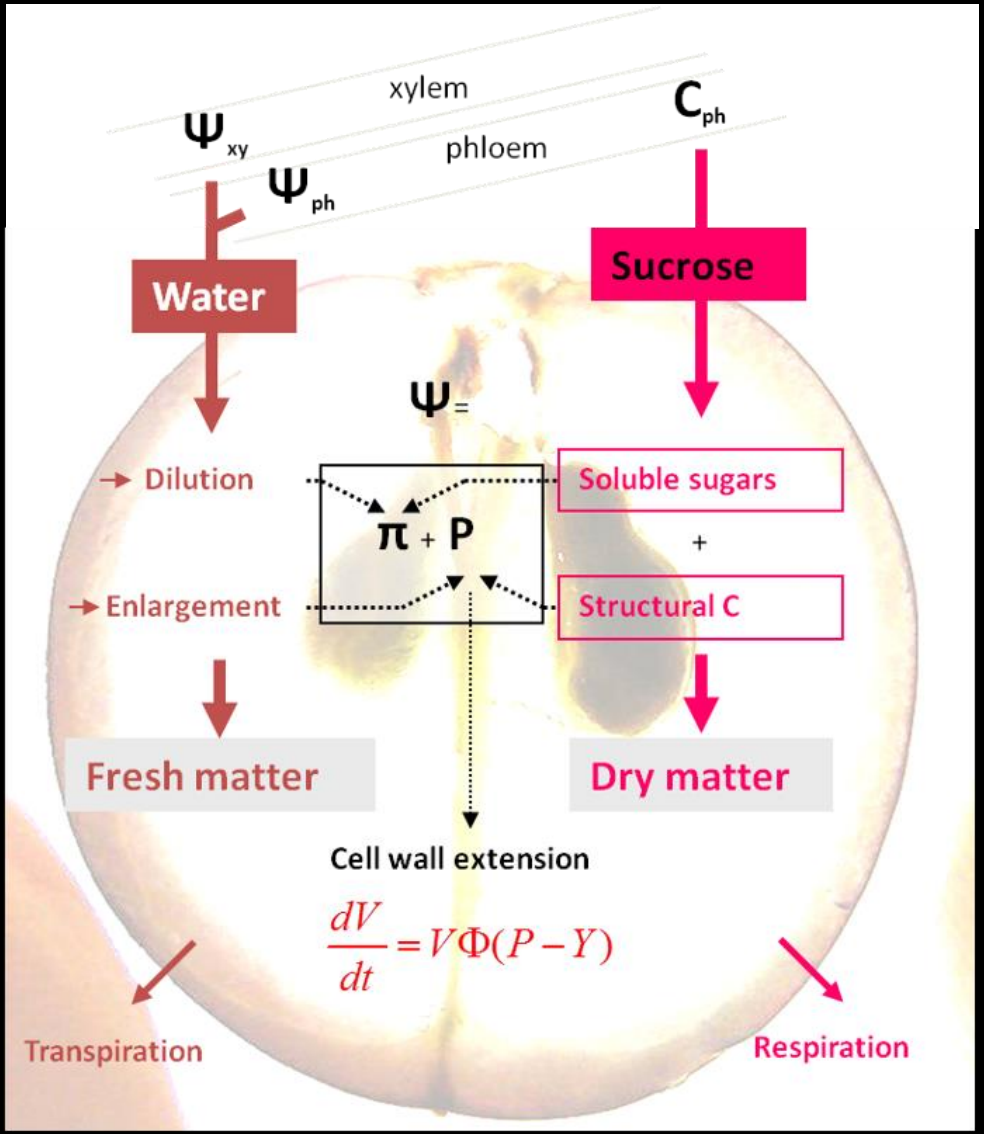


(Evers *et al*., 2010; Buck-Sorlin *et al*., 2011; Zhu *et al*., 2015)



Zhu *et al*., 2018 AOB; Zhu *et al*., 2019 JXB

Berry growth module



- **Main physiological processes:**

Water influx
Mass flow = f (Lp, s , a_f, DY)

Water loss
Transpiration = f (r, A_f, T , RH)

Carbon influx
Active transport = f(V_m, L_m, t*, t, C_{ph})
Mass flow = f (Lp, s, a_f, DY)
Passive diffusion = (P_s, A_f, DCsug)

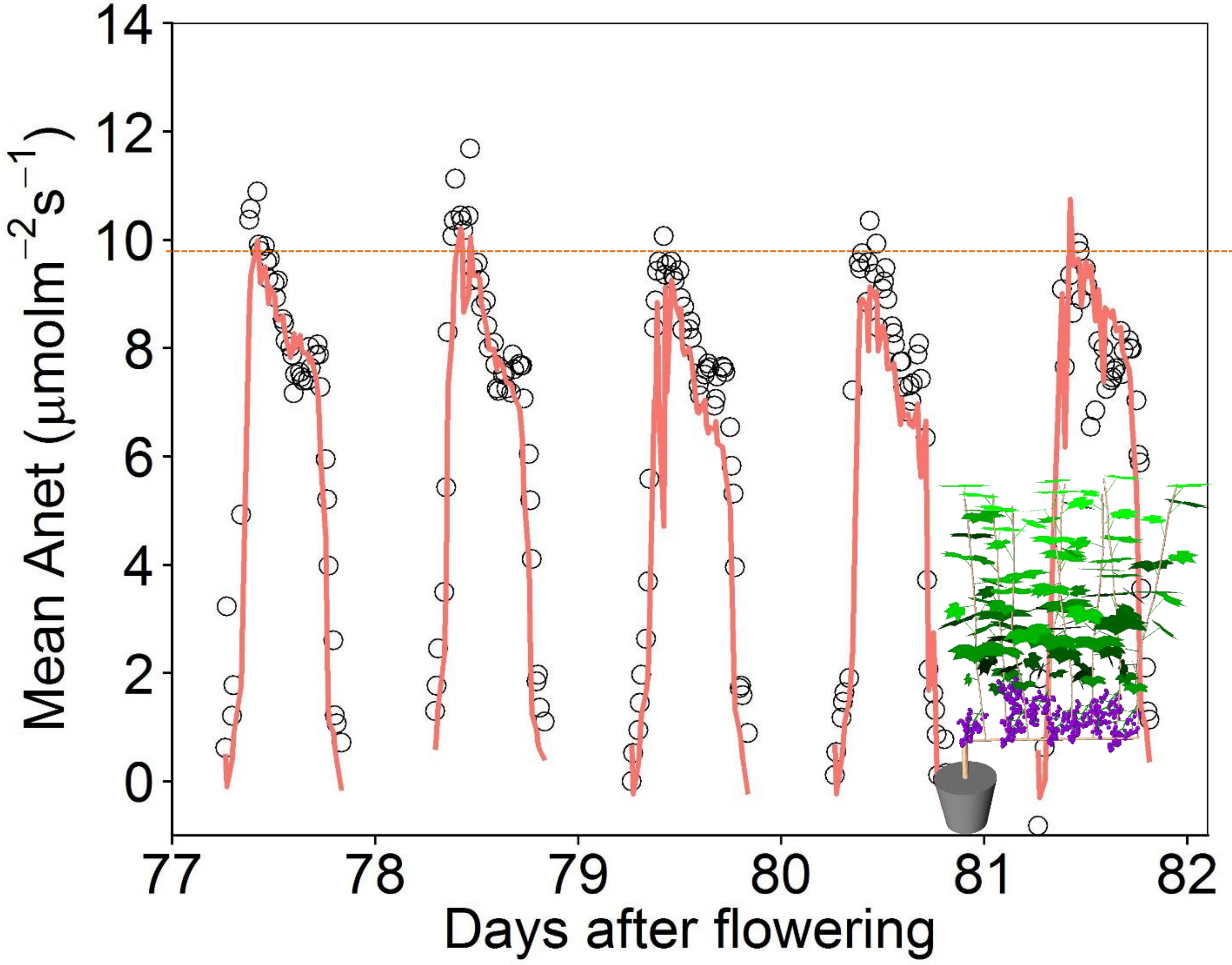
Carbon loss
Respiration = **f (q_m, q_g, Q_{10}, T)**

Fishman & Génard, 1998;
Dai et al, 2008;

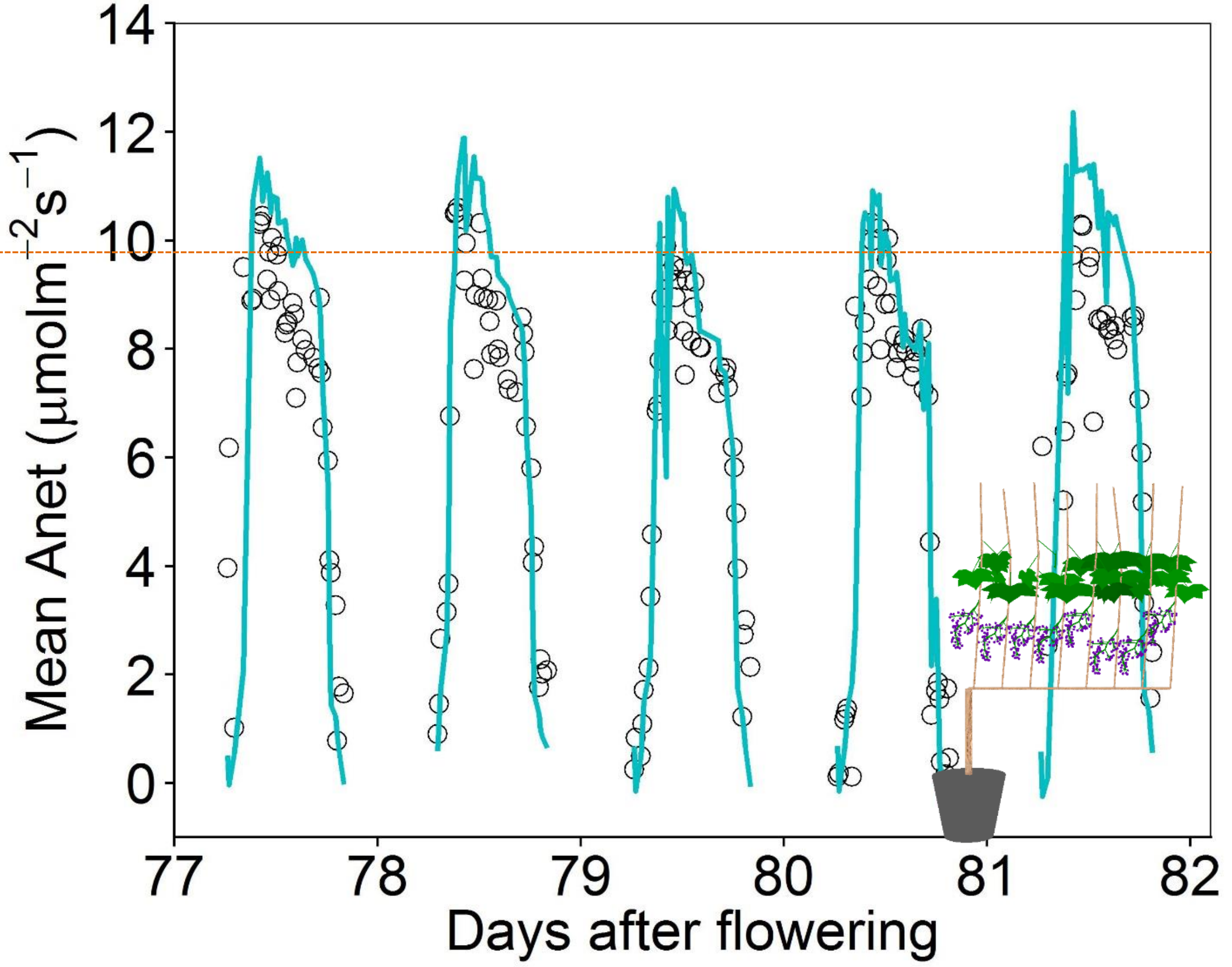
Fruiting-cutting
Cabernet sauvignon
One-cane-pruned
Sangiovese

Whole-plant photosynthesis

12 leaves per shoot

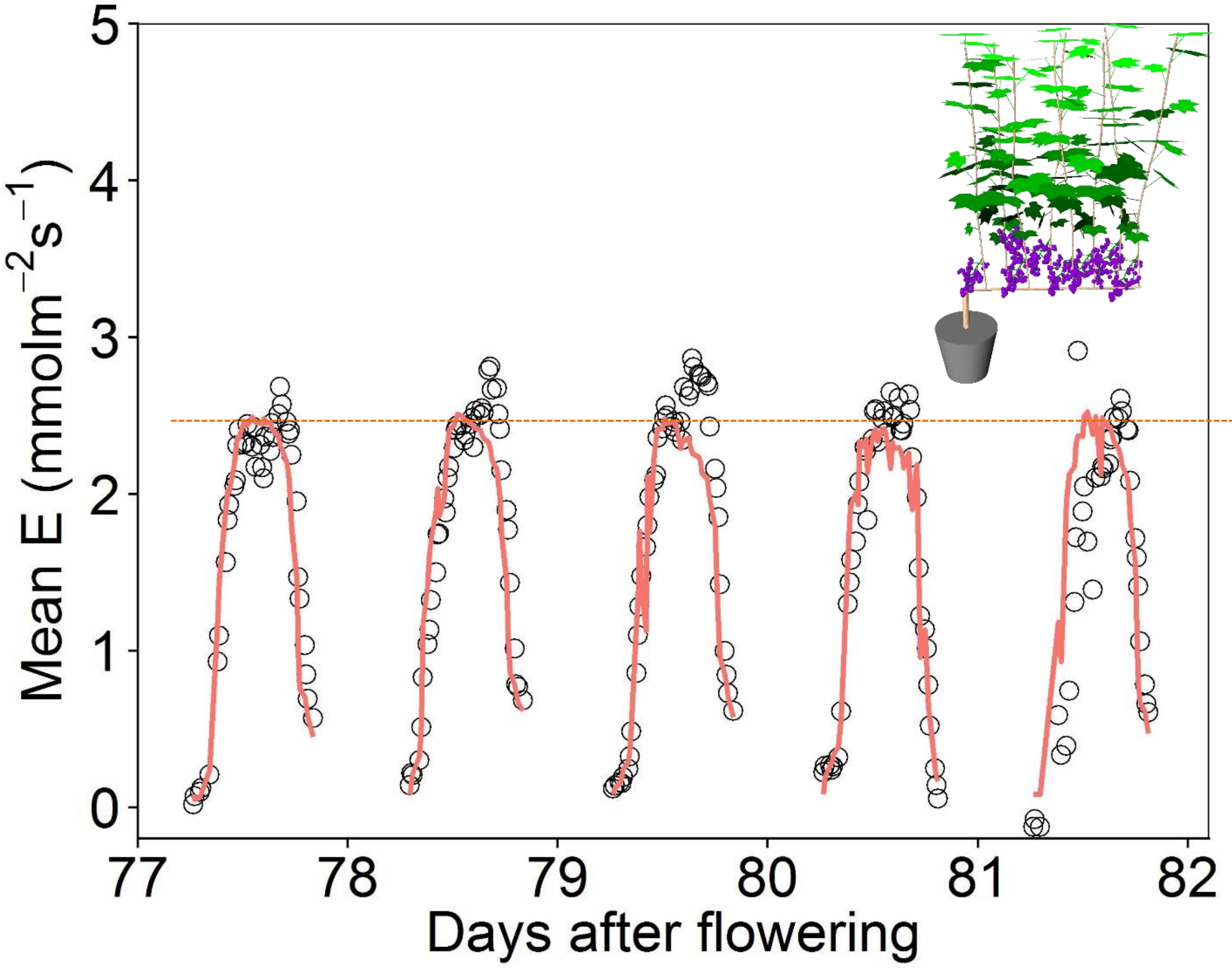


3 leaves per shoot

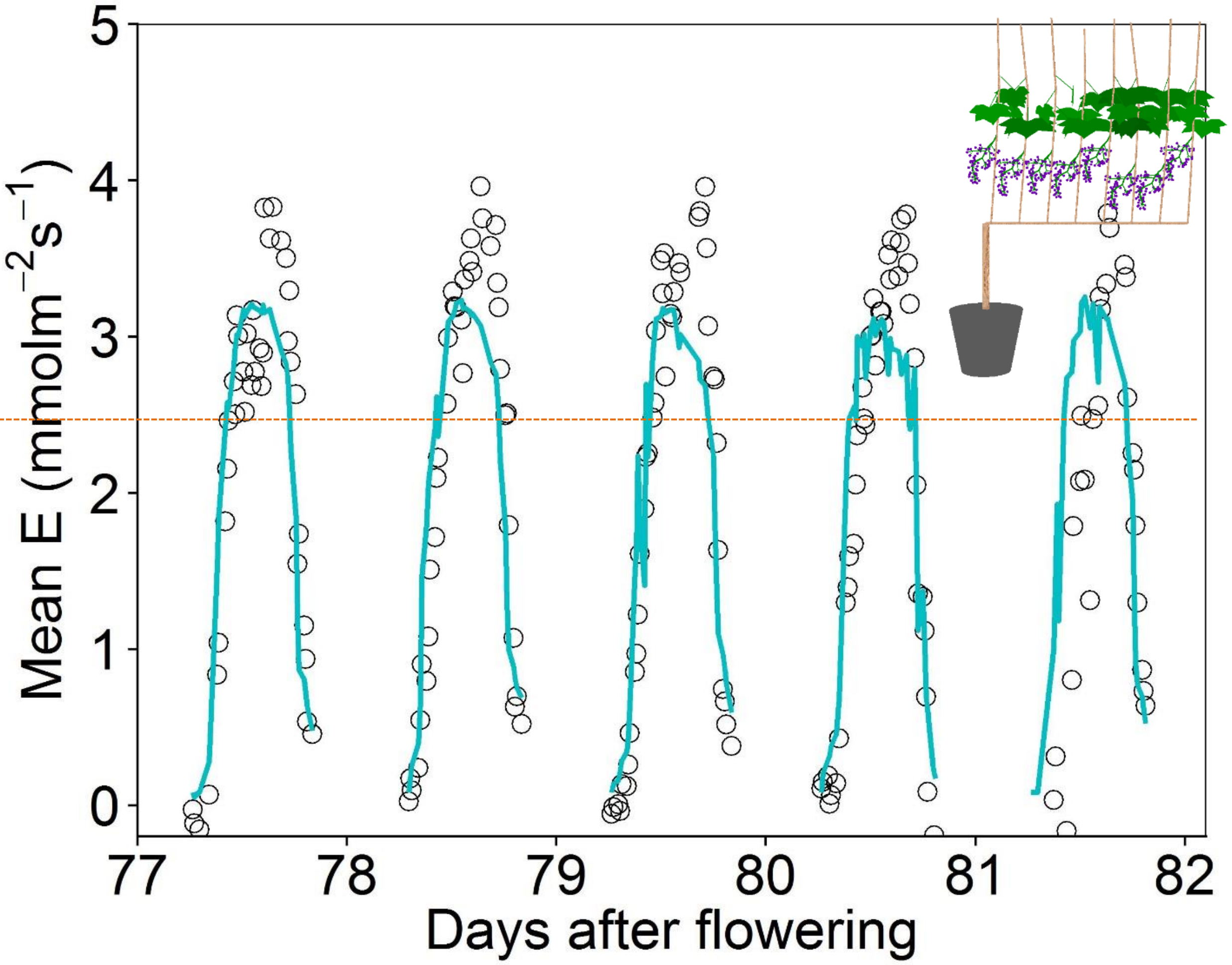


Whole-plant transpiration

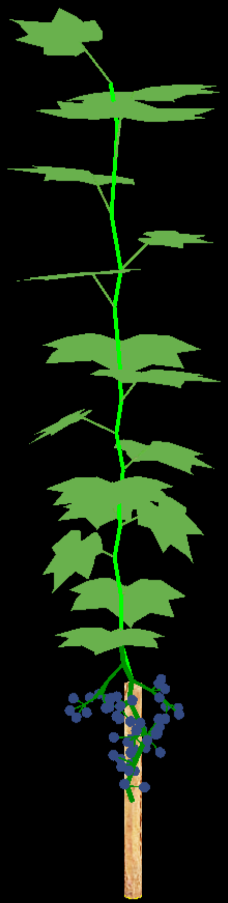
12 leaves per shoot

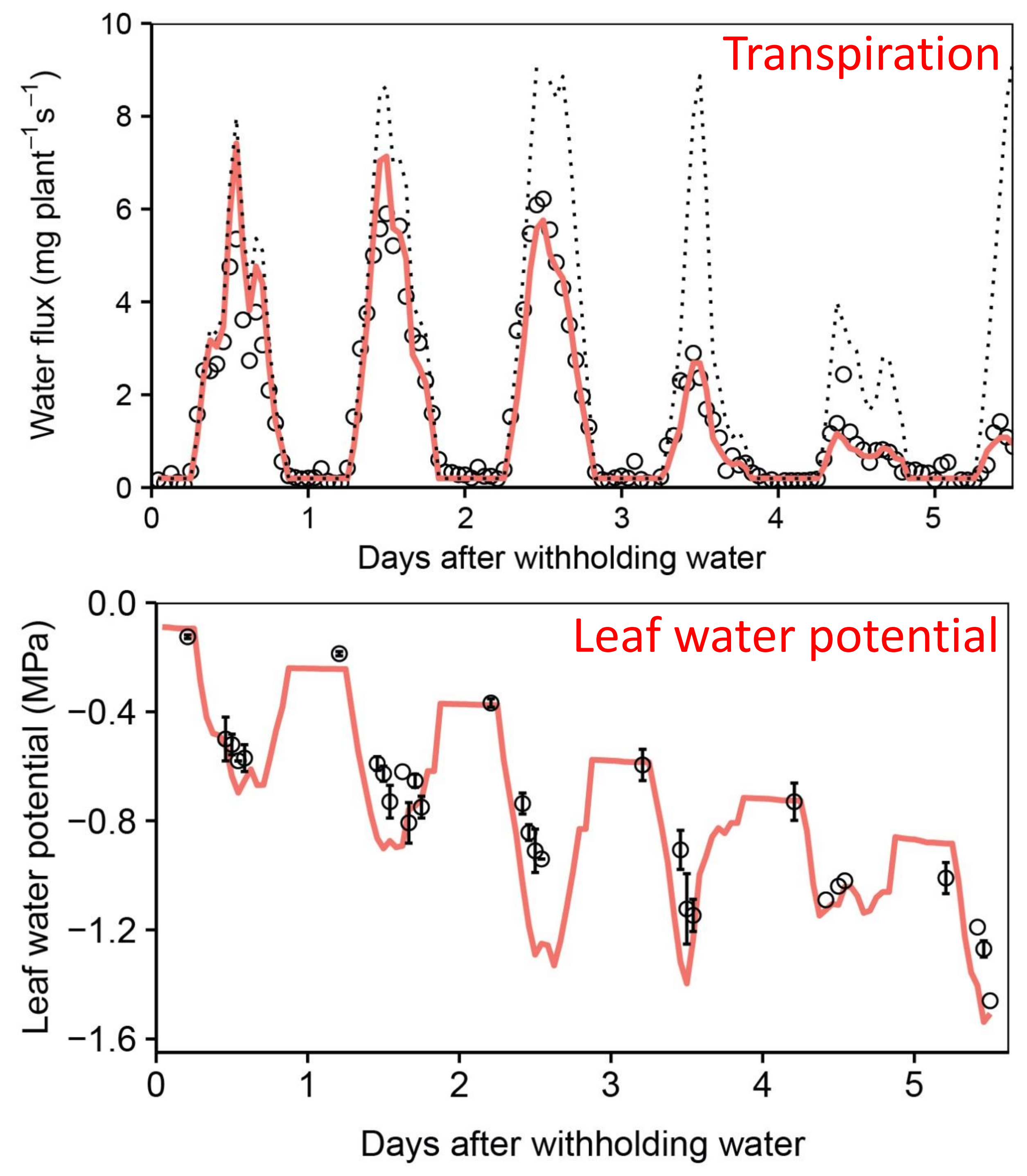


3 leaves per shoot

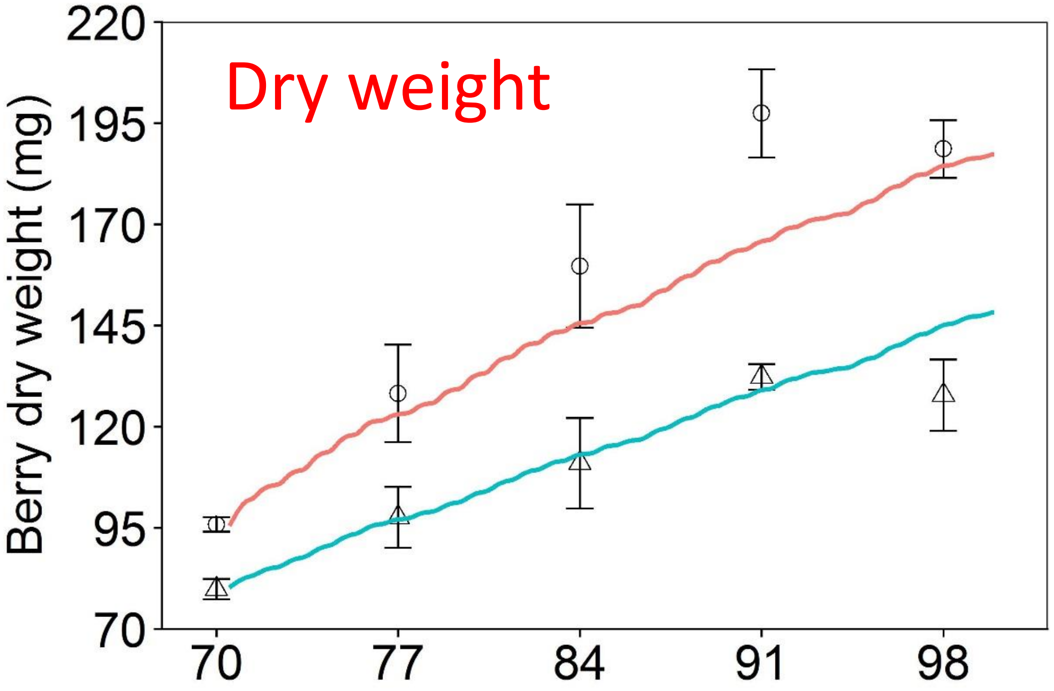


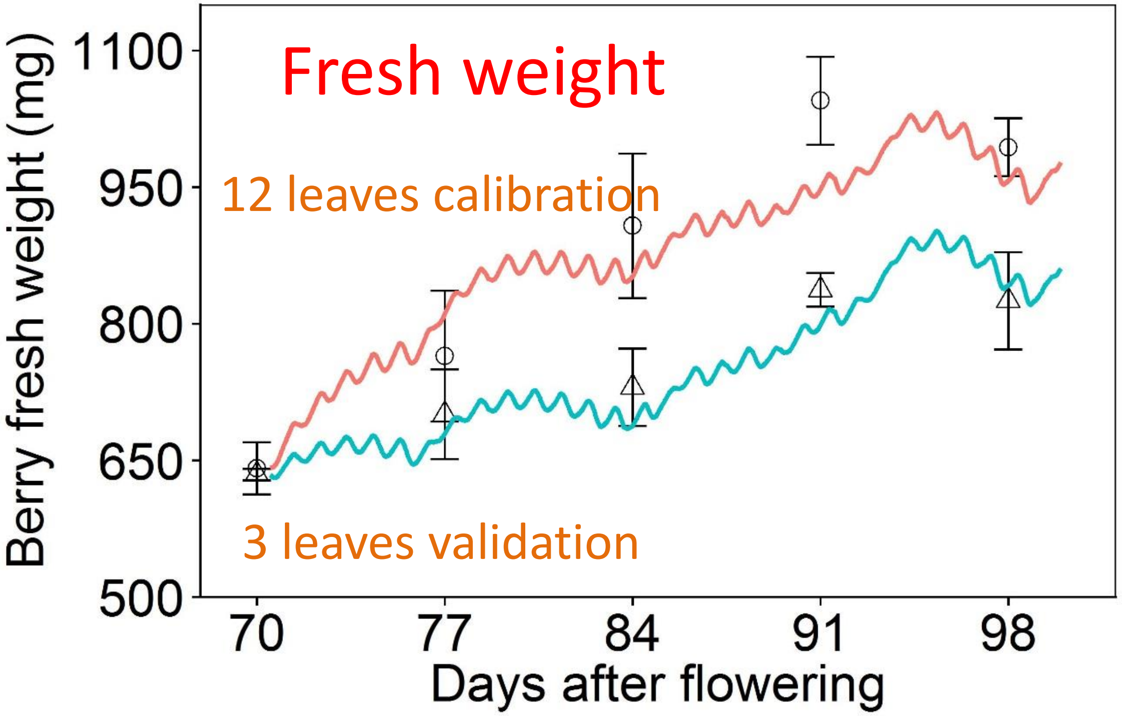
Whole-plant water flux within a drying cycle

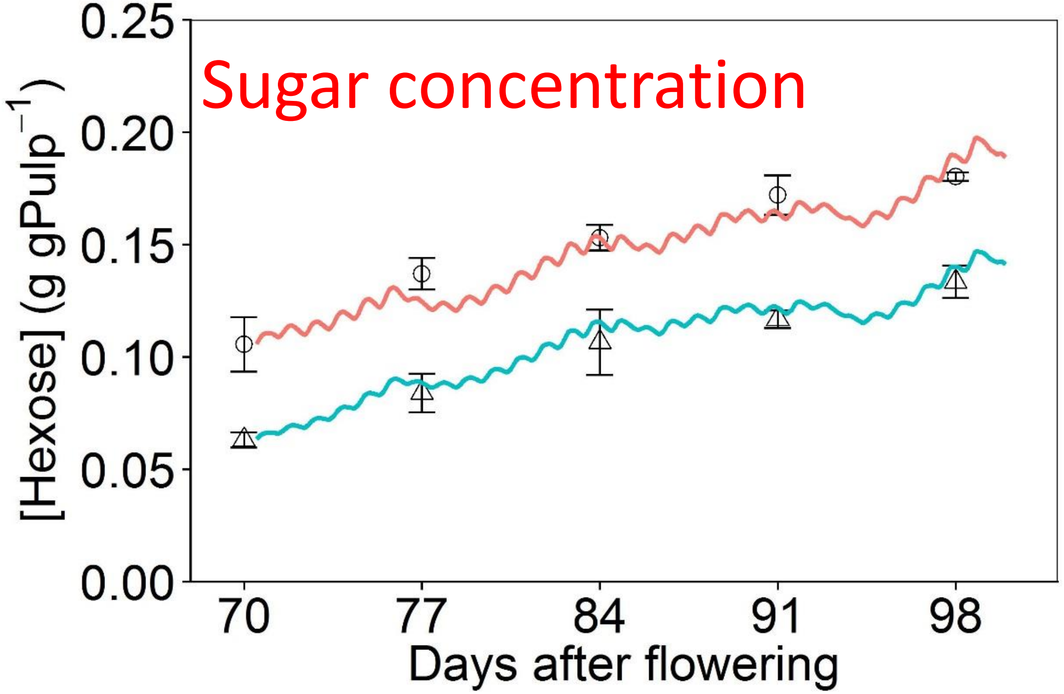




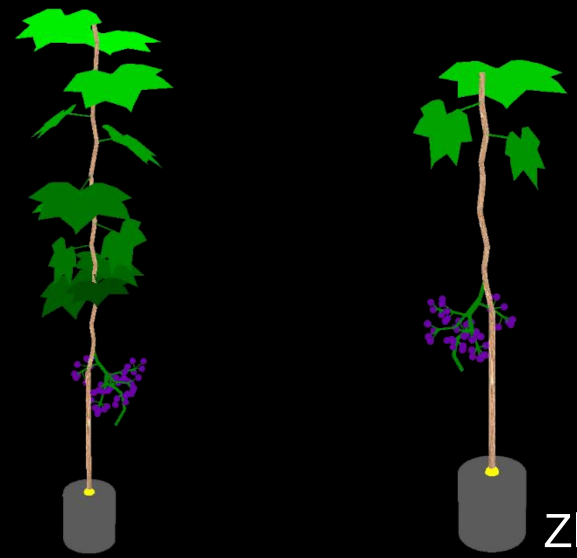
Zhu *et al.*, 2018 AOB







Cabernet sauvignon

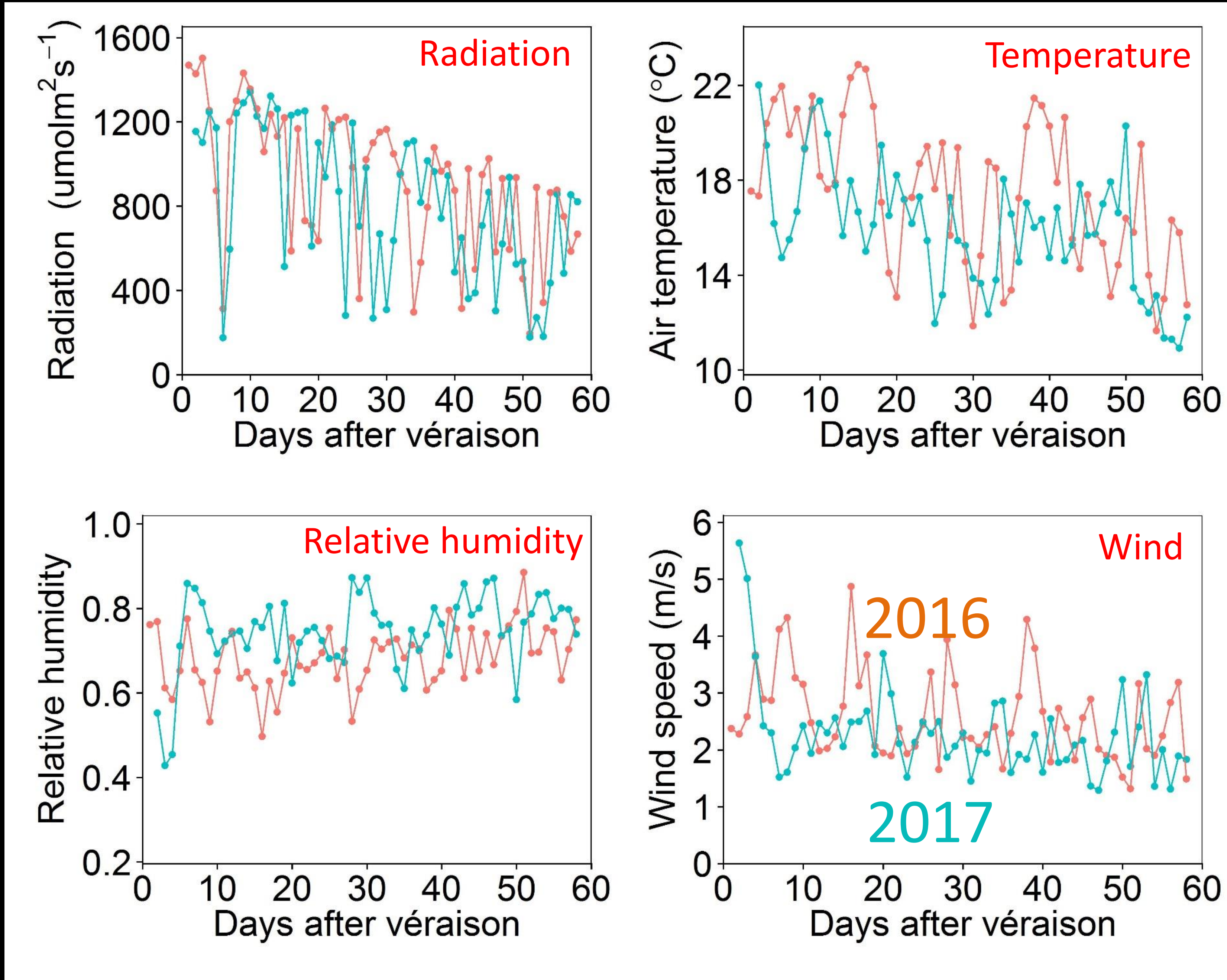


Zhu *et al*., 2019 JXB

Scenario simulations on berry growth

- Climatic effects
- Canopy trimming
- Different training systems

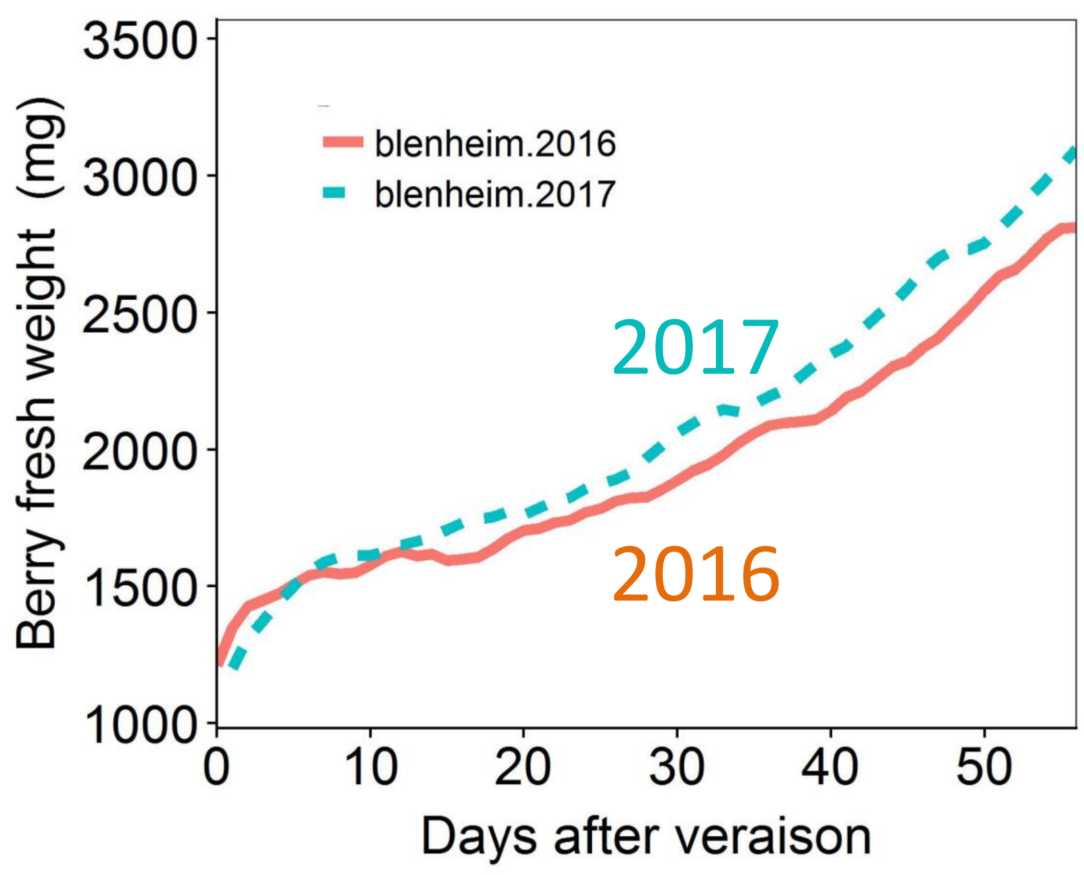
Climatic conditions after véraison (Feb. 12)



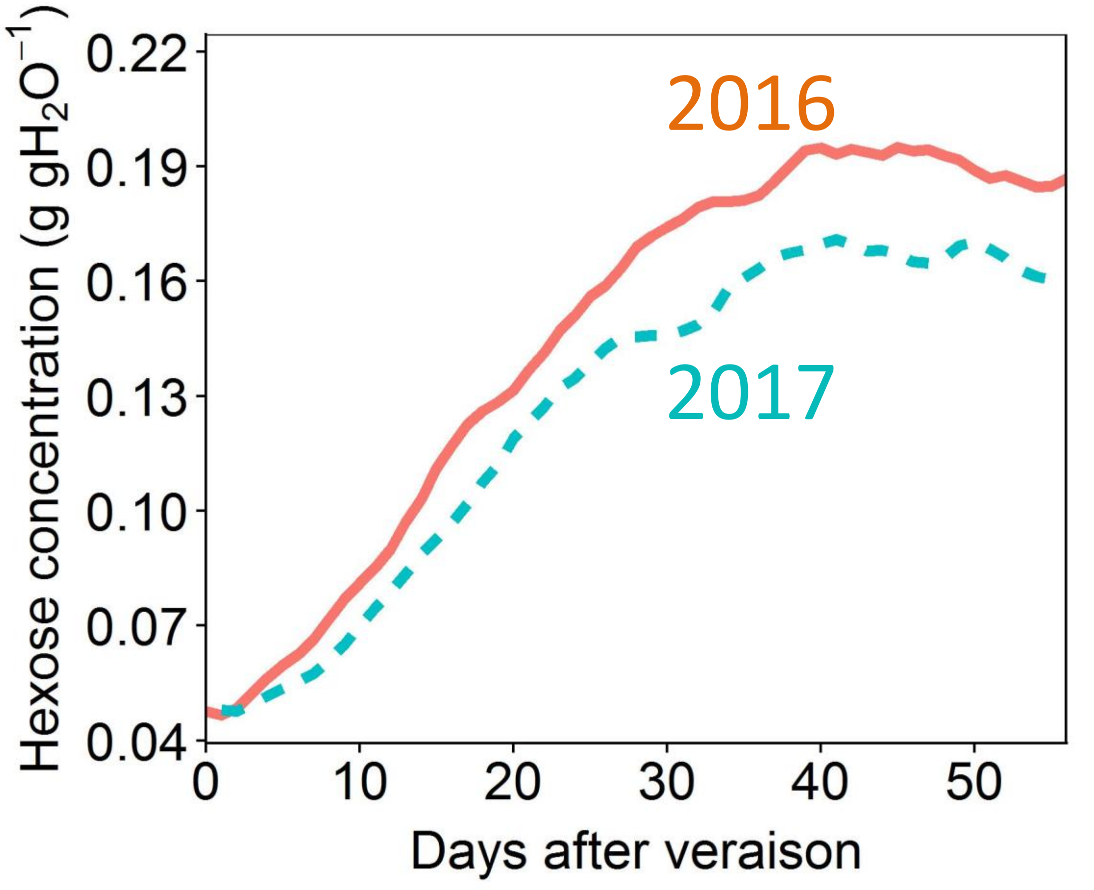
2016 is warmer and drier than **2017**

Scenario 1: climatic effects

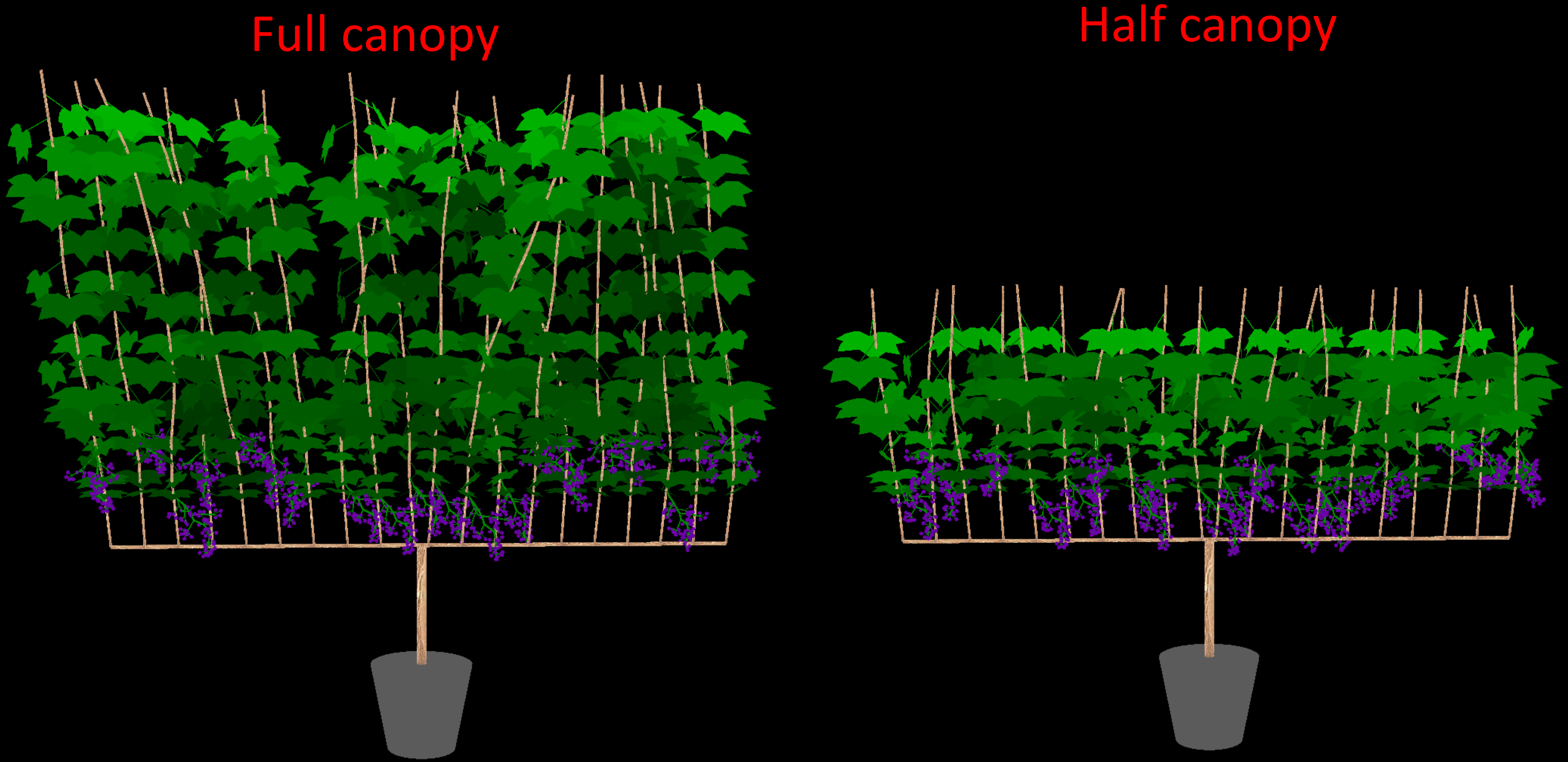
Fresh weight



Sugar concentration



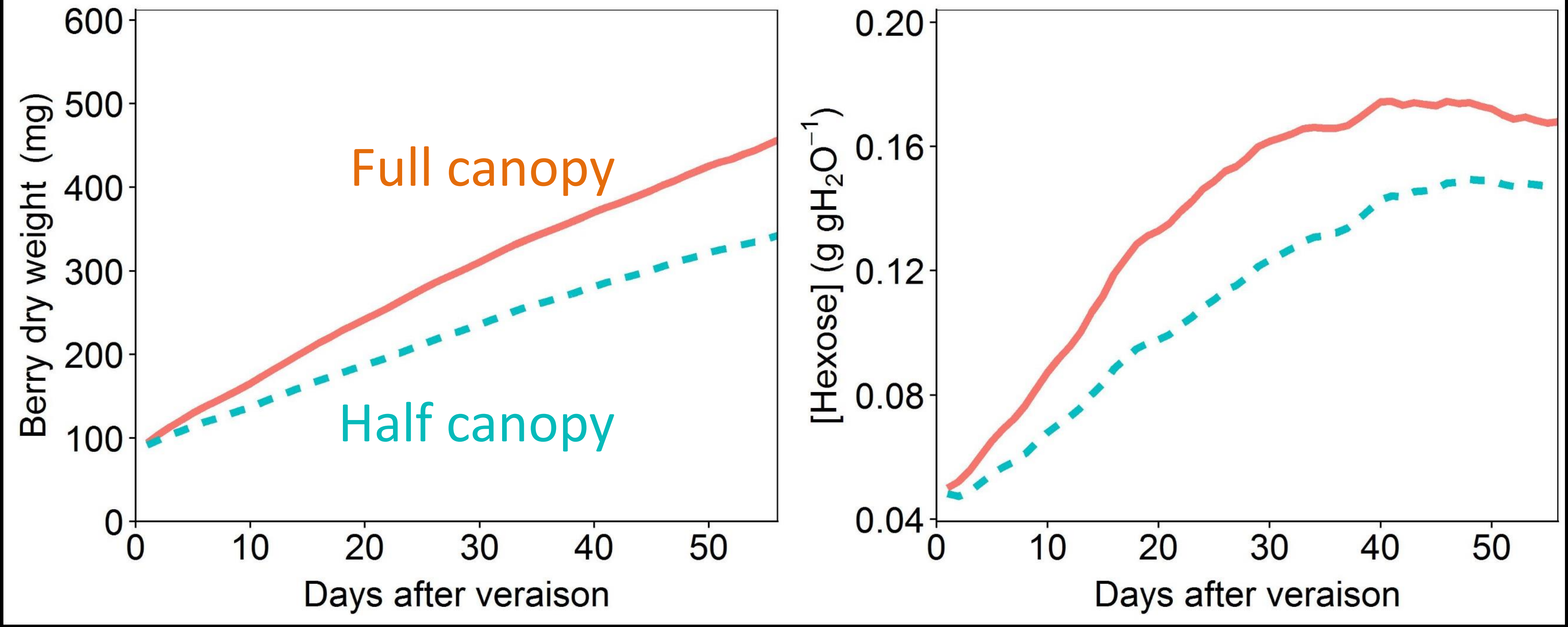
Scenario 2: canopy trimming



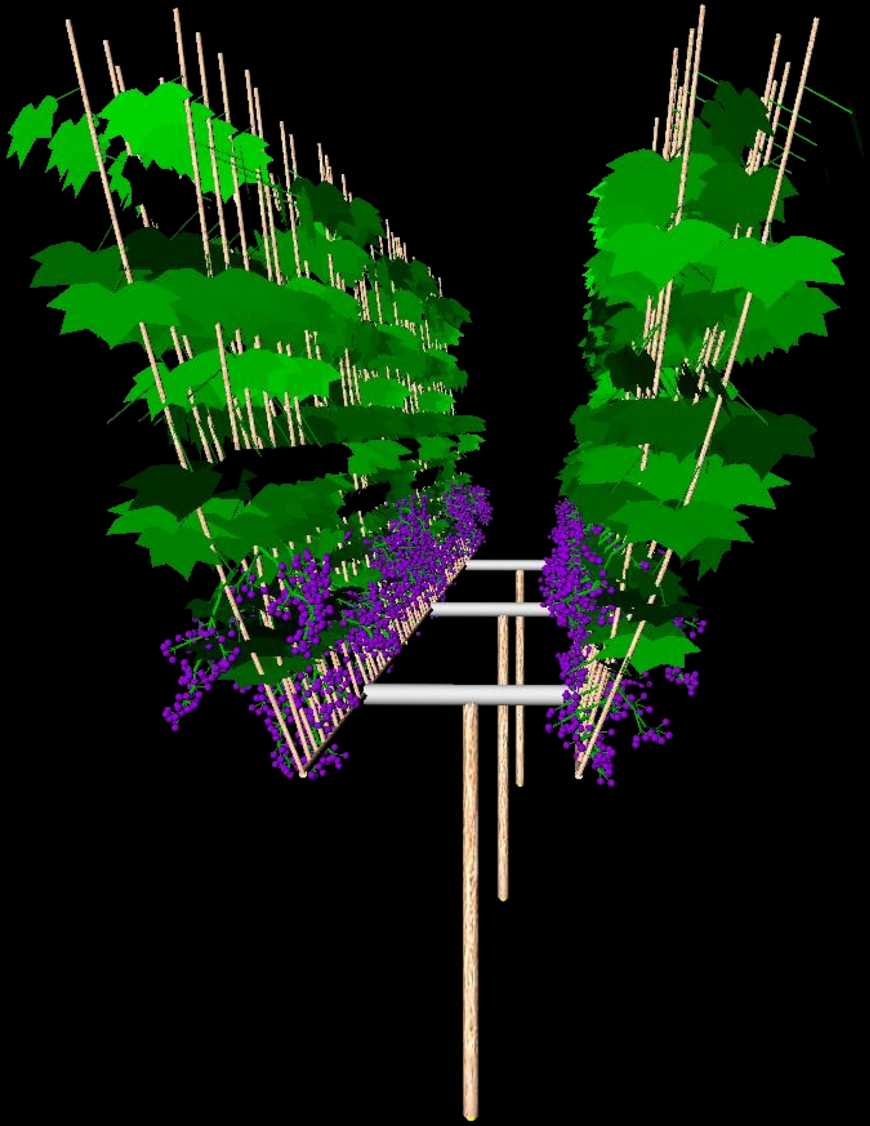
Scenario 2: canopy trimming

Dry weight

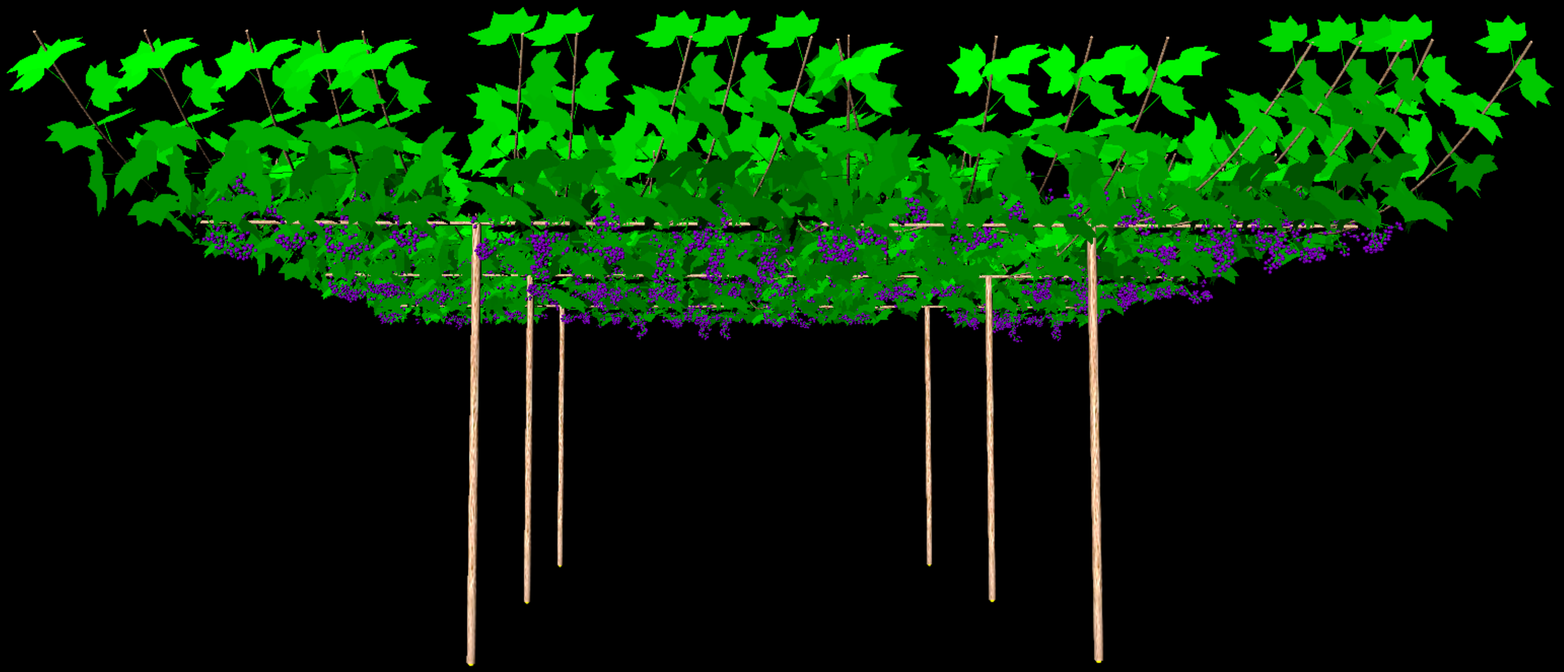
Sugar concentration



Lyre

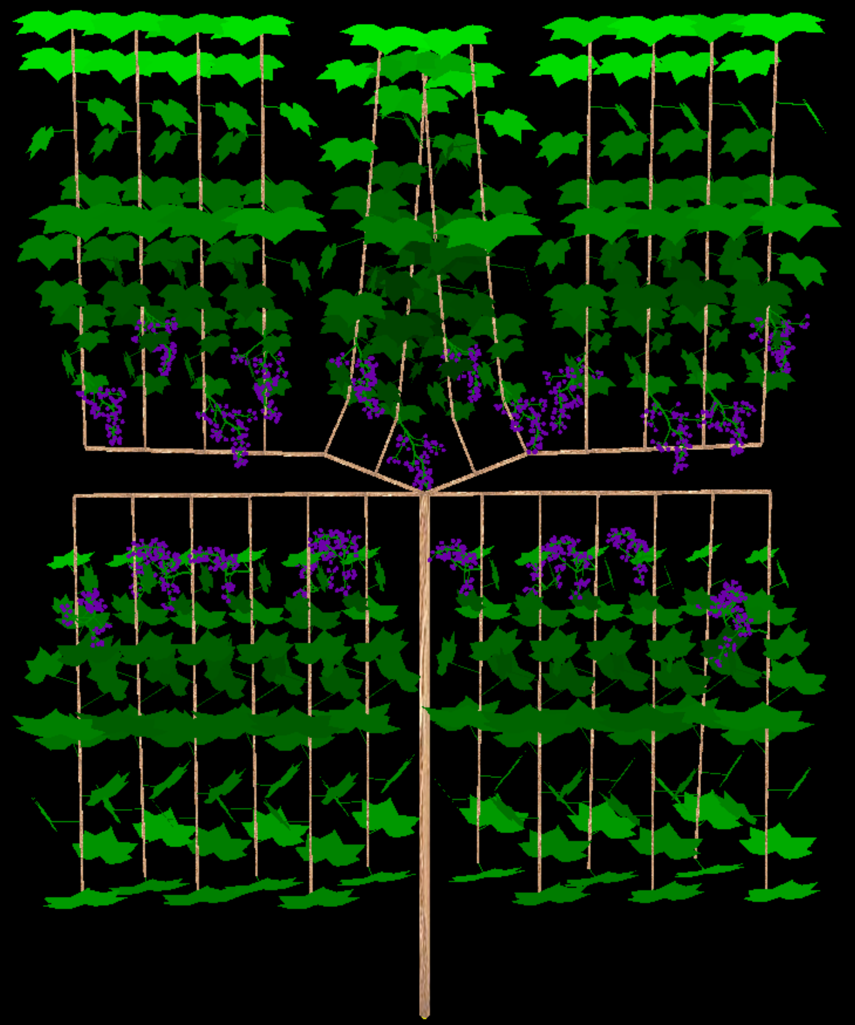


Pergola

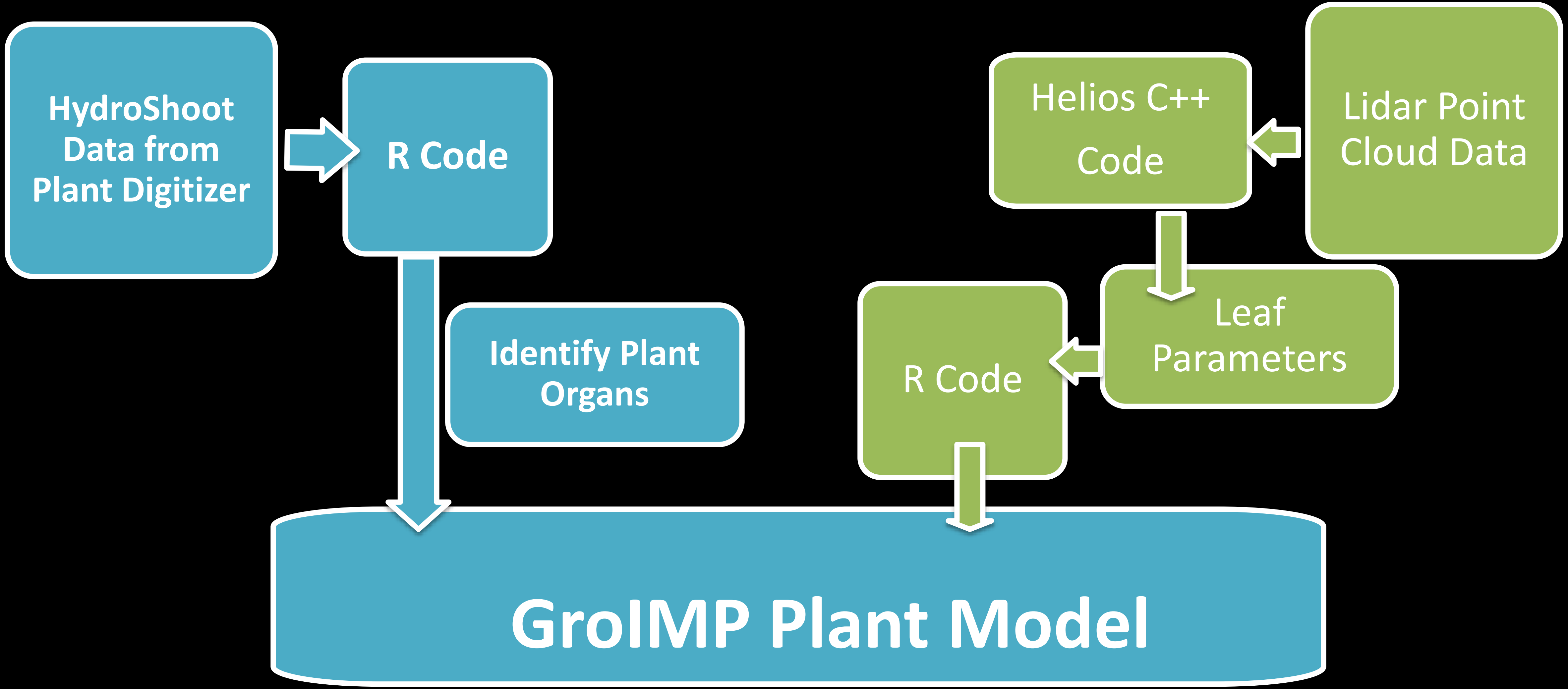


Geneva double curtain

Scott Henry



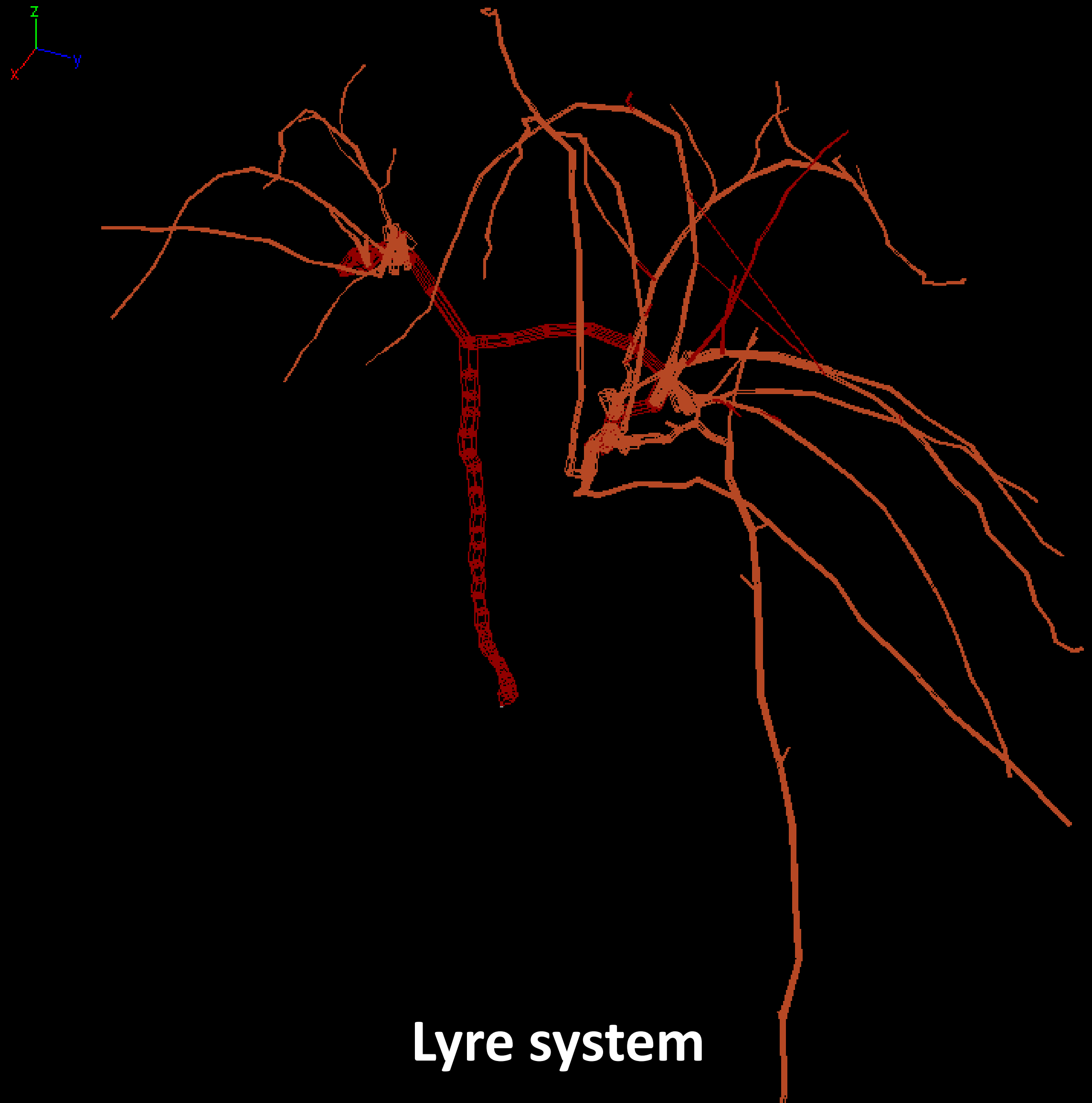
Reconstructing Plant Architecture from Point Cloud



Slide credit: Aarthy Sree B.

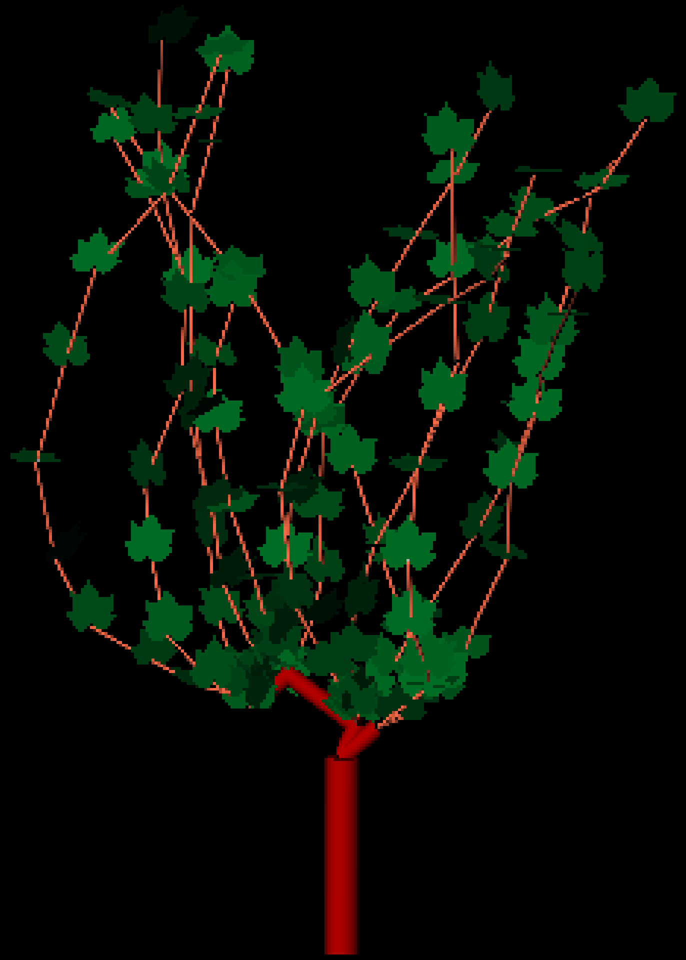
Reconstructed shoots

Vertical shoot position

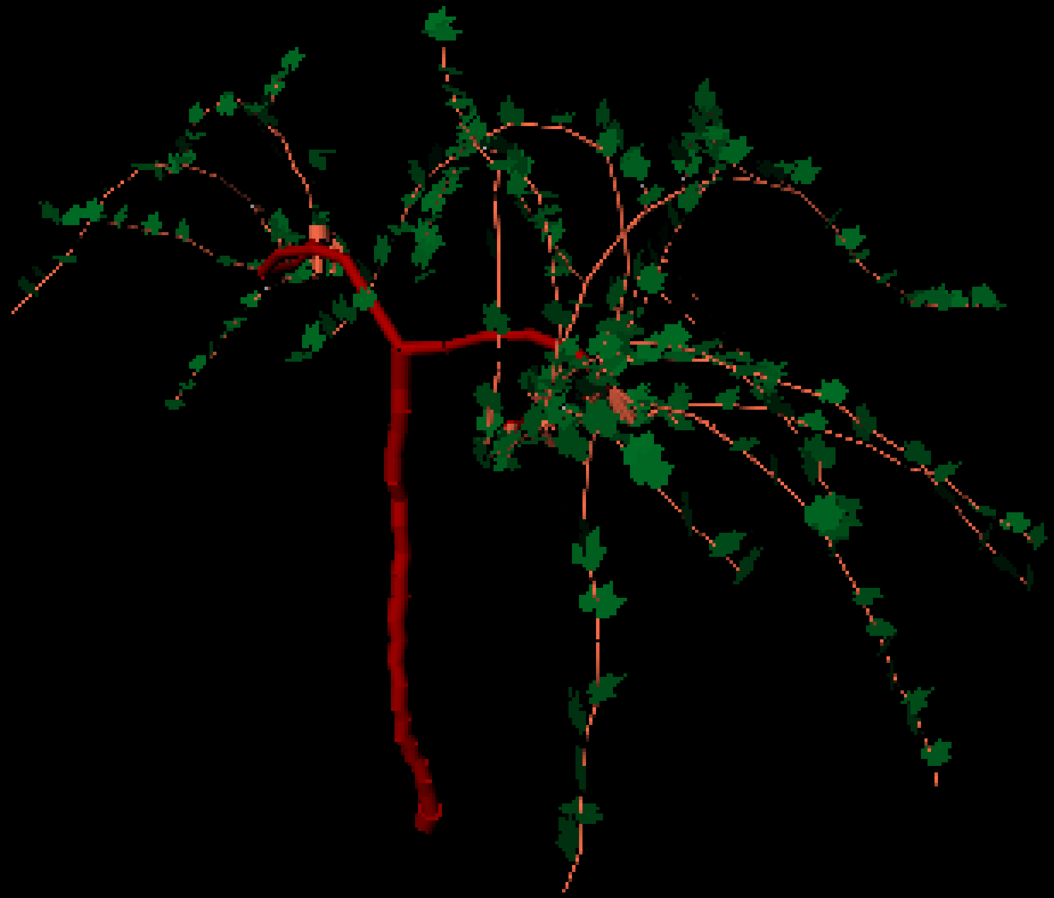


Lyre system

Reconstructed canopy



Vertical shoot position



Lyre system

Updated yield prediction of Marlborough Sauvignon blanc

In VineFacts Issue 4 on 17 October 2019 we outlined that modelling work being undertaken by Dr Junqi Zhu of Plant & Food Research is able to make predictions for each of the Marlborough Sauvignon blanc yield components:

1) Bunch number per vine

2) Berry number per bunch

3) Berry weight (g)

4) Bunch weight (g)

5) Yield per vine (kg)

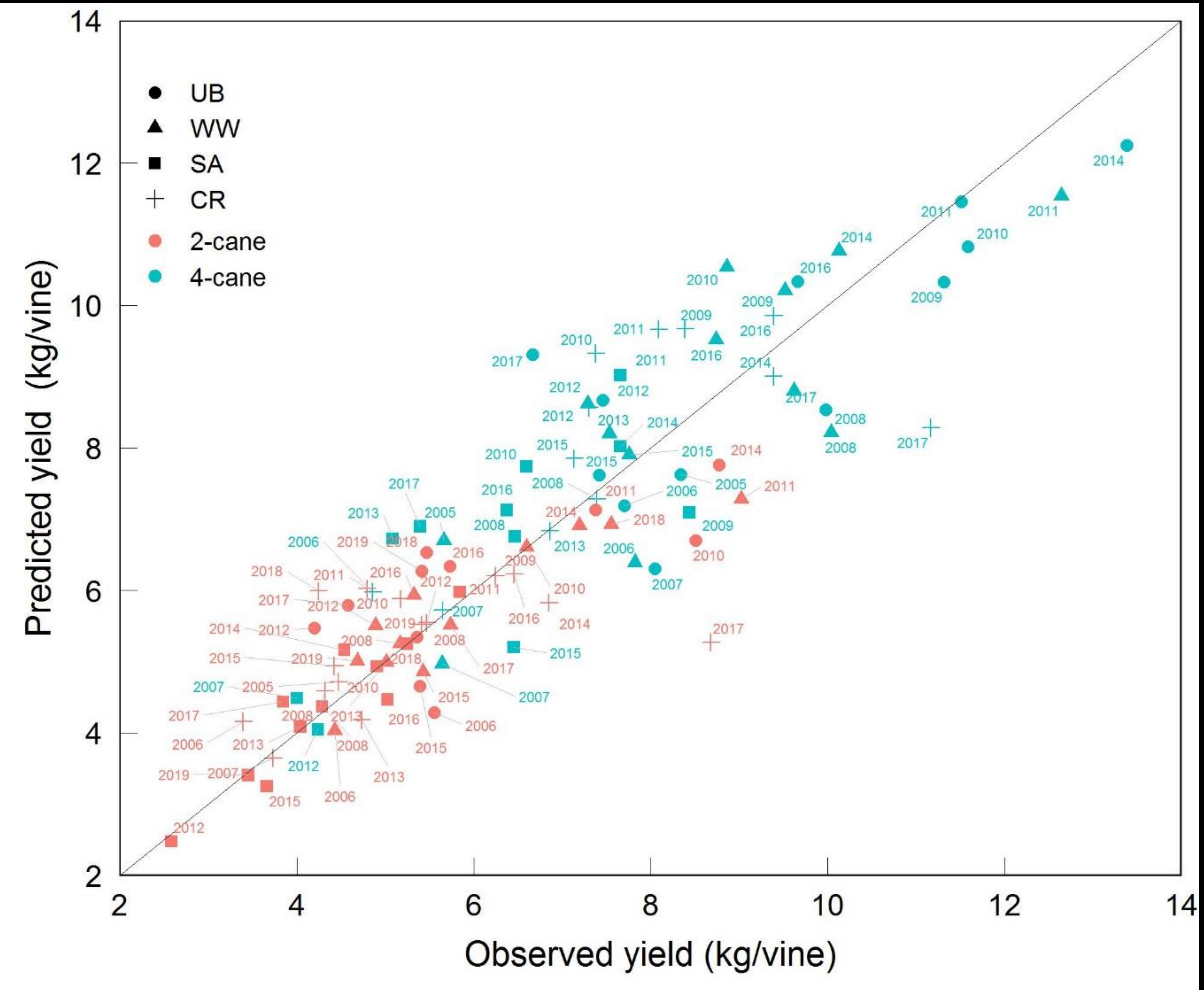
We are repeating the predictions of bunch number per vine that were included in VineFacts on 17 October. Additionally this article includes predictions for the 2020 vintage for the other yield parameters as outlined above.

Differences in weather conditions, especially temperature, between seasons can cause quite marked variation in the yield of grapes in New Zealand. This is typical of cool climate viticulture. The result is that it can be difficult to maintain stable yield from year to year in order to achieve consistent fruit quality and supply. Being able to reliably predict yield of grapes well in advance of

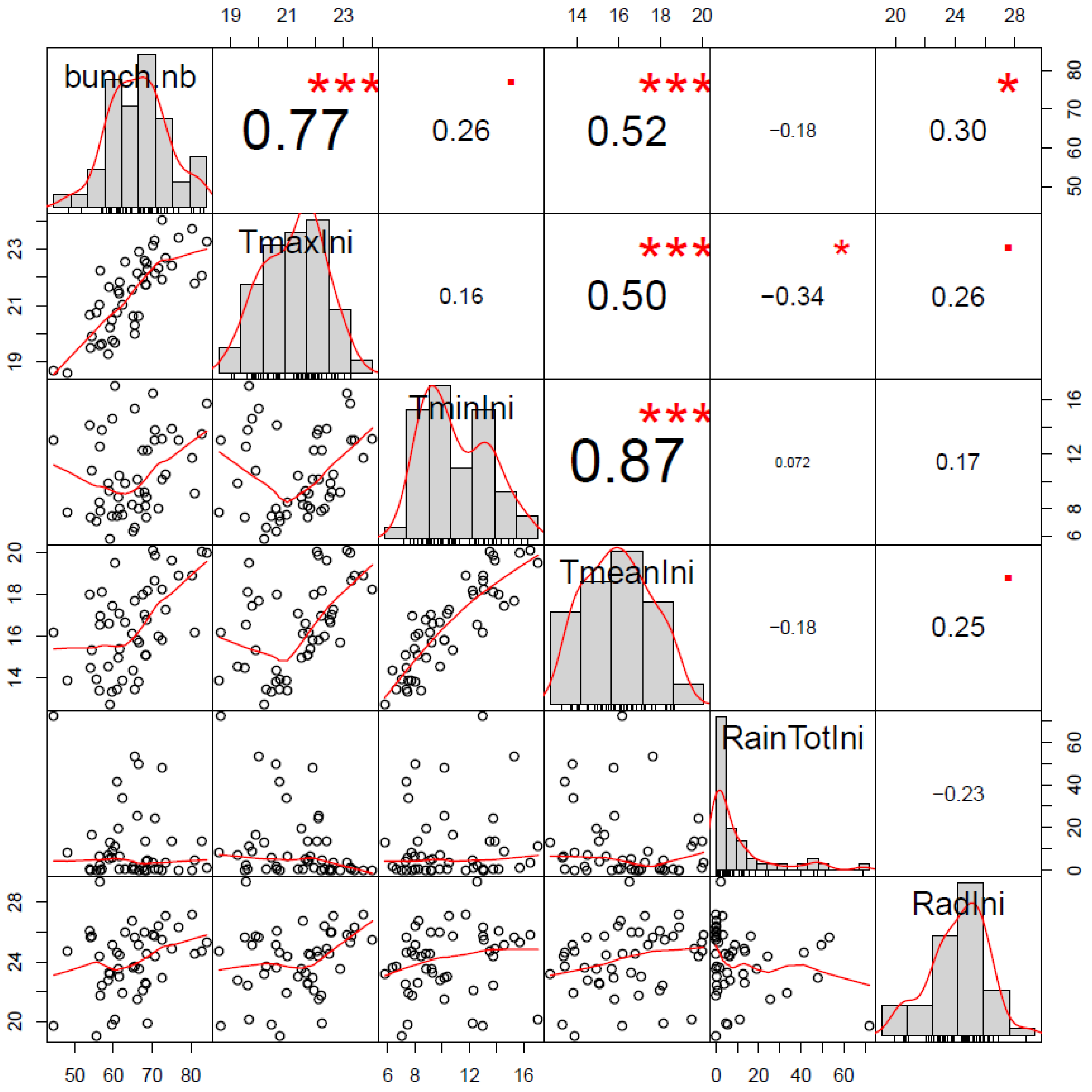
Yield prediction

Vineyard	Average yield per vine (kg)	Predicted yield per vine in 2020 (kg)	Predicted yield in 2020 as % of average
Central Rapaura	7.75	8.19	106%
Seaview Awatere	6.21	7.35	118%
Upper Brancott	9.52	11.13	117%
Western Wairau	8.80	9.74	111%

4-cane pruned vines have 4 canes each with 10 nodes laid down, plus 2*2 node spurs



UB
WW
SA
CR
2-cane
4-cane
Predicted yield (kg/vine)
Observed yield (kg/vine)
2
4
6
8
10
12
14



Correlation between bunch number and weather factors

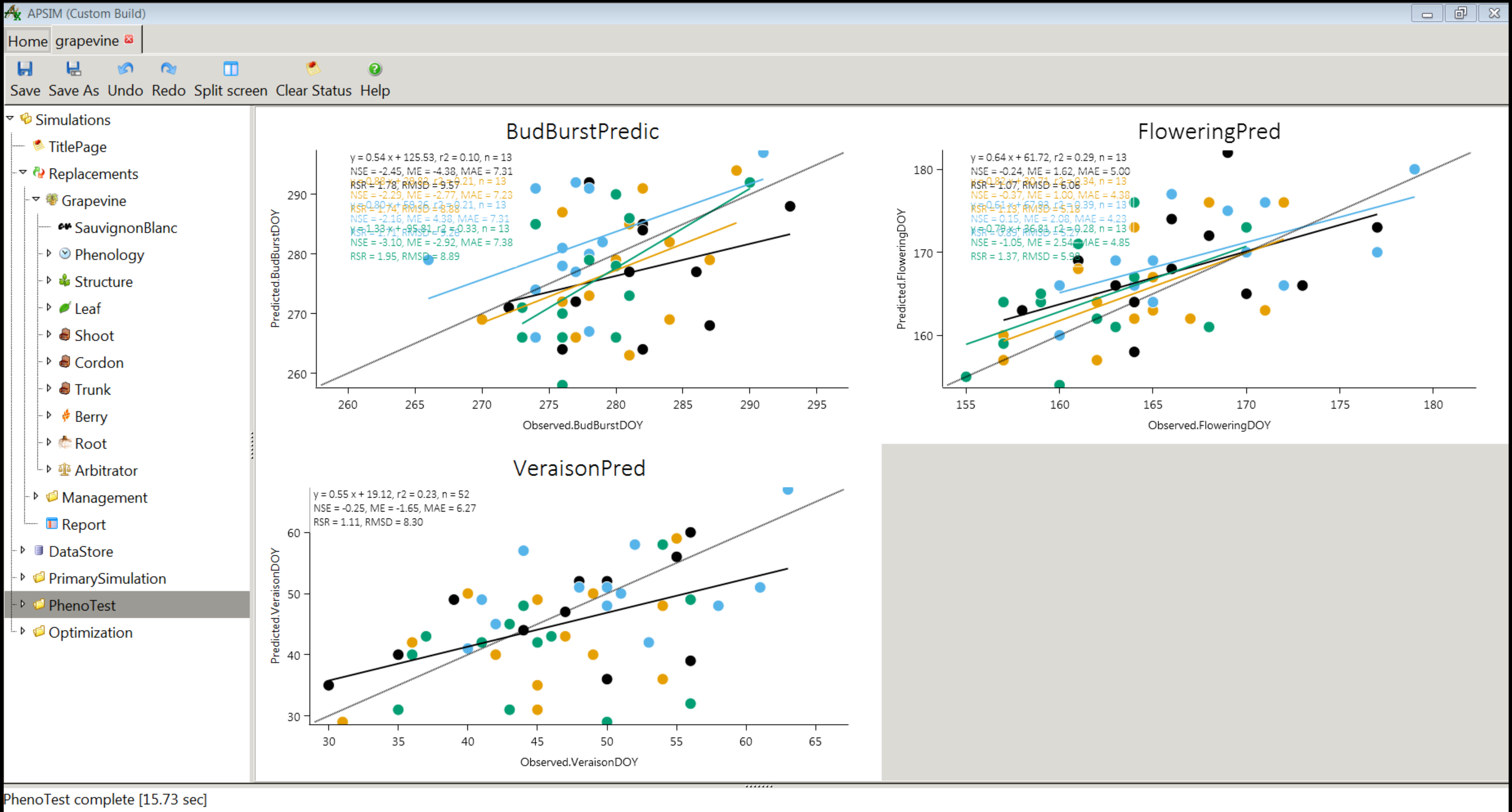
Critical periods

Yield component	Factors	TD backward	TD forward
Bunch number per plant	TmaxIni	15.90	1.27
	RadIni	10.42	0.14
Berry number per bunch	TmeanFlow	7.08	0.02
	RainTotFlow	10.50	2.69
	TmaxIni	7.92	30.37

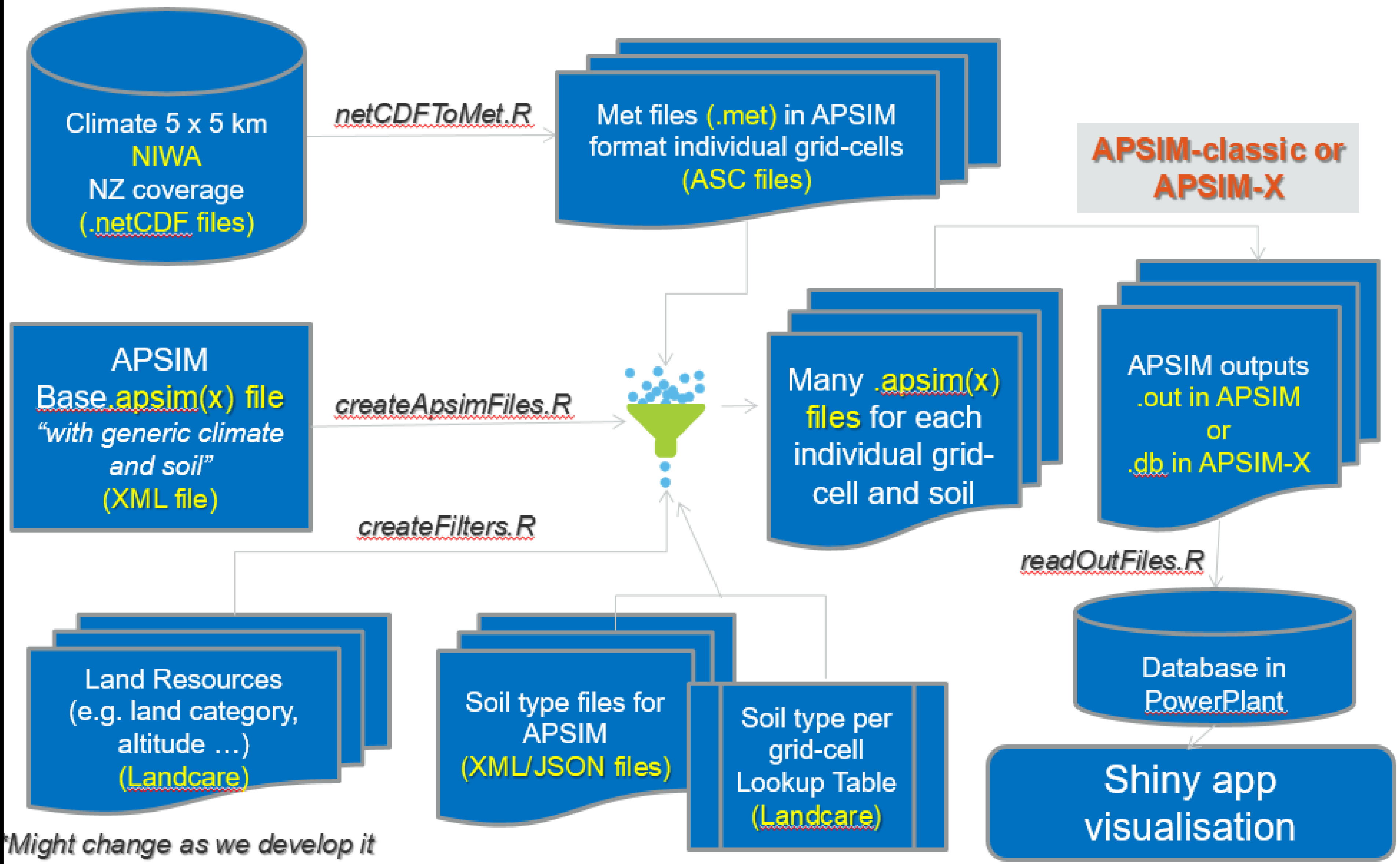
Current highlights

- Daily Tmax (not Tmean) most influential factor on berry number and bunch mass
- Optimized critical periods for Tmax mainly before 50% flowering either in the previous or current season
- Mean Radiation is also an important input variable
- Rainfall around flowering - negative effect
- Rainfall post-flowering - positive effect
- Statistical model explained 75-85% of the seasonal variations in yield per vine

Integrating into a plant growth model



ATLAS generic data flow



Slide credit:
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Michael Henke


Aarthy Sree B.


Alla Seleznyova


Mike Trought


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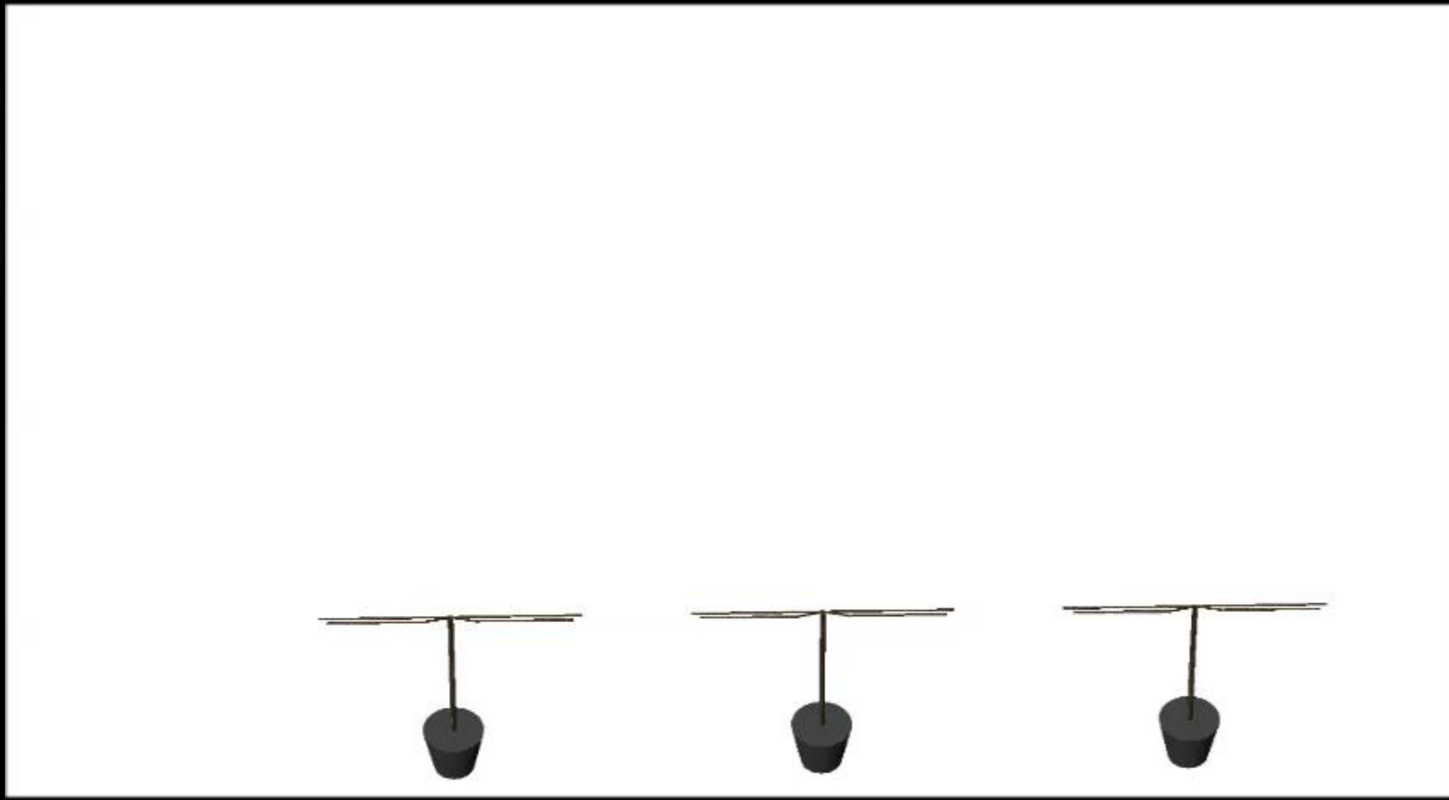
Michael Gènard

GroIMP team



innovine
INNOVATION IN VINEYARD

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