IHC2022, date (16 August 2022)
International symposium
Celebrating organic banana production

An app to convert short-term weather data into indicators of banana performance potential: calculated versus field values in Dominican Republic

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https://ahorappv2repdominicana.herokuapp.com/#

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Local weather stations – relevance for small growers?

Extreme events

Moderate variability

Adjust practices in real time
Quantify gap between field and potential
Identify potential to improve efficiency
Sharpen season to season outlook
Sharpen year to year outlook

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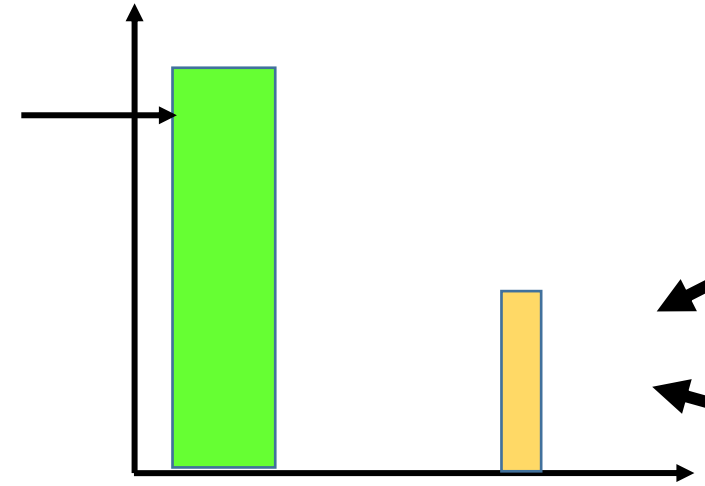
Short-term potential compared to field performance?

Equations

=



Calculated potential
Zone/period

Observed
In field

WHY
THE DIFERENCE?

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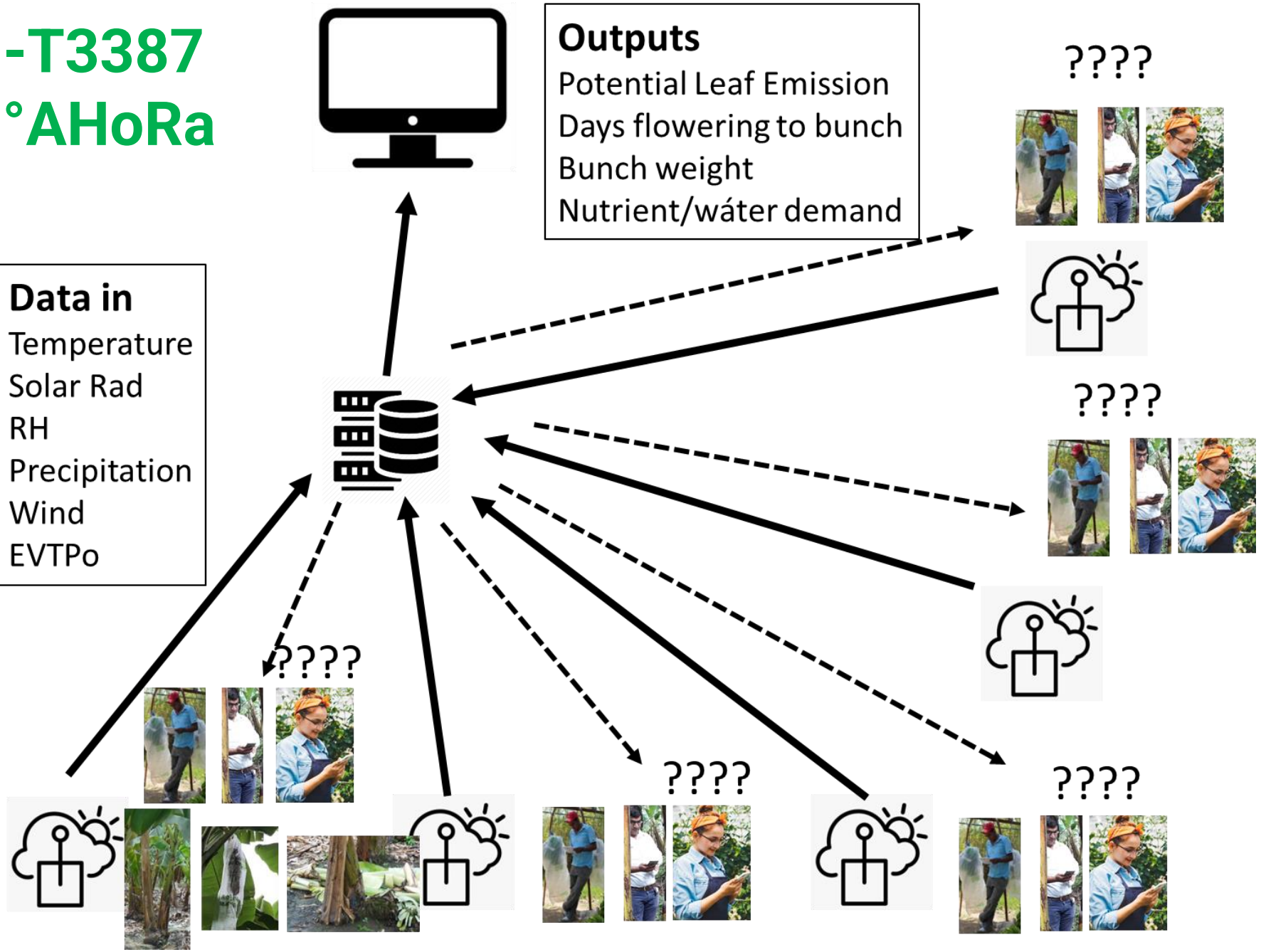
FONTAGRO RG-T3387 to design/build °AHoRa

COMPONENTS
Weather stations
Equation-based app
Banana growers with cell phones

°AHoRa

Outputs
Potential Leaf Emission
Days flowering to bunch
Bunch weight
Nutrient/wáter demand

Data in
Temperature
Solar Rad
RH
Precipitation
Wind
EVTPo



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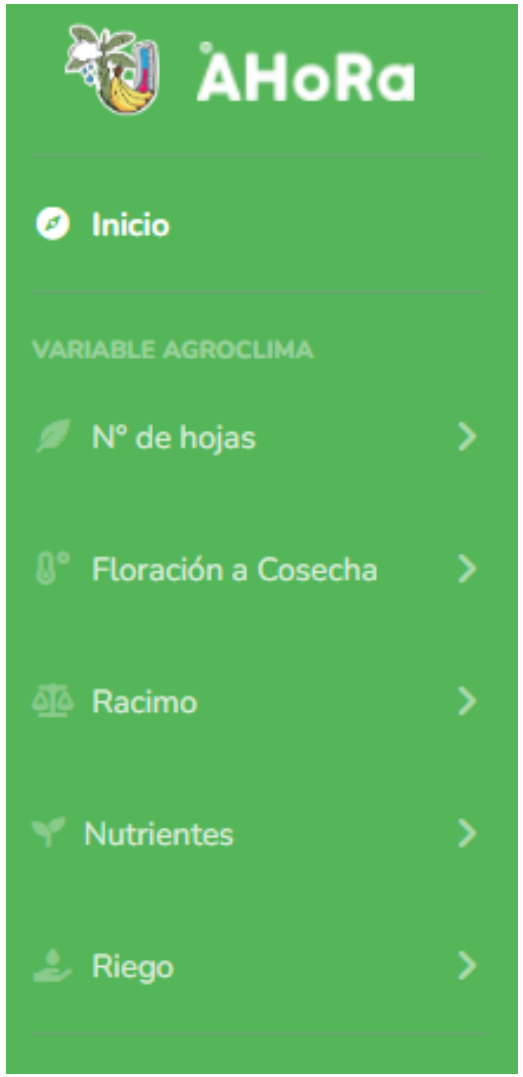

Menu –weather data used

3 indicators of banana performance

- Potential leaf emission (degree days)
- Weeks flowering to harvest (accumulated degree days)
- Potential bunch weight
  (solar radiation flowering to harvest)

2 indicators of management intensity:

- Nutrition (solar radiation)
- Water demand (rainfall & EVTPo)

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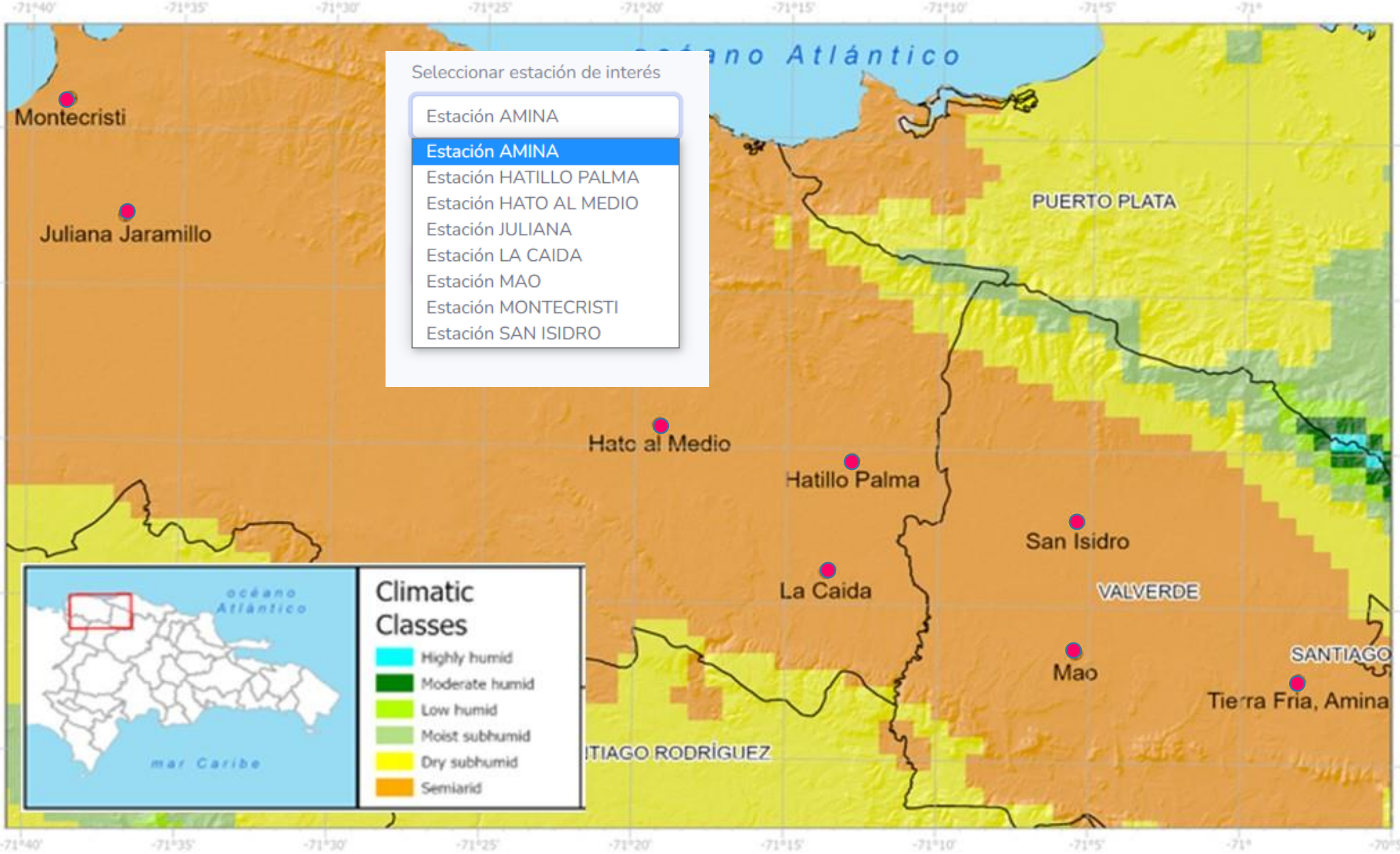
Network of weather stations – Banelino, Dominican Republic



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Field data collection schedule to compare with app values

(20 growers in five groups around five local weather stations)

Week	6	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	23	24
Leaf emission																		
Mark youngest open leaf			X	X	X													
Leaf count 14 days					X	X	X											
Leaf count 28 days							X	X	X									
Leaf count 42 days									X	X	X							
Time flowering to harvest																		
1st calculation				X	X													
2nd calculation					X	X												
3rd calculation						X	X											
Bunch recovery rate				X	X	X												
Bunch weight																		
1st sampling			X	X	X	X	X											
2nd sampling									X	X	X	X	X	X	X	X	X	X
Nutrient use	X	X	X	X	X	X	X	X	X	X								
Irrigation	X	X	X	X	X	X	X	X	X	X								

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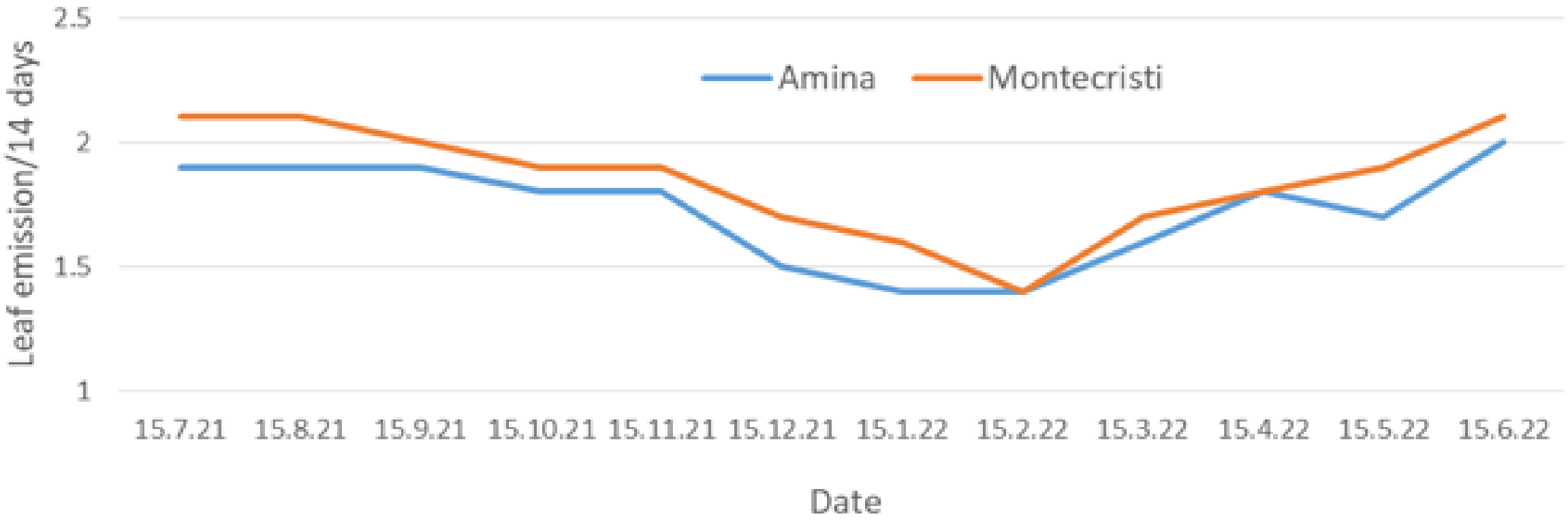
Potential leaf emission rate - *°AHoRa*



Calculation using weather data:

leaves = Sum daily GDDs for 14 day period/108

GDD= Average daily temp – base temperature 13°C

Turner D., & Lahav E. (1983)

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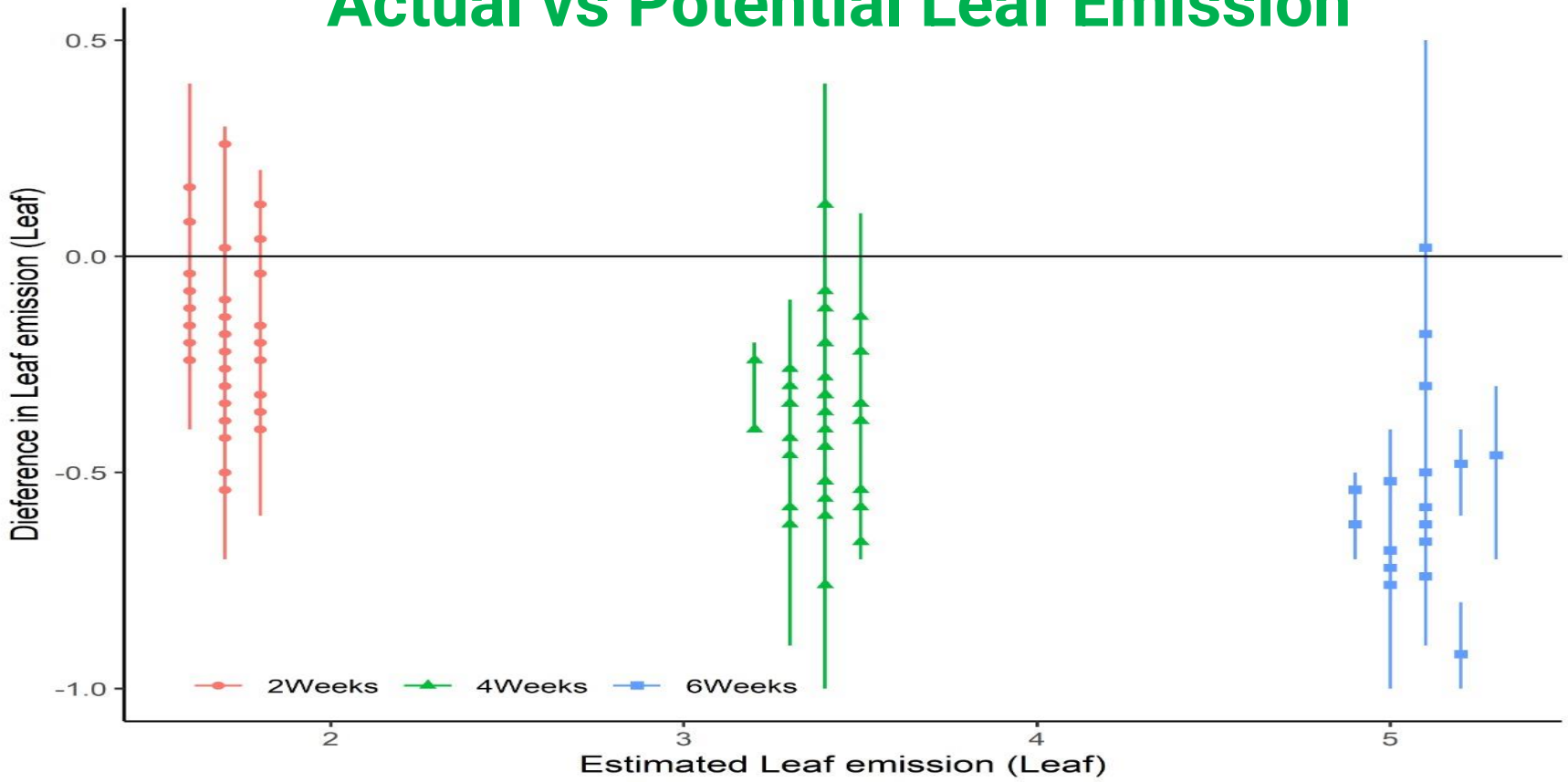
Actual vs Potential Leaf Emission



- Field values above calculated values more frequent for shorter periods
  challenges of estimating cigar leaf status and counting day

- Field values below potential with high within field variability – why?
  Flood irrigation and field irregularities, soil health and structure for water holding

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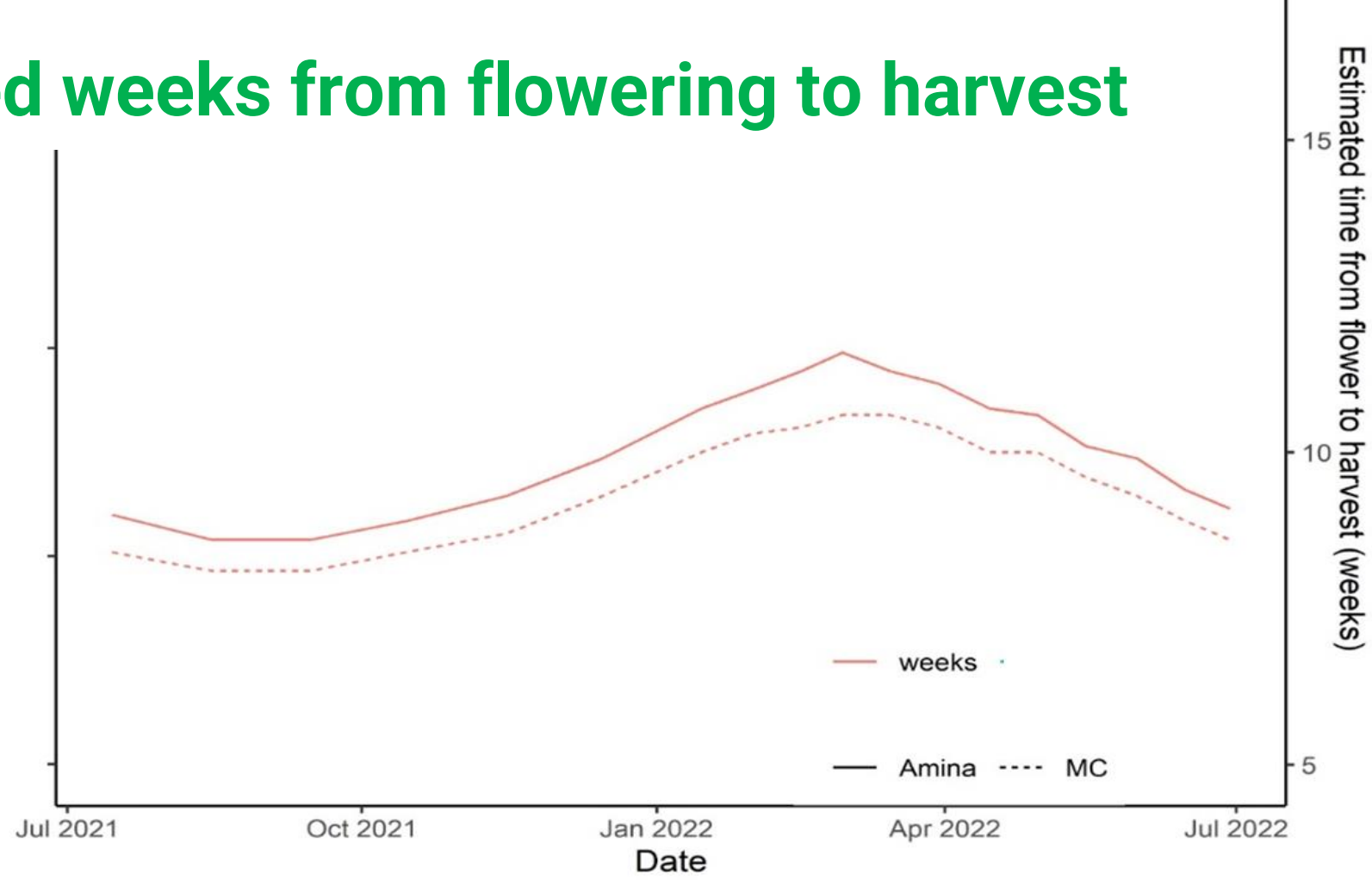
Calculated weeks from flowering to harvest



Calculation using weather data:

Sum daily GDD from harvest backwards = 900 GDD

GDD= Average daily temp – base temperature 13°C

Ganry 1978

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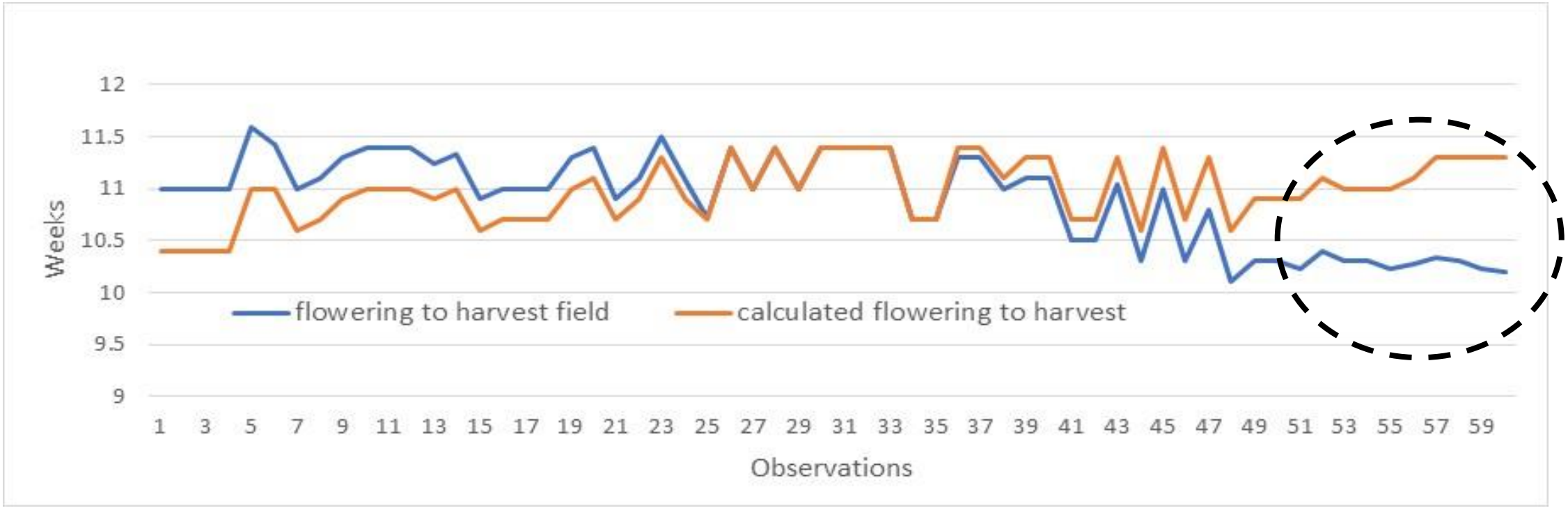
Calculated vs Field - weeks from flowering to harvest



- Close correspondence between field and calculated values (83% cases < 6% difference) as result of marketing association quality assurance measures

- Field data on bunch recovery rate indicate from 5-20% bunches unprocessed for 45% of flagging colors – possible remedies?

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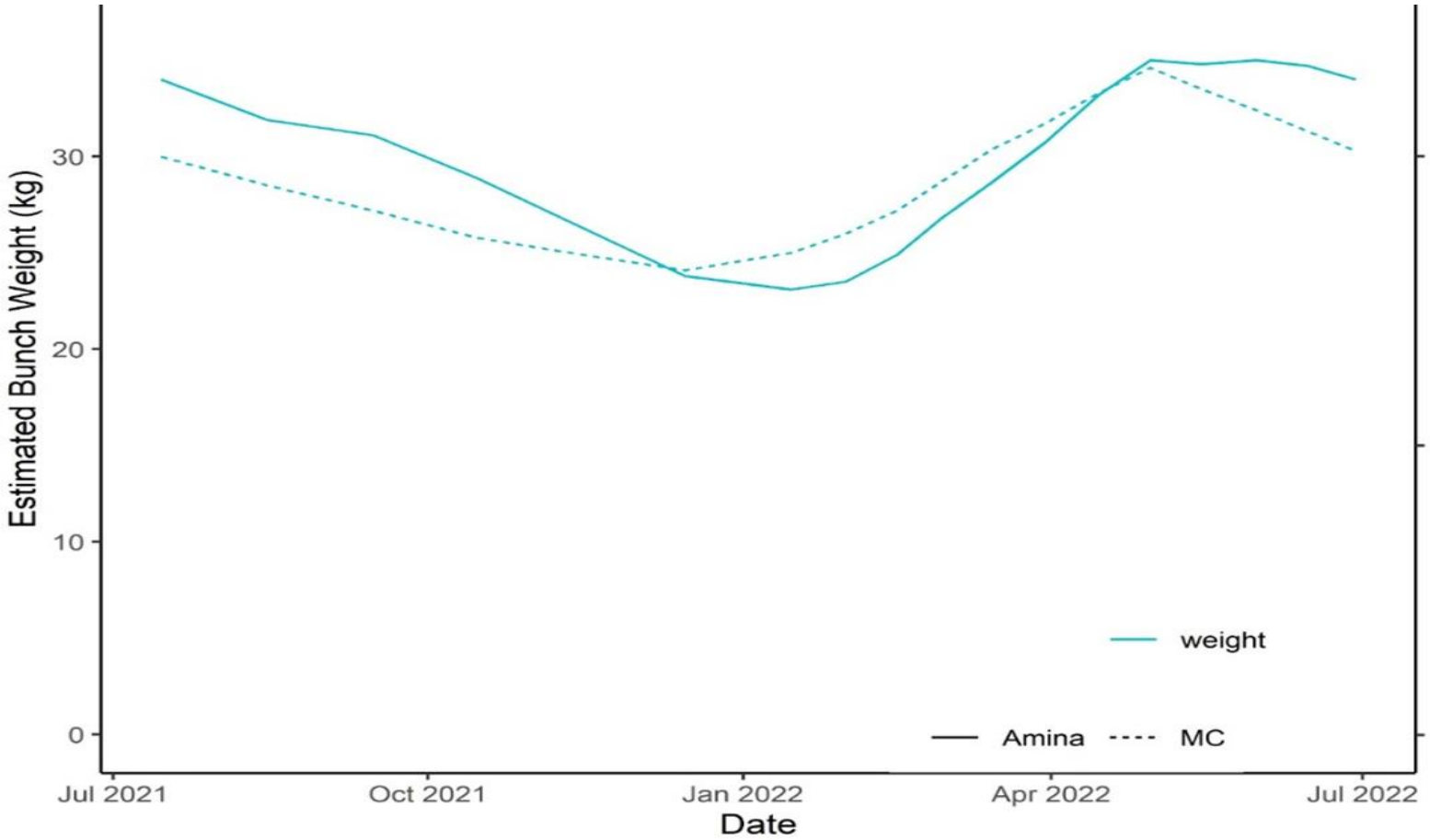
Potential bunch weight at 2400 plants/ha



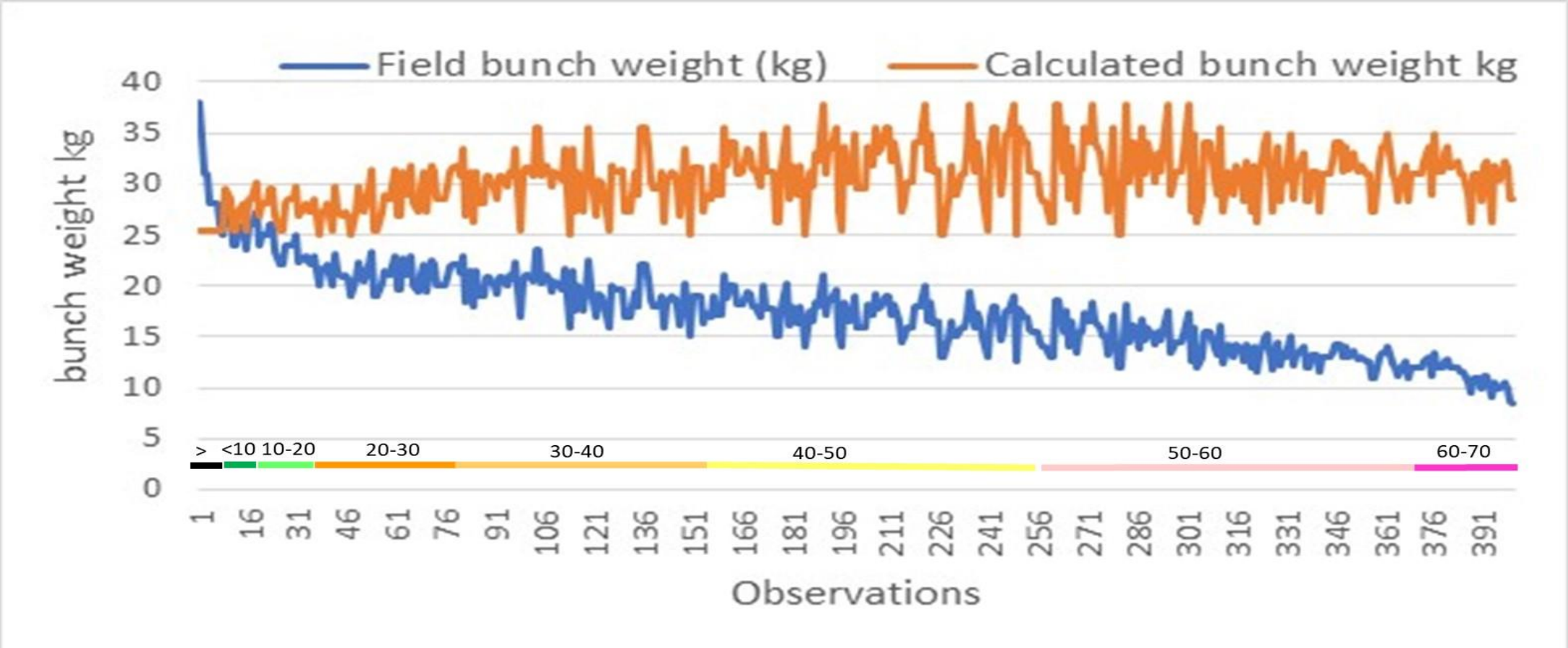
Calculation using weather data:

Bunch weight = sum of daily Incident radiation*$(1 - e^{-KL})$*1.5g biomass DW***m2**/.25/1000

For days summing 900 GDD; K=extinction coefficient (0.7), L=LAI (3.5); **m2** per mat for mat density

Tixier unpublished

Calculated vs Field – bunch weights



- Most bunches are > 20% below potential and many only 50% of potential.
  Several bunches weighed more than potential – collection error or ???

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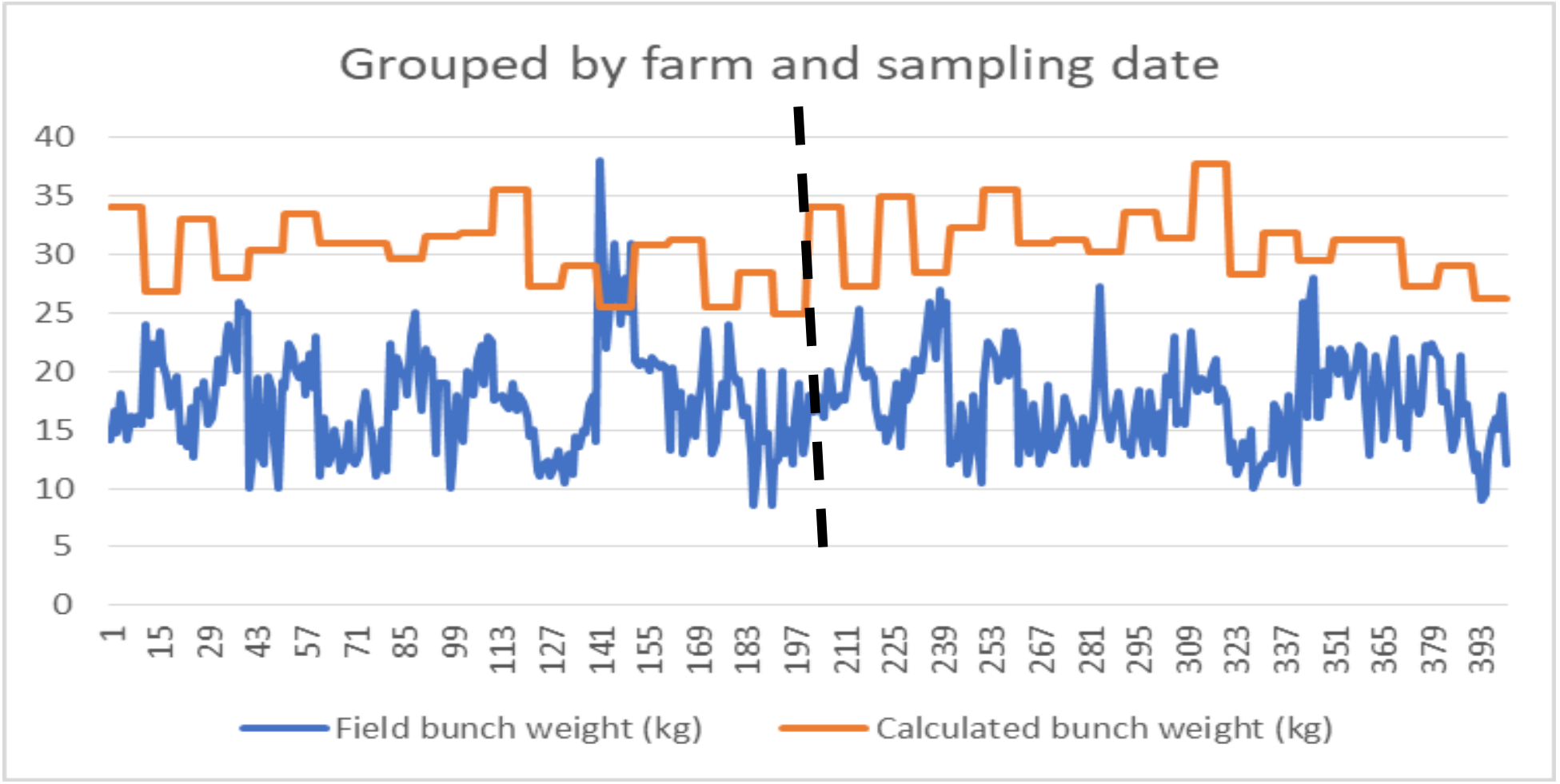
Calculated vs Field – bunch weights



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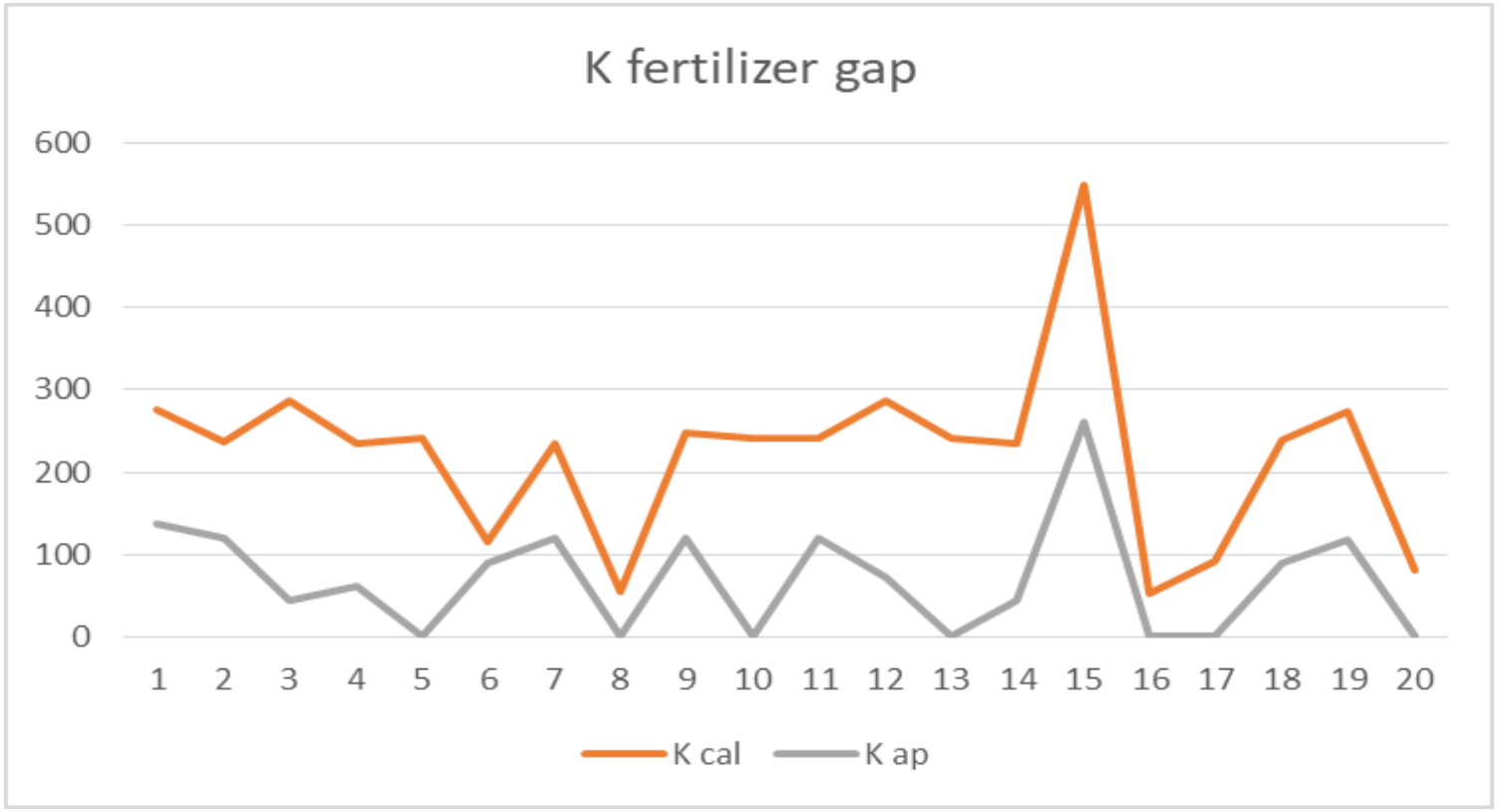
- Potential varies by location and plant density by 10 kg
- Farms vary on bunch uniformity – remedies
- Trade-offs among bunch size, mat density and bunches/mat/year

Calculated vs field nutrient application

Current cost crisis – nutrient use does not cover N, P, K in harvest

However, adjustment needed
In calculation:
30 instead of 50% export

Options gap
for organic crop nutrition



Calculation using weather data:

sum of daily Incident radiation*$(1 - e^{-KL})$*1.5g biomass DW*10000m2***0.5***% N or K

For application interval

Turner 1989

Calculated vs actual irrigation interval – smallholder tool

°AHoRa calculations – water demand

For 7 day period: **Crop water demand**
Crop EVTPo
Crop EVTPo-effective rain

For 7, 14, 28 day interval (soil root zone):
Irrigation amount to cover crop demand
Depending on type of irrigation and soil

For 7, 14, 28 day interval
Maximum time to next irrigation
Based on specified date of irrigation and prevailing effective rain and crop EVPTo

Week of the year

FARM	6	7	8	9	10	11	12	13	14	15	16
1	3				3		3		1		
2	2		2	2	3	3	3	3	3		
3	2		2		2		1		1		3
4	2		2		2	3	3	3		2	3
5	2		2		2		1		1		
6	2		2		3	3	3	3	3	3	
7	2		2		1	3		3		3	
8	2		2		2		1		1		
9	2		2	3		2		2	3	3	
10	2		2	2	2		2		2		
11	2		2		2		2	3	3	3	3
12	1			2			1		2		2
13	2	2	2	3	2	2	3	3	2	2	3
14	2		2		2		2		1		
15	3	3	3	3	3	3	3	3	3	3	
16	2		2		2		1		1		
17	2		2		1		1		1		
18			2			1		2		2	
19	2		1		2		2		1		1
20	3	3	3	3	3	3	3	3	3	3	3

14 days

10 days

Very dry | Dry | Moist | Wet

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Observations - Conclusions

*** °***AHoRa*** is proof of concept with immediate practical use.

*** Growers and field technicians are favorable to the indicators,

*** Equations are adequate to this use through comparison

However, growers / field technicians not trained or practiced in data-based weather and crop monitoring.
Training needed for the app to become an every day management tool, especially on variability within field, by season and from year to year for efficiency and resilience

Bigger data sets across seasons and years to adjust equations.

EXAMPLE
potential bunch weight response to mat density
(49, 39, 33 kg for 1600, 2000 and 2400 mats/ha – Amina harvest 5 August)

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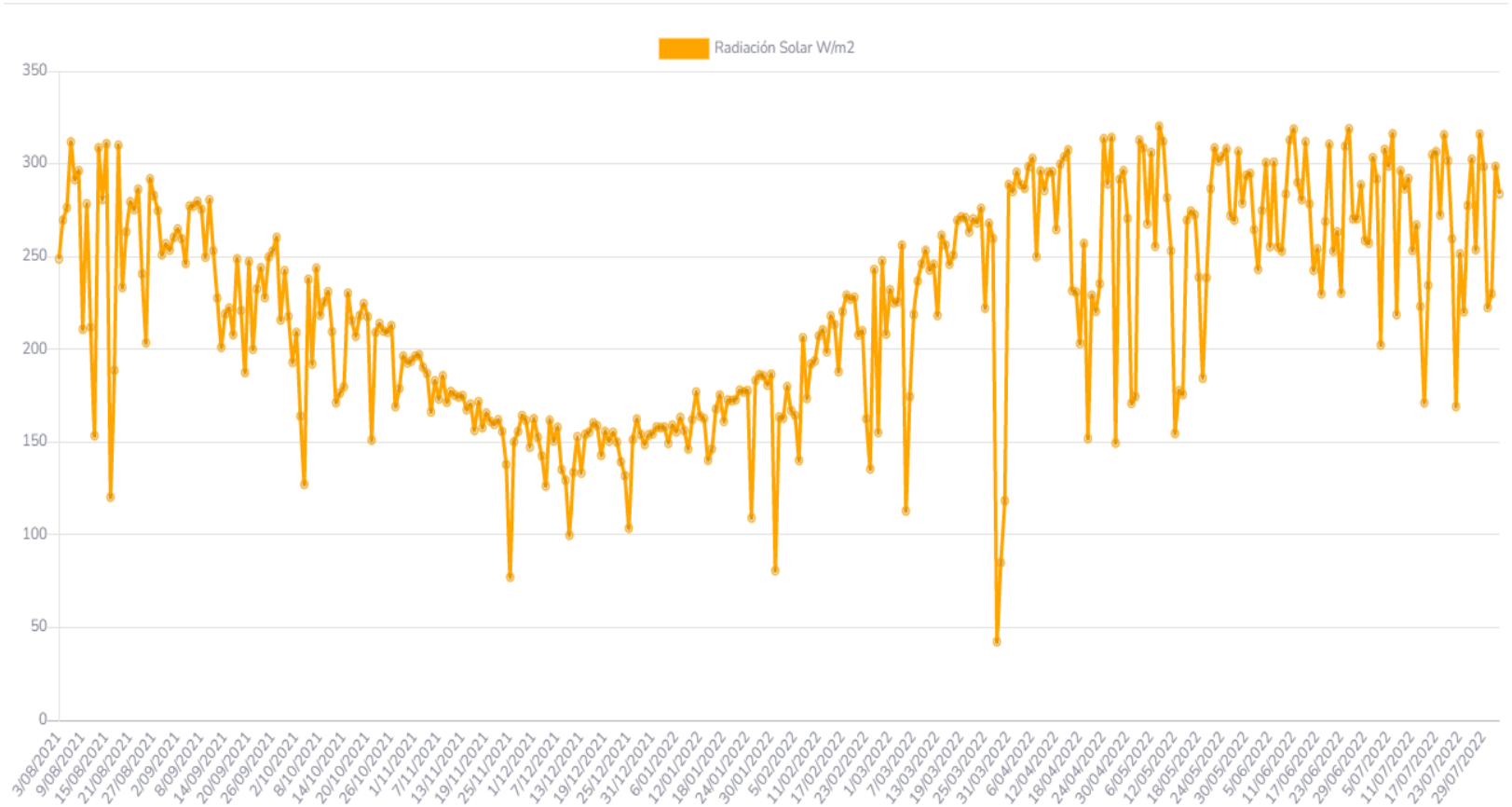
Observations - Conclusions

- Opportunities for a next generation app:
    - Data storage options for growers for easier improvement monitoring
    - Display of historical variability for the local station may stimulate management approaches to resilience
    - Analysis of short term weather to identify emerging problematic weather events – BLS outbreaks, high water demand, cold damage

Muchas gracias – Thank you – Merci beaucoup



Amina
Nutrients
365 days

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