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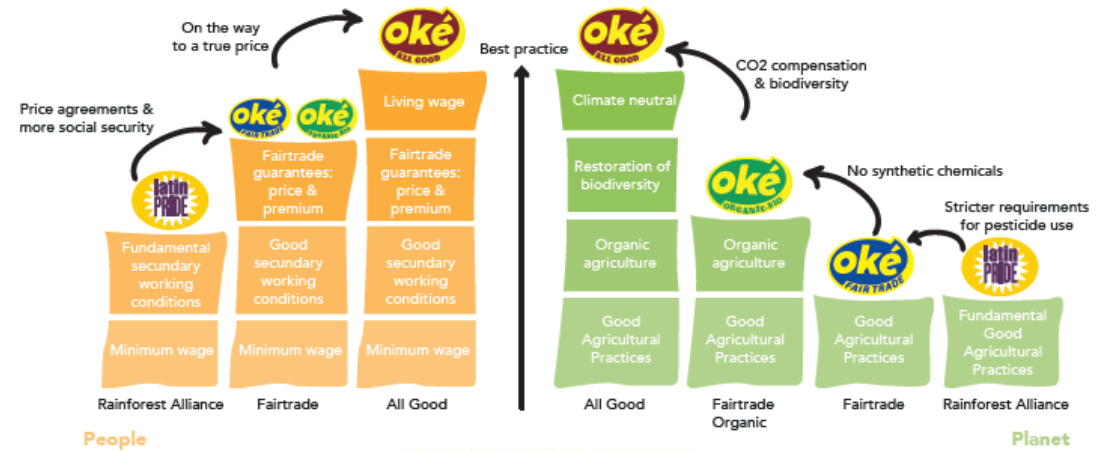
Using AI and CA to Reduce Crown Rot in Bananas



AgroFair



- The pioneer of Fairtrade and Fairtrade organic bananas
- Today an integrated, producer-co-owned, banana and tropical fruit producer/importer.
 - Cooperatives of small farmers own 33% of company shares – fair say, fair share, fair price
- Sustainability focus points linked to SDGs
 - See our 2020 sustainability report at www.agrofair.nl



The problem: crown rot

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Especially in organic bananas

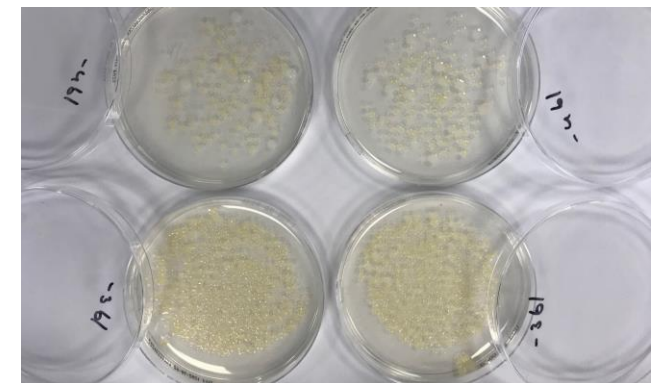
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Crown rot in summary



- The cutting surfaces are prone to **rotting** during the 2-4 week sea transport.
- Preventive treatment with **synthetic antifungals**
 - not allowed in organic bananas
- **no effective organic antifungals** – remember the Citrex scandal
- Small farmer **training** in hygienic pack house post-harvest procedures is essential! → e-learning
- Organic bananas: crown rot is seasonal
- **Significant economic damage** \approx 1-2% of sales value
- etiology is unclear:
 - A fungal complex, but what are the causal factors?
 - Controlled Atmosphere is believed to suppress crown rot



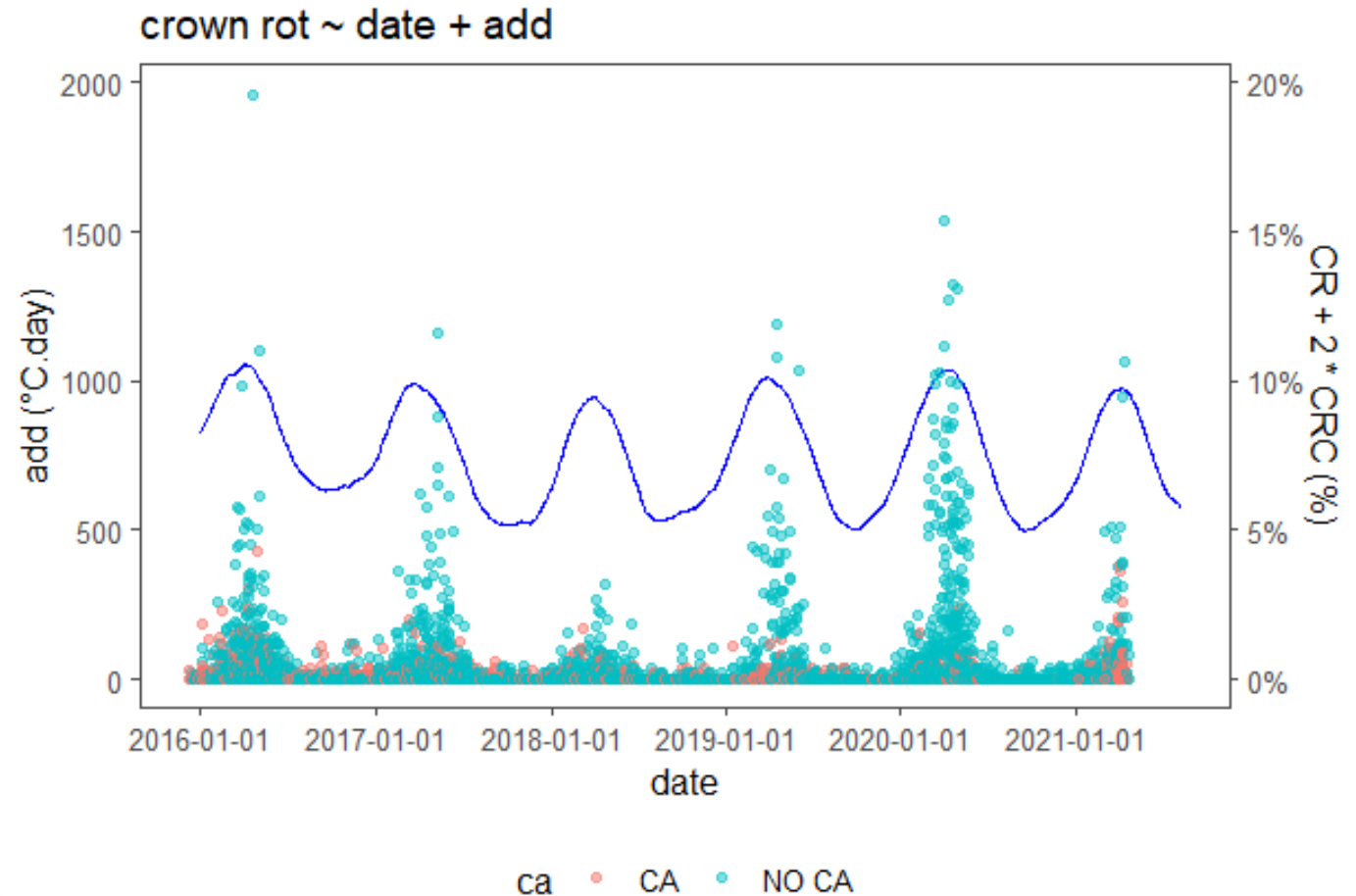
Arrival quality assessment

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Data analysis

- A standard quality assessment of every single container arriving in Europe
- This gives us > 5000 data points per year, > 20,000 over 4 years.
- For the seasonal effect, we retrieved historic weather data from the plantation sites.
- **Result:**
 - clear seasonal effect, related to average temperature
 - Clear reduction influence of Controlled Atmosphere



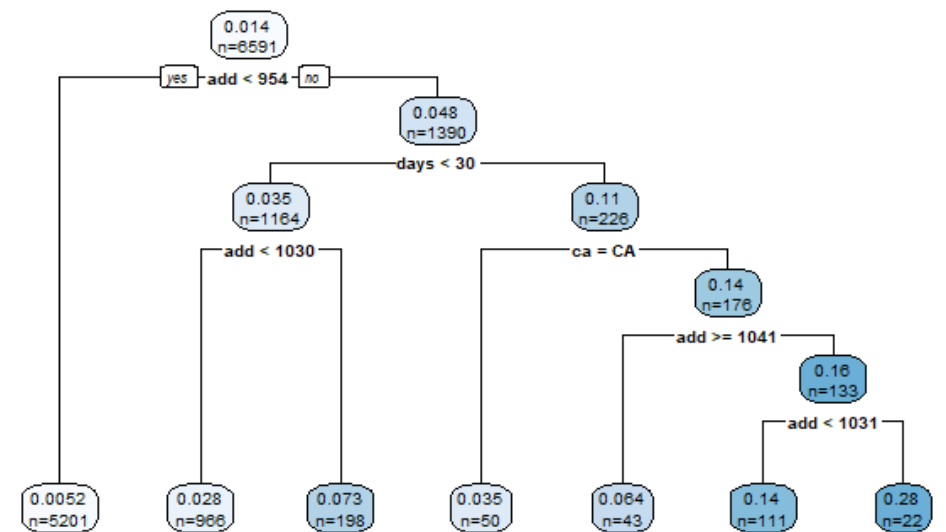
Predicting crown rot with AI



- Dimetra.eu built an AI application for us that allows:
 - To predict for every order, **before shipment**, if there is a higher risk of crown rot and if **Controlled Atmosphere** reduces that risk
 - The AI model is trained with the historic data of 4 years, using a “random forest” of decision trees.
 - The predictive inputs are values such as:
 - The country of production
 - The production date
 - The temperature sum at production date
 - The expected transit time
 - The use or not use of Controlled Atmosphere
 - The producer
 - The packaging type

The model then gives an advice to use or not use Controlled Atmosphere. This reduces the costs of crown rot and minimizes the use of CA deployment.

decision tree weighted CR



Crown Rot Report - Dominicaanse Republiek

Low Occurences: 49250, 49254, 49255, 49256, 49257, 49247, 49248, 49251, 49252, 49253, 49234, 49239, 49242, 49243, 49244, 49245, 49246

High Occurences: 49250, 49254, 49255, 49256, 49257, 49251, 49252, 49253

Attention Needed: 49250, 49256, 49257, 49251, 49252, 49253

Model Stats for Week #: 41		Average CR: 0.01222		Average CRC: 0.00566		P(occurs) = 0.48	
Lot #	Supplier	Organic	Week #	Transit	Avg. Grade	AGDD	
49250		True	41-2021	16 days	40"	1010	BANAVAC POLYPACK
24735	plastic: BANAVAC	True	42-2017	15 days	42"	1006	NO CA high high
			canoca: NO CA	result: no			CA low
49254		True	41-2021	16 days	40"	1010	BANAVAC POLYPACK
24735	plastic: BANAVAC	True	42-2017	15 days	42"	1006	NO CA high high
			canoca: NO CA	result: no			CA low
49255		True	41-2021	16 days	40"	1010	BANAVAC POLYPACK
24735	plastic: BANAVAC	True	42-2017	15 days	42"	1006	NO CA high high
			canoca: NO CA	result: no			CA low
49256		True	41-2021	16 days	40"	1010	BANAVAC POLYPACK
24735	plastic: BANAVAC	True	42-2017	15 days	42"	1006	NO CA high high
			canoca: NO CA	result: no			CA low
49257		True	41-2021	16 days	40"	1010	BANAVAC POLYPACK
24735	plastic: BANAVAC	True	42-2017	15 days	42"	1006	NO CA high high
			canoca: NO CA	result: no			CA low

Results



The AI model predicts no, low or high Crown Rot Risk.
Performance of 96% **accuracy** to predict the correct risk.

When the model predicts high risk, we order Controlled Atmosphere transport, especially for the **longer transit times**.

The results for the Peru season have been **very positive**. On average, a reduction of 50% of crown rot has been achieved and the economic impact has been reduced dramatically.

The cost of investment has been in the order of 20,000 . The payback time has been less than one year.

Conclusion



Artificial Intelligence using Machine Learning algorithms can play an important and effective role in **reducing the presence of quality problems** in fresh fruit logistics.

AI can **reduce food waste** and make the logistics chain **more predictable**.

There are numerous possibilities to develop models and solutions for other quality problems and other chilled or frozen food or pharma products.

The availability of good (historic) **data** is required.

The model was developed by **Dimetra.eu** in collaboration with AgroFair.

AgroFair participates in the “digital twin” project of **Wageningen University**, with Maersk, Westfalia and other partners.