



fruitful crop advice

Management zones in orchards- use of GPS, drones and cameras

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Why manage zones?

Aim is a more uniform orchards with less than 15% variation in growth and yield

Reasons:

- More efficient
- Easier to manage
- Environment friendly
- Better fruit quality

How to manage zones?

- Need tools to manage zones
- Need a spreader with GPS, which can apply fertilizer at a variable rate – variable rate application (VRA)
- Need a recommendation for different zones
- Need VRA maps where to apply the fertilizer and at what rate

Currently FCA uses three approaches to show variation

1. Drones
2. Satellite image
3. Fruit count - quadbike with camera

Drone model

- One drone flight in January with leaf sample. Use drone image to apply post-harvest nitrogen (N) and spring N the following season
 - Image - 0,05m x 0,05m resolution
 - Recommendation according to canopy area (vigour indication)
 - Total growth for the season
 - Norms according to row with, plant spacing, fruit type and cultivar
 - Aim is 4100m² canopy area per ha
 - E.g. If 4,5m x 1,5m planting => 1481 tree/ha
 - 4100m²/1481 trees = 2,77m²/tree
 - Compare year to year

Drone – zone VRA of N



Koelfontein Block 7: PTR - 3,3ha – micro irrigation
(4,5m x 1,5m)

Zone	Avg. Canopy Area	Size	Number of trees
1	2,53m ²	0,22ha	329
2	2,72m ²	0,68ha	1002
3	2,93m ²	1,52ha	2240
4	3,16m ²	0,69ha	985
5	3,40m ²	0,24ha	346



Aim is 2,77m² for area

Block 7 canopy area over 2 seasons



2023



2024

Drone data over three seasons

	2022		2023		2024	
Zone	Avg. Canopy Area (m ²)	Size (ha)	Avg. Canopy Area (m ²)	Size (ha)	Avg. Canopy Area (m ²)	Size (ha)
1	2,75	0,25	2,65	0,26	2,53	0,22
2	2,91	0,63	2,80	0,67	2,72	0,68
3	3,06	1,67	2,98	1,50	2,93	1,52
4	3,35	0,67	3,26	0,67	3,16	0,69
5	3,73	0,35	3,61	0,3	3,40	0,24
	avg. 3,23	variation 20%	avg. 3,12	variation 20%	avg. 2,94	variation 14%

Koelfontein fertilizer program 2023/2024 (kg/ha)

Block		Zone	ha	Canopy area	Bud- break	Cell division	Cell enlarge ment	Post harvest
					LAN	Urea	Urea	Urea
7	PTR	1	0,22	2,53	250	100	100	175
		2	0,68	2,72	100	50		175
		3	1,52	2,93	0			150
		4	0,69	3,16	0			125
		5	0,24	3,40	0			0

Aim is 2,76m² for area

Drone model...

- Apply N according to growth
- Growth been defined by “Canopy area” in m²
- Saving in N fertilizer – Dutoit Agri EC
 - 7% on N fertilizer
- Cost of drone flight R350/ha

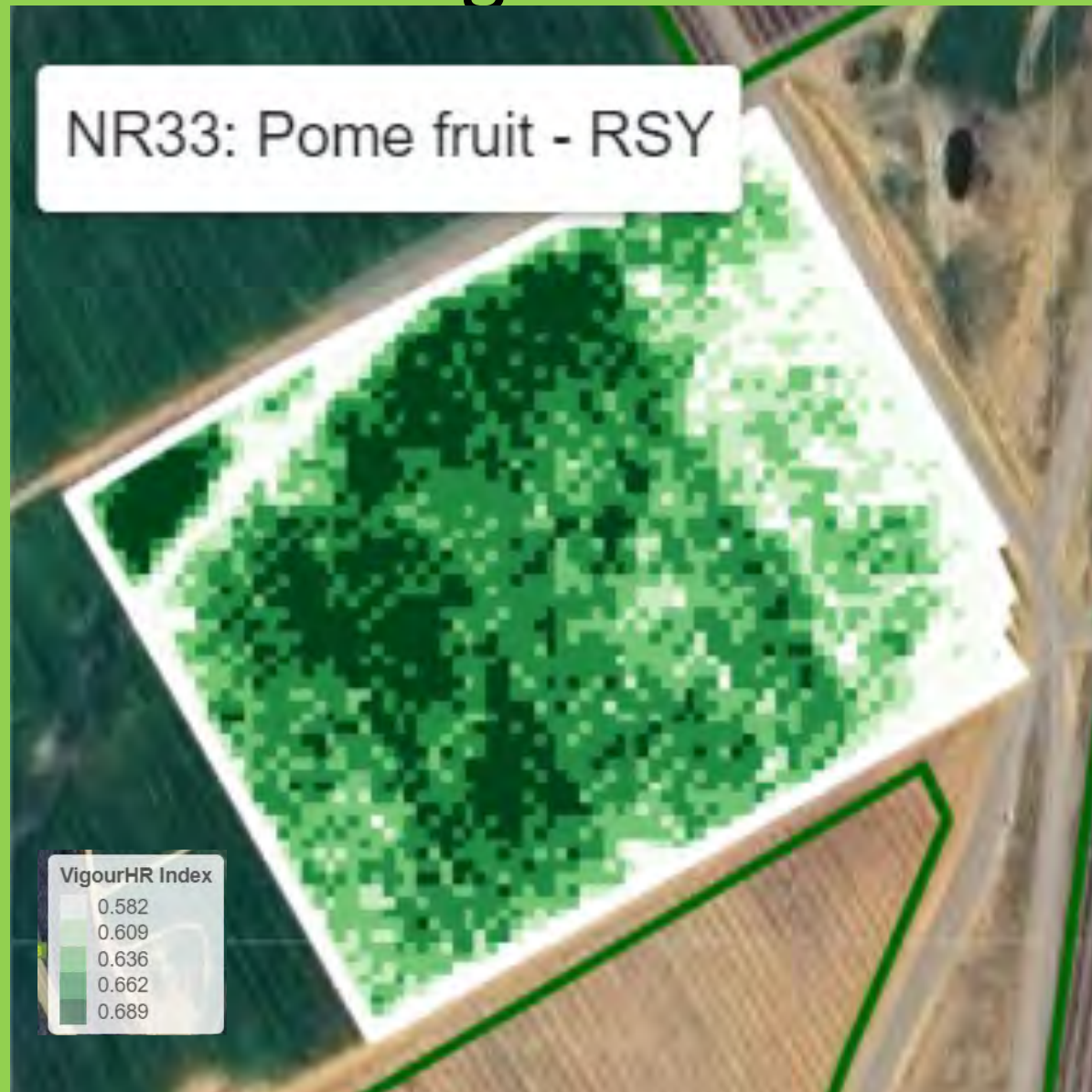
Drone: VRA of compost and regalis

- Apply compost according to growth, only weak zones
- Apply regalis only to vigorous zones in block and not per block
- Apply extra foliar feed – “Groeimix” to weak areas
- Less variation in block will lead to better fruit quality

Satellite image and fruit count

- Use a high resolution (0,8m x 0,8m) NDVI image at mid-Jan. to validate the vigour; accordingly apply post-harvest and spring N at variable rate
- With fruit count @ 35mm fruit size (mid-Dec.), generate an expected yield map
- Apply remaining potassium (K) fertilizer in Jan.
- Post-harvest N fertilizer is an integrated map between the yield map and NDVI
- Use the Red Ant fertilizer applicator

High resolution NDVI of block NR33 at Nooitgedacht



“Ground Truthing” of NDVI image

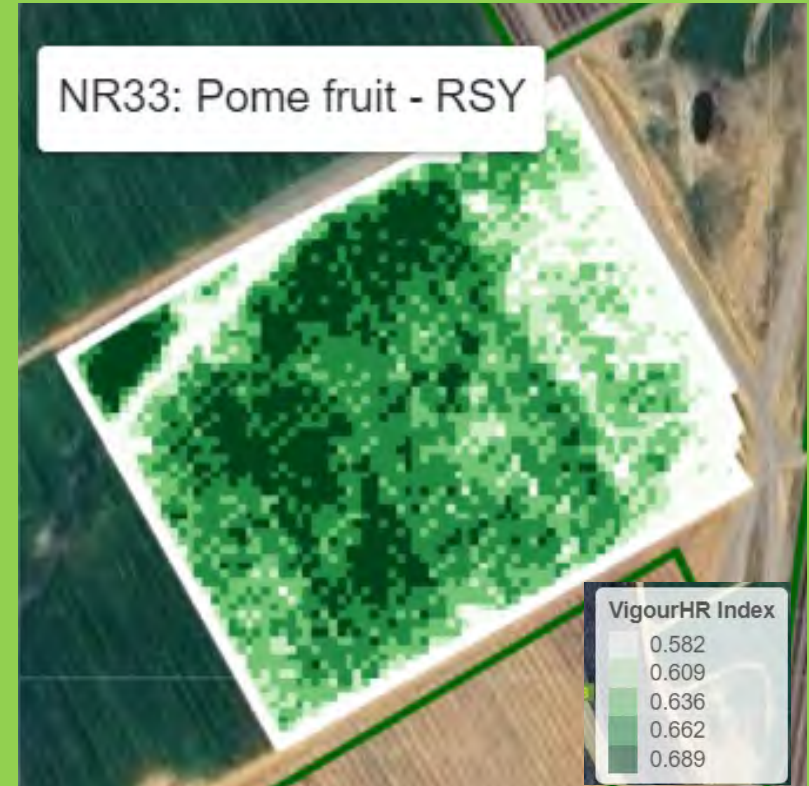
- NDVI image divide each block in 5 zones
 - Zone 1 is weakest vigour and zone 5 most vigorous
- “Ground Truthing”: Zones must be validated in field, given a growth index of 1-5, where 1 is weak and 5 is vigorous
 - For example, zone 1 growth may be a 3 (normal) and the rest of zones may be too vigorous
 - Disadvantage: needed to be done annually for each block and zone, in January.

NDVI Vigour – “ground truthing”

NDVI image 2023



NDVI image 2024

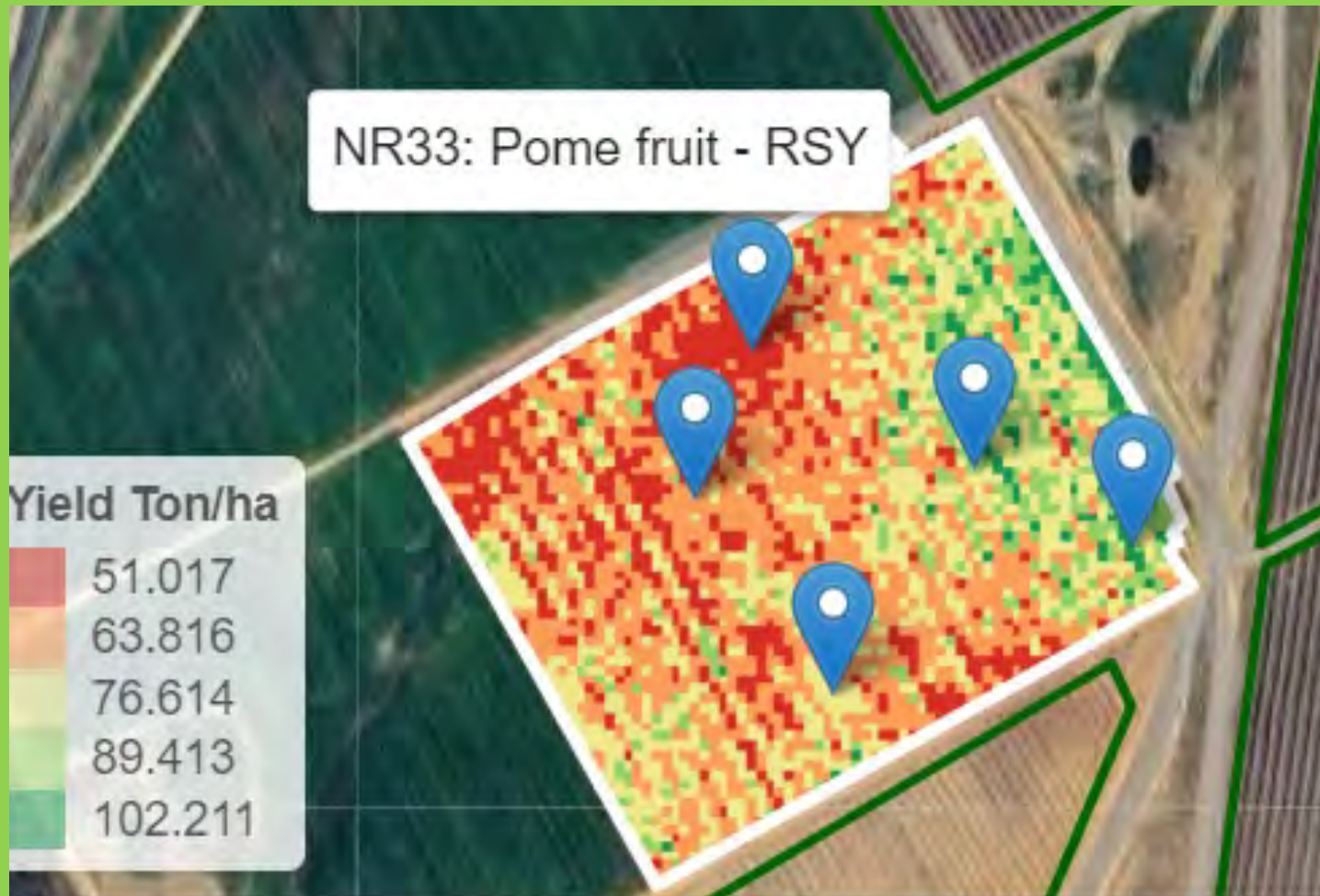


Block	Cultivar	Year	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
NR 33	RSY	2023	1	3	3	3	4
NR 33	RSY	2024	2	3	3	4	5

Nooitgedacht Fertilizer program 2023/2024 (kg/ha)

Block		Vigour Zone	Growth	Bud- break	Cell division	Cell enlarge- ment
				LAN	Urea	Urea
NR33	RSG	1	2	200	0	0
		2	3	0	0	0
		3	3	0	0	0
		4	4	0	0	0
		5	5	0	0	0

Expected yield map for NR33



Expected yield map for NR33

Zone Label	Avg Fruit Weight [g]	Predicted Yield [Tons]	Ton/Ha	Area [Ha]
Low	155	28.777	51.017	0.564
Low/Medium	155	71.864	63.816	1.126
Medium	155	61	76.614	0.796
Medium/High	155	29.287	89.413	0.328
High	155	10.871	102.211	0.106
Total	155	201.799	69.102	2.92



Calculate Yield



Delete Yield Prediction

Final production was 85 ton/ha

VRA of potassium fertilizer according to yield map

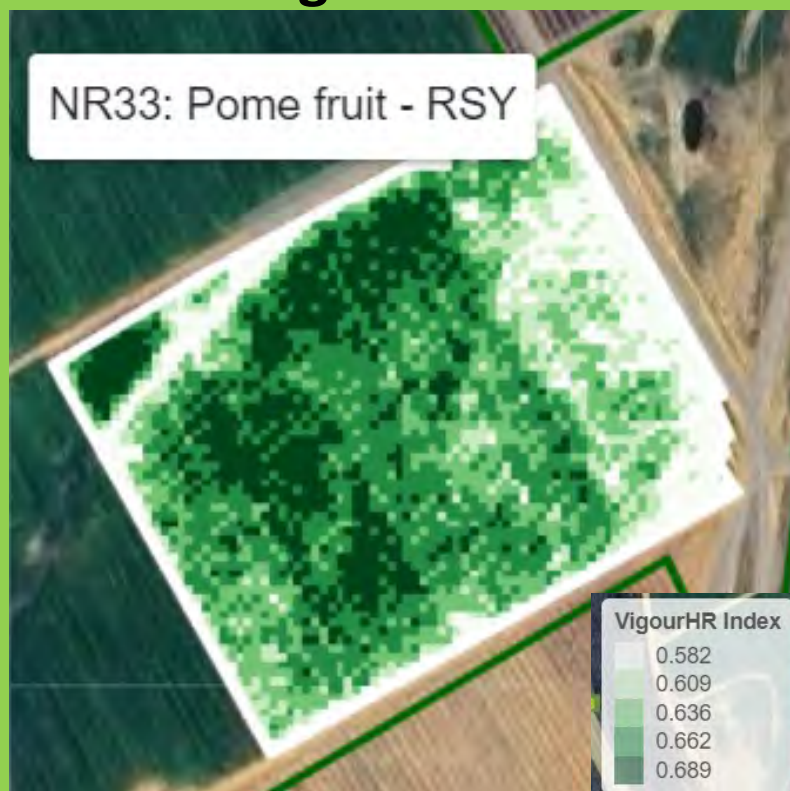
- Precision farming starts at a yield map, consider the progress annual crops have made in precision farming
- Expected yield map
 - Apples use about 1,8kg potassium (K) per ton of fruit
 - The expected yield map is generated at around 35mm of fruit size – mid-Dec.
 - Reserve 20-30% of potassium for January application
 - Apply Jan. potassium according to difference between estimated crop and estimated yield map

Nooitgedacht fertilizer program (kg/ha)

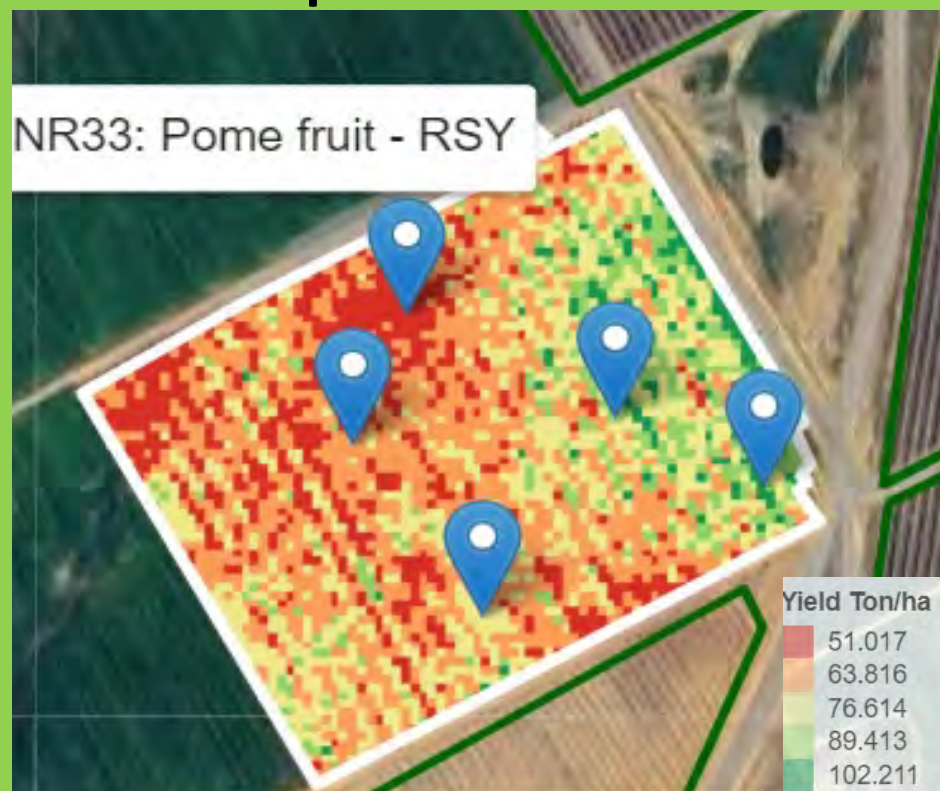
Block		Yield	Zone	Growth	Bud-break	Cell division	Yield Zone	Yield Map	January
		Ton/ha			LAN	Urea		Ton/ha	KCL
NR33	RSG	90	1	2	200	0	1	51	0
		90	2	3	0		2	64	0
		90	3	3	0		3	77	0
		90	4	4	0		4	89	0
		90	5	5	0		5	102	40

Integrated VRA of post-harvest N

NDVI image 2024



Yield Map 2024



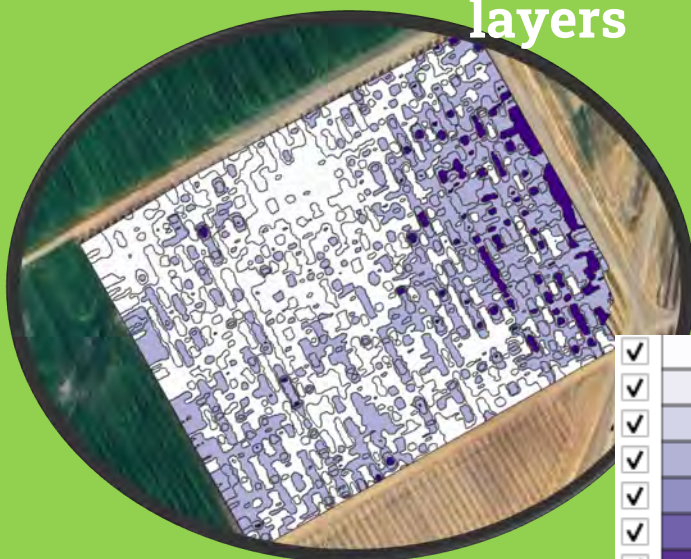
Integrated VRA of post-harvest N

Nooitgedacht, Block NR33, RSG						
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Yield	Production (ton/ha)	51	64	77	89	102
Rec.	N (kg/ha)	59	64	71	78	87
NDVI	% of N	100%	100%	100%	70%	0%
	Growth	2	3	3	4	5

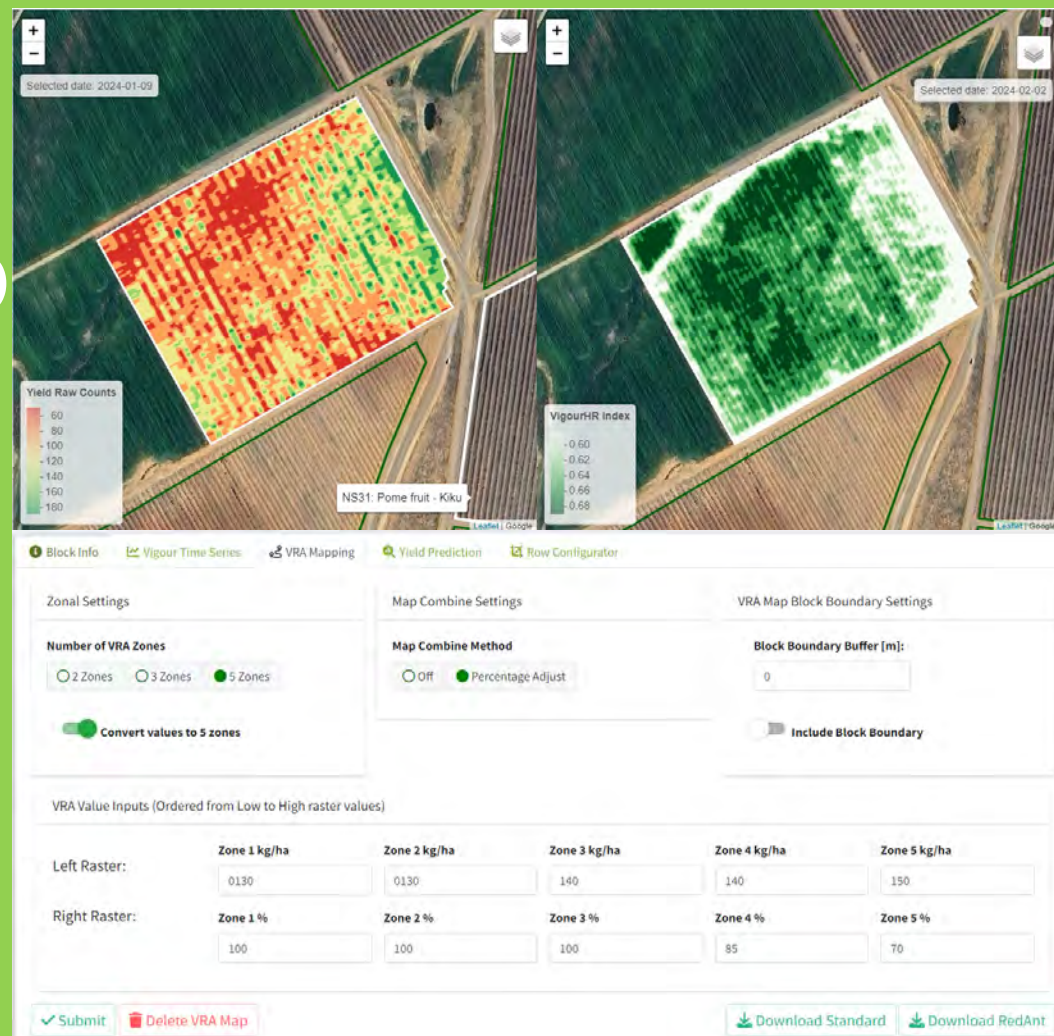


Variable Rate Fertiliser Maps (VRA Mapping)

Based on two layers



✓	130 - 130
✓	130 - 130
✓	130 - 135
✓	135 - 140
✓	140 - 140
✓	140 - 140
✓	140 - 145
✓	145 - 150



Conclusion

- There is variation in blocks in growth and production
- Technology can improve uniformity in an orchard with variable rate fertilizer, lime, compost and spray applications
- **You will need tools to apply VRA– capital cost**
- Added benefits of technology
 - Expected Yield Map
 - Yield prediction (no. of bins, packing material and cold rooms)
 - Groom thinning of areas in block
 - Allocation of fruit in terms of storage
 - NDVI images
 - Areas which under perform
 - Irrigation



fruitful crop advice

Thank you

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Acknowledgements

- Dutoit Agri and Koelfontein - farm data presented
- Aerobotics - data from aeroview platform
- Revolute systems - data from revtoolbox