August 22, 2023

ALMOND BOARD OF AUSTRALIA

Fertigation Planning Tool

Currently in Development

Josh Fielke – Industry Development Officer

Hort Innovation
Strategic levy investment

ALMOND FUND

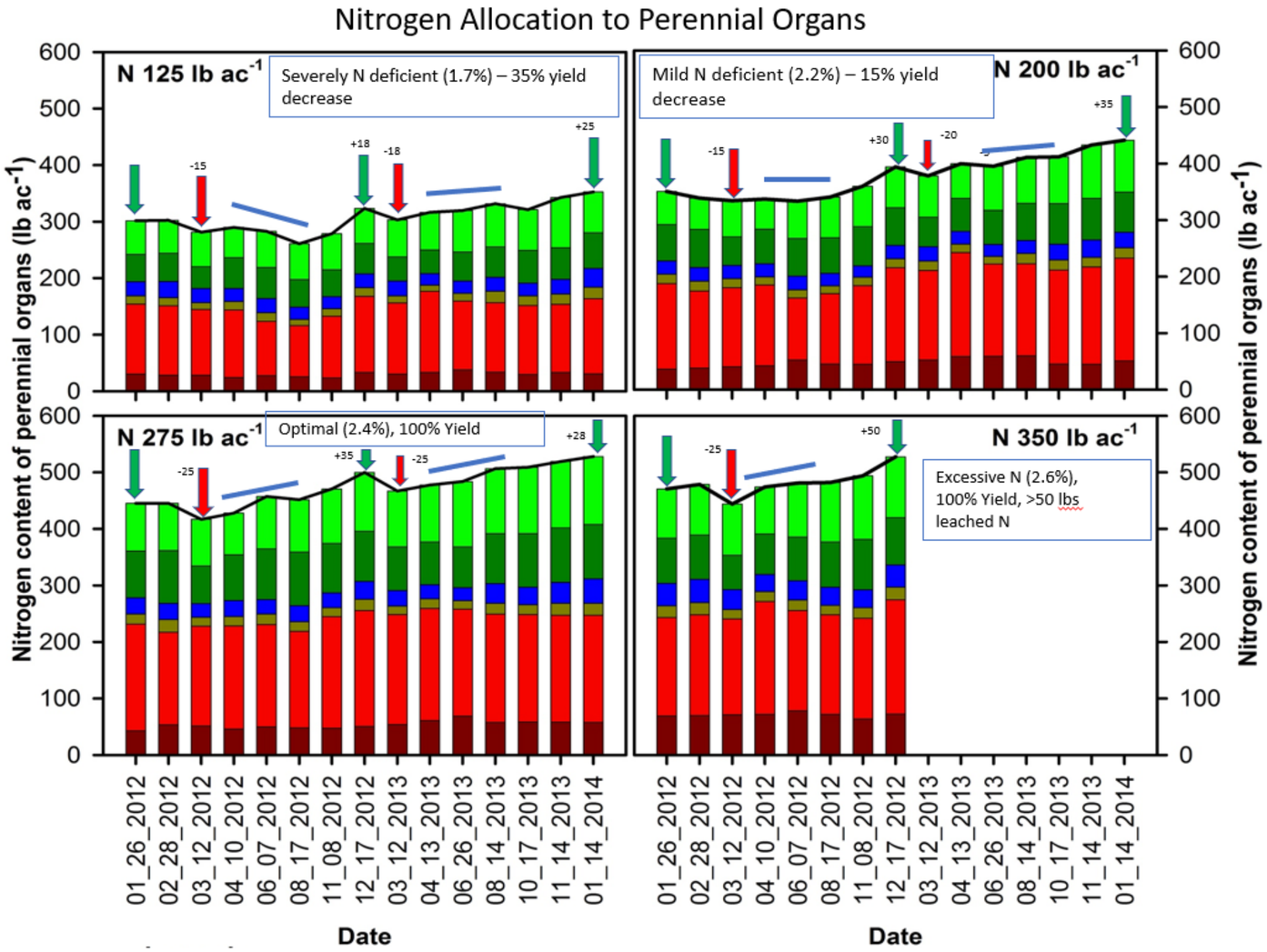
The purpose and background of the tool

- Planning out fertiliser use can be a long and complicated mathematical process.
- This tool aims to simplify the process while guiding the user with international research.
- This tool was developed on the back of the ‘More for less’ topics from the ABA 2022 conference and discussions with the ABA Production Committee.

Why should we try and be more precise?

- We want to know what we are doing and why we are doing it.
- Applying fertiliser to the trees needs is the best possible way to create maximum efficiency within the orchard both sustainably and financially.
- Can affect production and quality if nutrition is undersupplied.

Patrick Brown – Conference 2022, Adelaide



The end goal

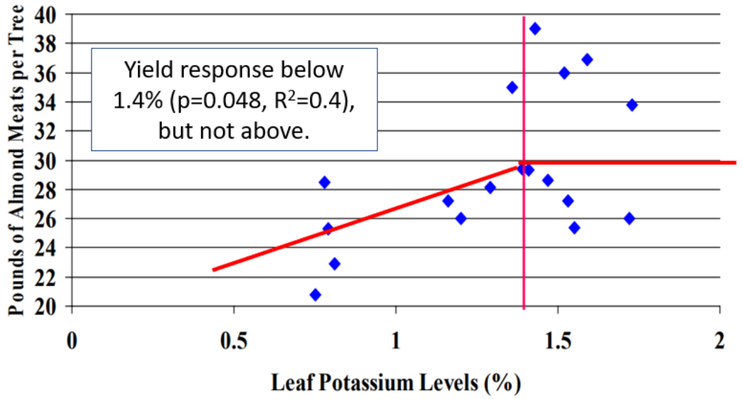
Leaf test results in January! Why N?

N – 2.5% (Multiple sources)

K – Minimum 1.4 but needs more investigation

Roger Duncan, 1999-2001

- Research has indicated that mid-summer leaf K% over 1.4% is sufficient.
  - No yield response has been observed with increasing values.
  - Belief of “silent hunger” within orchards leading to application.
  - Been in orchards with 1.8-2.0%, no greater yields than 1.4%.
- Fertility program should match export at 90 kg K2O/ton of kernel removed.



Research trial by R. Duncan, 1999-2001

CT Trial Standards

Table 3: Current and proposed leaf analysis standards for January sampling

Nutrient		Current Australian	Current Californian	CT Trial Averages (T1,T2)	Grower Survey Averages	Proposed New Australian
N	%	2.0 - 2.5	2.2 - 2.5	2.99	2.71	2.5 - 2.7
P	%	> 0.1	0.1 - 0.3	0.14	0.14	> 0.1
K	%	1.4 - 1.7	> 1.4	2.76	2.47	2.2 - 2.5
Ca	%	> 2.0	> 2.0	2.42	3.23	> 2.0
Mg	%	> 0.25	> 0.25	0.46	0.68	> 0.40
Na	%	< 0.25	< 0.25	0.07	0.04	< 0.25
Cl	%	< 0.3	< 0.3	0.41	0.31	< 0.40
Zn	mg/kg	25 - 30	> 15	335.20	144.23	> 30
Mn	mg/kg	> 20	> 20	162.83	347.16	> 20
Fe	mg/kg	-	-	88.76	183.88	> 50
Cu	mg/kg	> 4	> 4	5.65	18.72	> 4
B	mg/kg	25 - 65	30 - 65	40.25	36.54	30 - 65
S	%	-	-	0.17	0.21	> 0.15

lmond Board of Australia Inc.
William Street, PO Box 2246 I Berri South Australia 5343
P + 61 8 8582 2055 I F + 61 8 8582 3503
E admin@australianalmonds.com.au I W www.australianalmonds.com.au

The end goal

So how do we get there?

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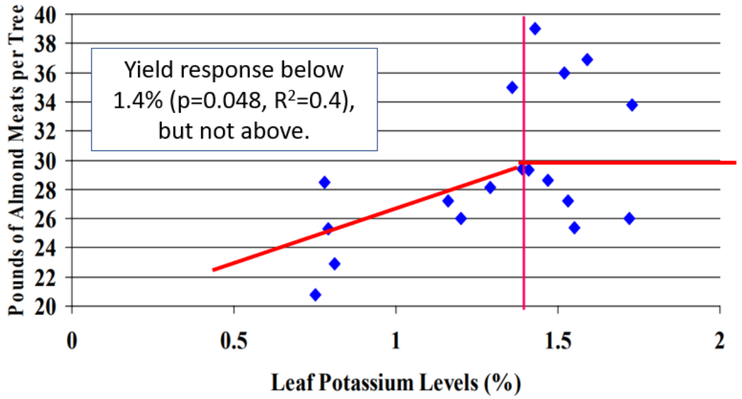

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Efficient Nutrient Management Approach
-the 4 R's- IPNI

Applying the **Right Rate**

- Match supply with tree demand
  - Determine tree demand
  - Consider all inputs- fertilizer, organic N, water, residual soil N.

At **Right Time**

- Apply coincident with root uptake.
- Apply coincident with demand

In the **Right Place**

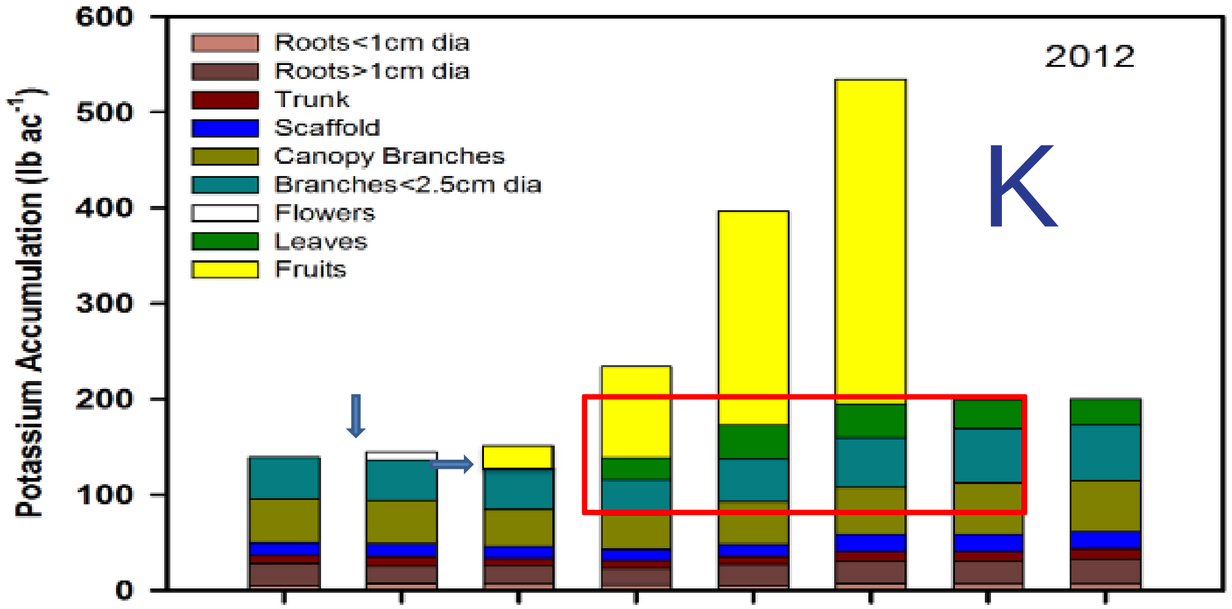
- Ensure delivery to the active roots
- Integrate with irrigation/fertigation practices
- Consider orchard variability.

Using the **Right Source/Right Balance**

- Eliminate limiting nutrients, minimize leaching potential, stabilize N in root profile….

Nitrogen Best Management – Almond Board of California

http://www.ipni.net/4r



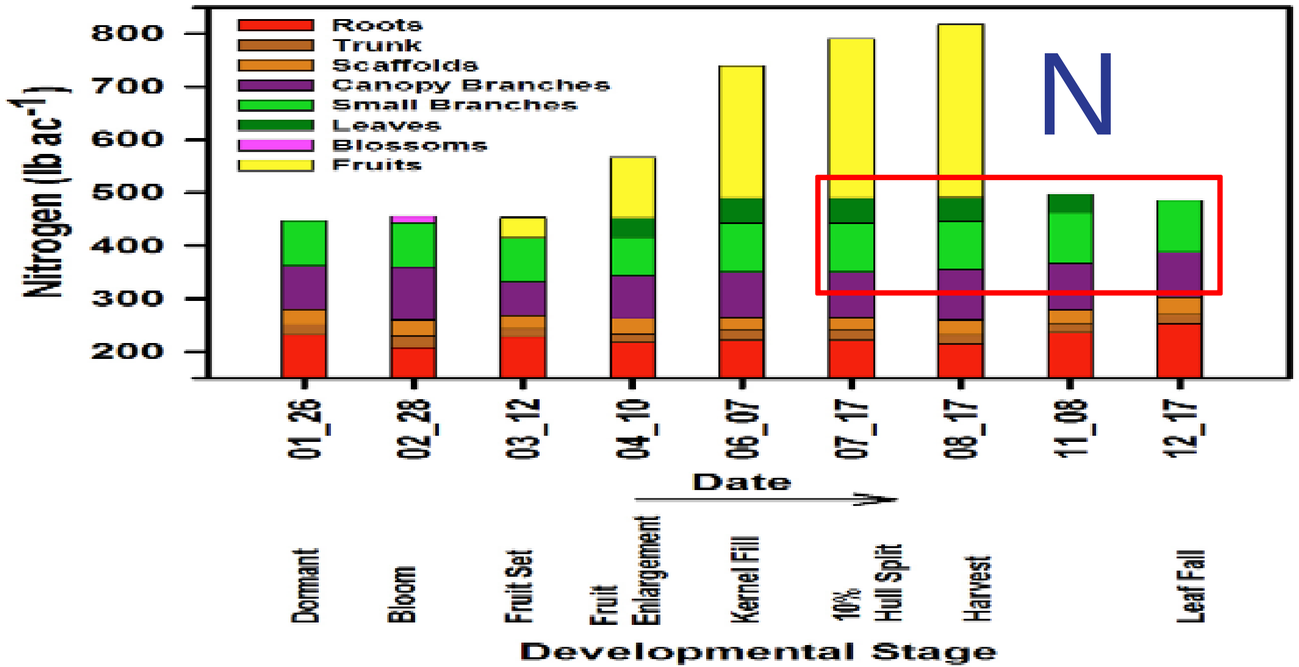
K uptake commences a little earlier, stored K pool is smaller than N, but uptake is significantly greater in late fruit development. K storage occurs earlier than N

Nutrients in removed fruit

N = 75 kgs/1000 kernel yield + growth

K = 88 kgs/1000 kernel yield + growth

K demand for growth and storage is lower than N.



Potassium Questions:

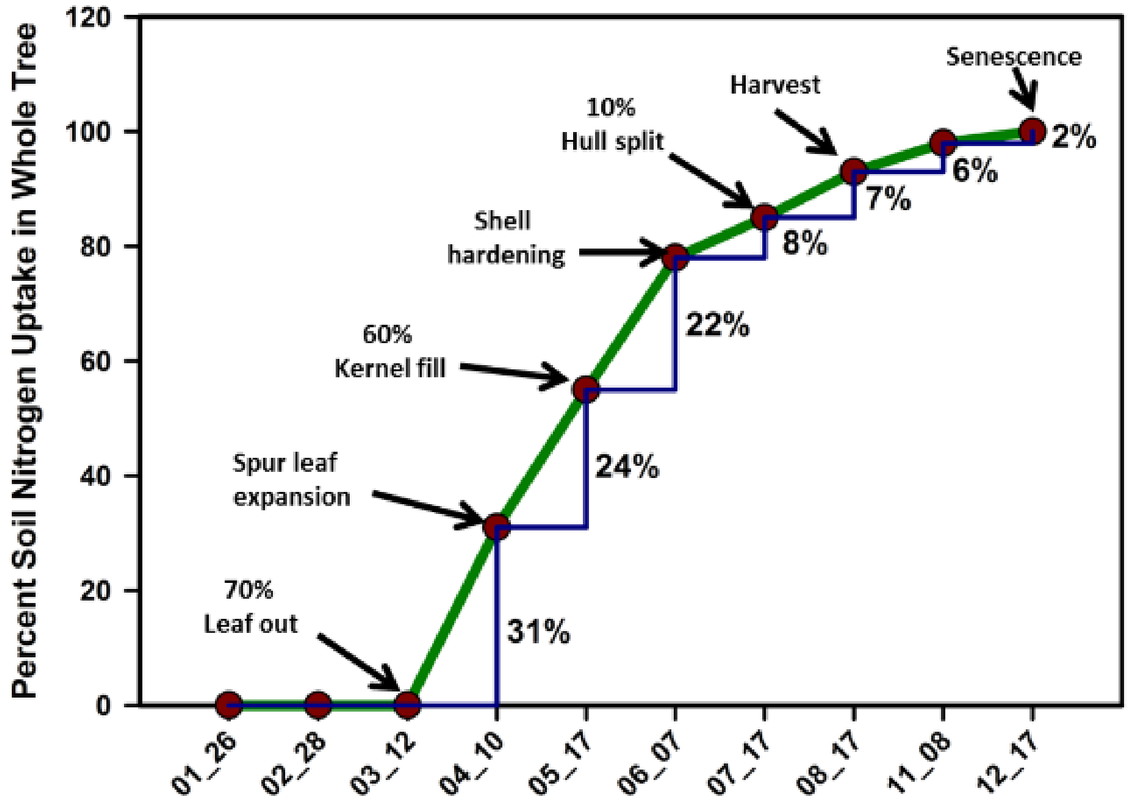
-K is expensive, are we using it efficiently?

-Is SOP banding the right approach in predominantly micro/drip irrigated orchards

- K is WAY more variable than N!

Tree and Yield Progression with Orchard Age

Age years	**Total Non-Yield Nitrogen Demand** leaf + woody biomass	**Nitrogen Demand for Yield** kernel lbs.	**Representative Yield Capacity by Year for Nonpareil** 14 x 22 planting	**Representative* Total Nitrogen Demand** lbs. per acre
1	30	0	0	30** (3 oz/tree)
2***	55	0		
3	65	Expected yield x 0.068		
4	55	Expected yield x 0.068		
5	45	Expected yield x 0.068		
6	40	Expected yield x 0.068		
7 – 15	40	Expected yield x 0.068		
16 – 25	30	Expected yield x 0.068		

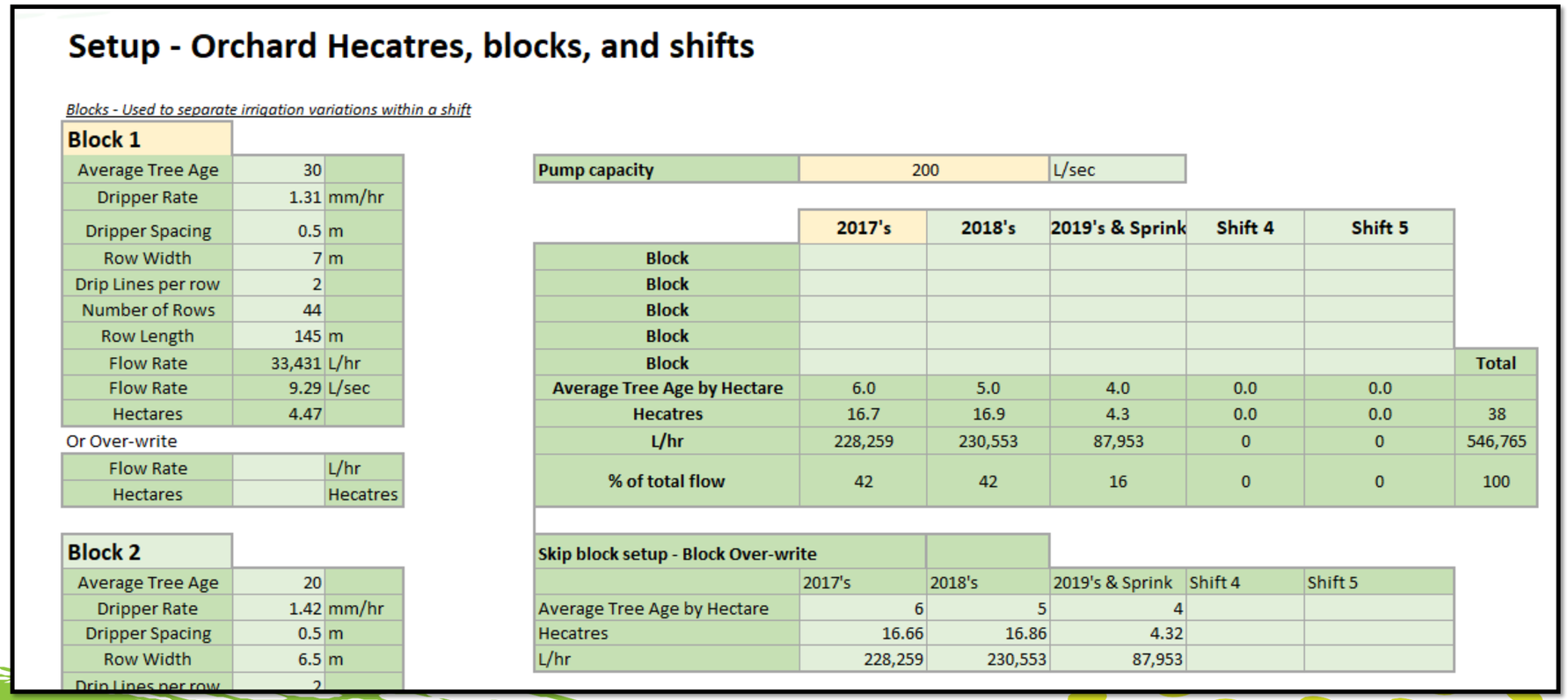


Planning with the Fertigation Calculator

- Assists to design a program based on the trees requirements
- Helps to work out a budget for the program
- Automatically creates mixes to meet the program required for stages
- Progress Reports

Usability

- Setup blocks, and shifts to get hectares and an application rate



Setup - Orchard Hecatres, blocks, and shifts

Blocks - Used to separate irrigation variations within a shift

Block 1		
Average Tree Age	30	
Dripper Rate	1.31	mm/hr
Dripper Spacing	0.5	m
Row Width	7	m
Drip Lines per row	2	
Number of Rows	44	
Row Length	145	m
Flow Rate	33,431	L/hr
Flow Rate	9.29	L/sec
Hectares	4.47	

Or Over-write

Flow Rate		L/hr
Hectares		Hecatres

Block 2		
Average Tree Age	20	
Dripper Rate	1.42	mm/hr
Dripper Spacing	0.5	m
Row Width	6.5	m
Drip Lines per row	2	

Pump capacity	200	L/sec

	2017's	2018's	2019's & Sprink	Shift 4	Shift 5	
Block						
Block						
Block						
Block						
Block						Total
Average Tree Age by Hectare	6.0	5.0	4.0	0.0	0.0	
Hecatres	16.7	16.9	4.3	0.0	0.0	38
L/hr	228,259	230,553	87,953	0	0	546,765
% of total flow	42	42	16	0	0	100

Skip block setup - Block Over-write					
	2017's	2018's	2019's & Sprink	Shift 4	Shift 5
Average Tree Age by Hectare	6	5	4		
Hecatres	16.66	16.86	4.32		
L/hr	228,259	230,553	87,953		

Usability

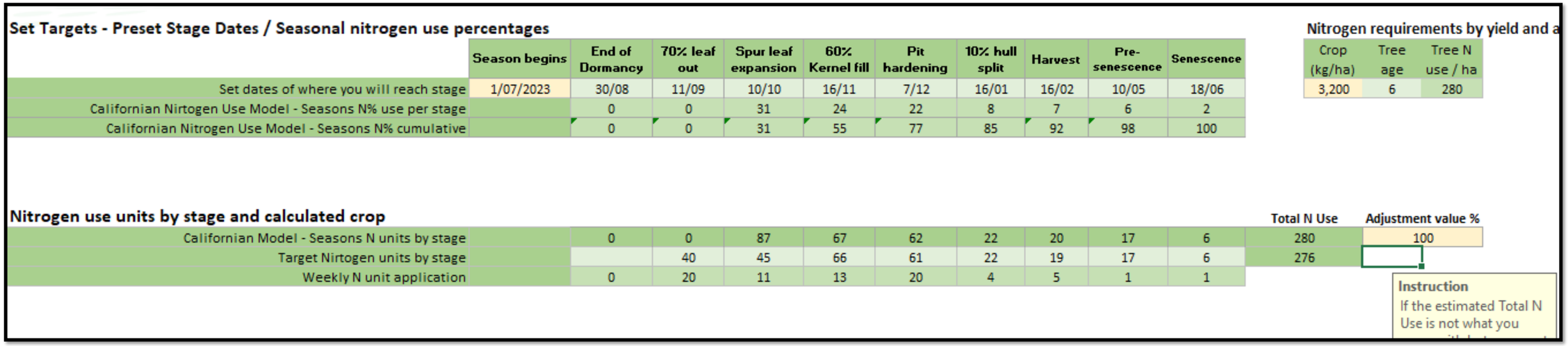
- Setup Fertiliser Products

Fertiliser Nutritional Breakdowns

Fert products	Packaging size	Price Per Kg ($)	N	P	K	Ca	Fe	B	S	Zn	Acid
Potassium nitrate	1200	40	13.2		38.1						
AN25	1000	30	25								
MAP	1200	15	12	27					18		
Potassium Sulfate	1200	20			41.5						
Calcium Nitrate	1000	35	15.5			19					
Iron							6				

Usability

- Setup timing of stages and be guided by expected crop use per hectare



Set Targets - Preset Stage Dates / Seasonal nitrogen use percentages

	Season begins	End of Dormancy	70% leaf out	Spur leaf expansion	60% Kernel fill	Pit hardening	10% hull split	Harvest	Pre-senescence	Senescence
Set dates of where you will reach stage	1/07/2023	30/08	11/09	10/10	16/11	7/12	16/01	16/02	10/05	18/06
Californian Nirtogen Use Model - Seasons N% use per stage		0	0	31	24	22	8	7	6	2
Californian Nitrogen Use Model - Seasons N% cumulative		0	0	31	55	77	85	92	98	100

Nitrogen requirements by yield and a

Crop (kg/ha)	Tree age	Tree N use / ha
3,200	6	280

Nitrogen use units by stage and calculated crop

										Total N Use	Adjustment value %
Californian Model - Seasons N units by stage	0	0	87	67	62	22	20	17	6	280	100
Target Nirtogen units by stage		40	45	66	61	22	19	17	6	276	
Weekly N unit application	0	20	11	13	20	4	5	1	1		

Instruction
If the estimated Total N Use is not what you

Usability

- Plan your program by elemental percentage or kg/ha and bag ratios

Mature Program

	N	P	K	Ca	Fe	B	S	Zn	Acid
Target	272	62	377	25	20				100
Planned	277	62	362	25	20	4	64	10	100
Planned %	102	100	96	100	100				100

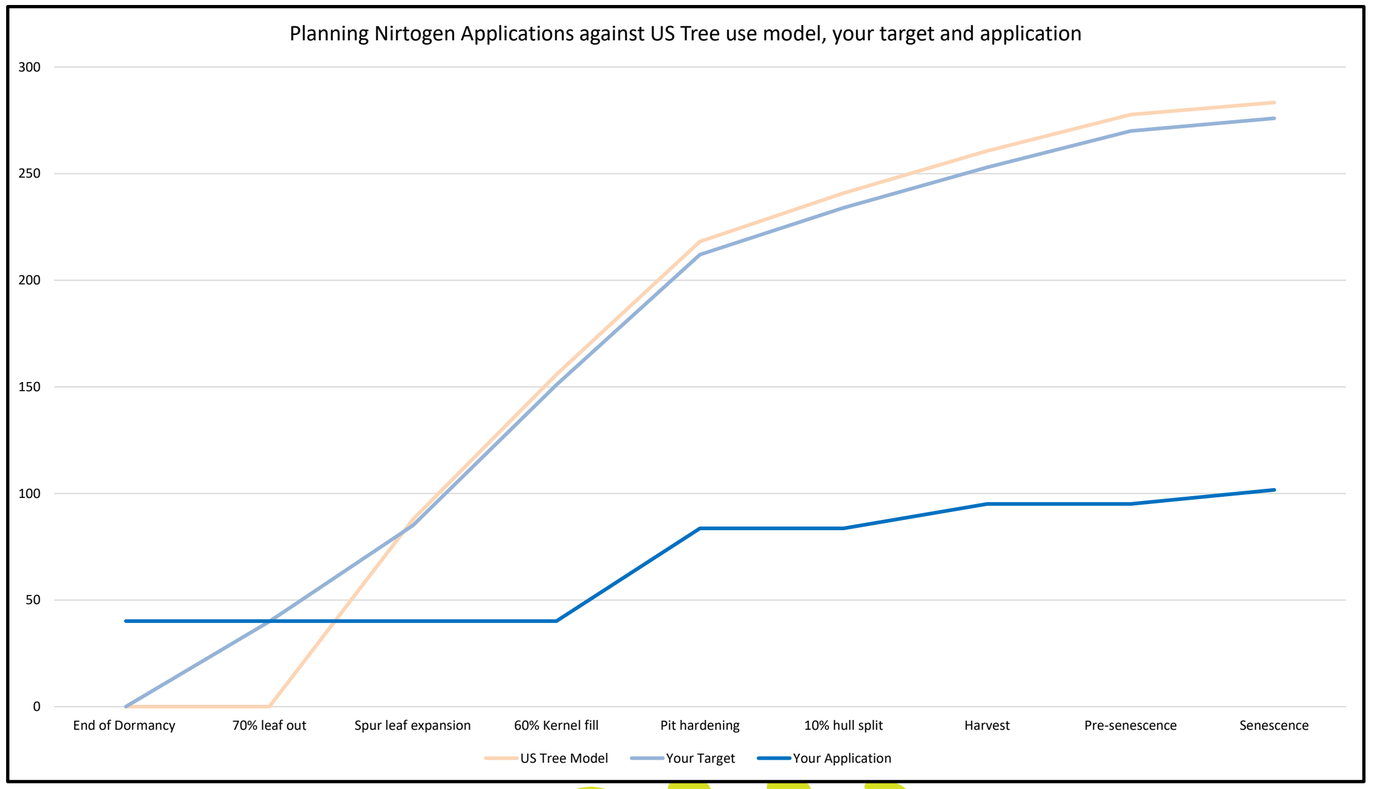
Application by product % to achieve units

Product	Mix	Focus element	% of element	OR KG/ha	Kg / ha	% of focus	$/ha	Bag ratio	N	P	K	Ca	Fe	B	S	Zn	Acid
Potassium nitrate	1	K	40		396	40	15,832	1.00	52		151						
AN25	1	N	12		131	12	3,917	0.40	33								
MAP	1	P	100		230	100	3,444	0.58	28	62					41		
Potassium Sulfate	1	K	56		509	56	10,174	1.29			211						
Calcium Nitrate	2	Ca	100		132	100	4,605		20			25					
Iron	2	Fe	50		167	50	0						10				
MX Special	3	Fe	50		752	50	0						10	4	19	10	
UAN	3	N	53		343	53	0		144								
Phos Acid	4	Acid	100		100	100	0										100
Magnesium Sulphate	3	N		30	30	0	0								4		

Usability

- Allocate you fertilizer based on your Nitrogen goals and seasonal ratios

			9 weeks from start of season to End of Dormancy		
			Stage Units	Goal by ratio	% of goal
			N 40	0	0
			P 9	0.0	0
			K 52	0.0	0
	Kg Planned	Kg left	kg/ha	Ratio Rec	% of Target
Potassium nitrate	396	144	57	57	14
AN25	131	3	19	19	15
MAP	230	171	33	33	14
Potassium Sulfate	509	36	73	73	14
Calcium Nitrate	132	61	19	19	14
Iron	167	156	11	11	7
MX Special	752	752		0	0
UAN	343	293	50	0	15
Phos Acid	100	95		0	0
Magnesium Sulphate	30	30		0	0



Plan is now set, manage your applications

There are 2 options:

1) By calendar amounts

	Start applying in week	Number of applications
End of Dormancy	5	2
70% leaf out	1	1
Spur leaf expansion	1	1
60% Kernel fill	4	2
Pit hardening	1	1
10% hull split	1	1
Harvest	1	1
Pre-senescence	1	1
Senescence	1	1

Stage	Year begins							
Date	1/07/2023	8/07/2023	15/07/2023	22/07/2023	29/07/2023	5/08/2023	12/08/2023	19/08/2023
Potassium nitrate					955		955	
AN25					318		318	
MAP					553		553	
Potassium Sulfate					1223		1223	
Calcium Nitrate					318		318	
Iron					184		184	
MX Special								
UAN					838		838	

2) By tank mix

Tank Mixes left to apply to					
End of Dormancy					
General Mix	Calcium Nitrate	Potassium Mix			
1.0	0.3	4.6			

Application by tank

Application stage	L to apply stage Nitrogen by mix	L to applied staged Phosphorus by mix	L to apply staged Potassium by mix	Week beginning
End of Dormancy	12,425			1/07/2023
End of Dormancy	12,575			1/07/2023

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Almond Board of Australia ABN 31 709 079 099

1801 Bookpurong Road, Loxton, S.A. 5333 | jfielke@australianalmonds.com.au | +61(4) 08 031 991

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