SOUTH AFRICAN SUGARCANE RESEARCH INSTITUTE

Varieties, ripeners and climate trends

Maximising RV Yield: SASIAA Annual Symposium
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Kerry Redshaw, Thobile Nxumalo,
Marvellous Zhou, Riekert van Heerden, Matthew Jones

South African Sugarcane Research Institute is a division of the South African Sugar Association

Presentation outline

- Performance of new varieties
  - Progress made with breeding and variety selection
  - Positive responses achieved with ripeners for maximising RV yields

- Climate trends and selecting varieties for the future

Performance of new varieties

- RV yields can be maximised by:
  - Planting varieties with improved cane yields, tons RV and pest and disease tolerance
  - Appropriate management of varieties
  - Applying ripeners to these new varieties to improve RV% to further increase tons RV

Latest varieties

- SASRI has a well established breeding and selection programme focused on:
  - producing superior varieties with high tons RV and
  - improved pest and disease resistance
- Once released, varieties are evaluated further in post-release variety evaluation trials:
  - across a wider range of agroclimatic regions
  - to facilitate the correct placement, disposition and management of these varieties

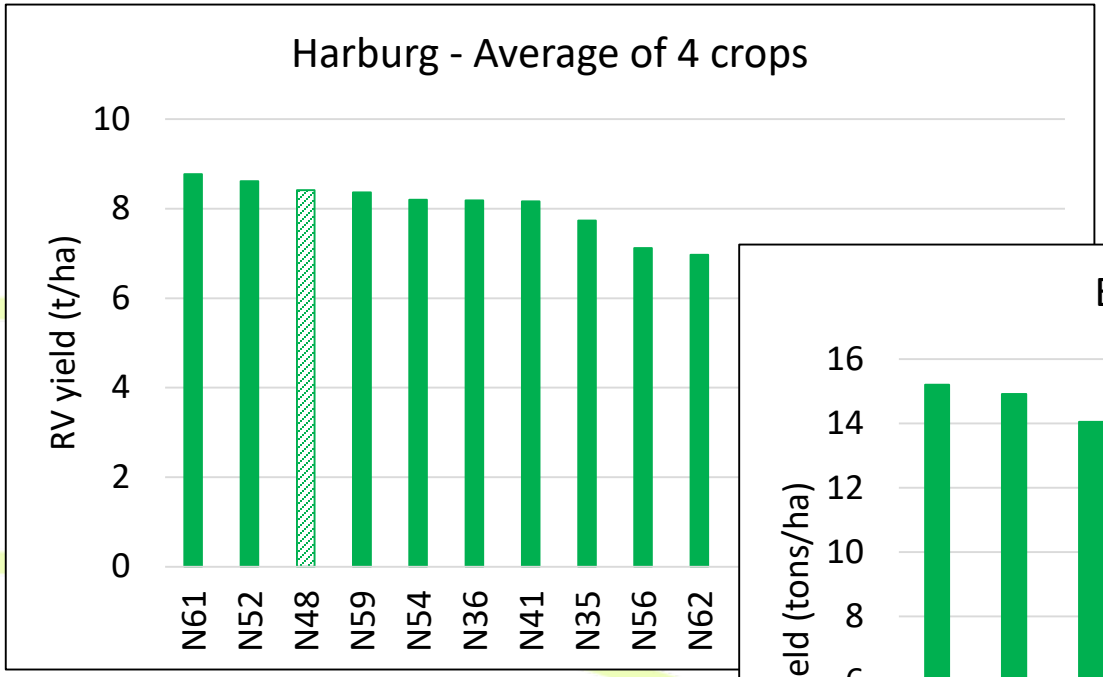
LATEST VARIETIES

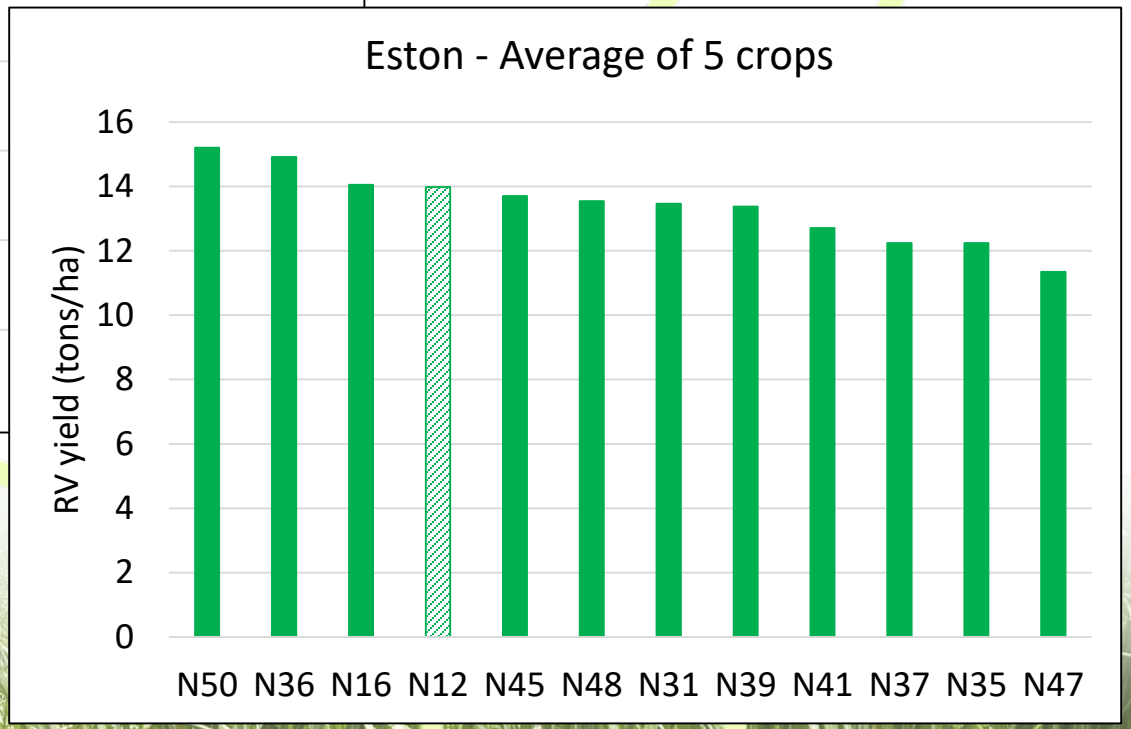
Varieties released from 2015 - 2020

Midlands

Variety	Year of release	Pest and disease ratings	Plant breeding trials			Post-release trials
			Tons Cane (%Δ Cont)	RV% (%Δ Cont)	Tons RV (%Δ Cont)	Tons RV (%Δ N48)
N61	2016	Smut (IS), Mosaic (R), Eldana (IR)	+29	-4	+24	+6
N62	2016	Smut (IS), Mosaic (IR), Eldana (R)	+29	-2	+26	+9
N66	2018	Smut (IR), Mosaic (R), Eldana (R)	+10	+5	+13	NA
N69	2019	Smut (I), Mosaic (IR), Eldana (IR)	+25	-7	+14	NA
N74	2020	Smut (R), Mosaic (R), Eldana (R)	+3	+13	+18	NA
N75	2020	Smut (I), Mosaic (R), Eldana (R)	+4	+13	+20	NA

Midlands


Harburg - Average of 4 crops
RV yield (t/ha)
10
8
6
4
2
0
N61
N52
N48
N59
N54
N36
N41
N35
N56
N62

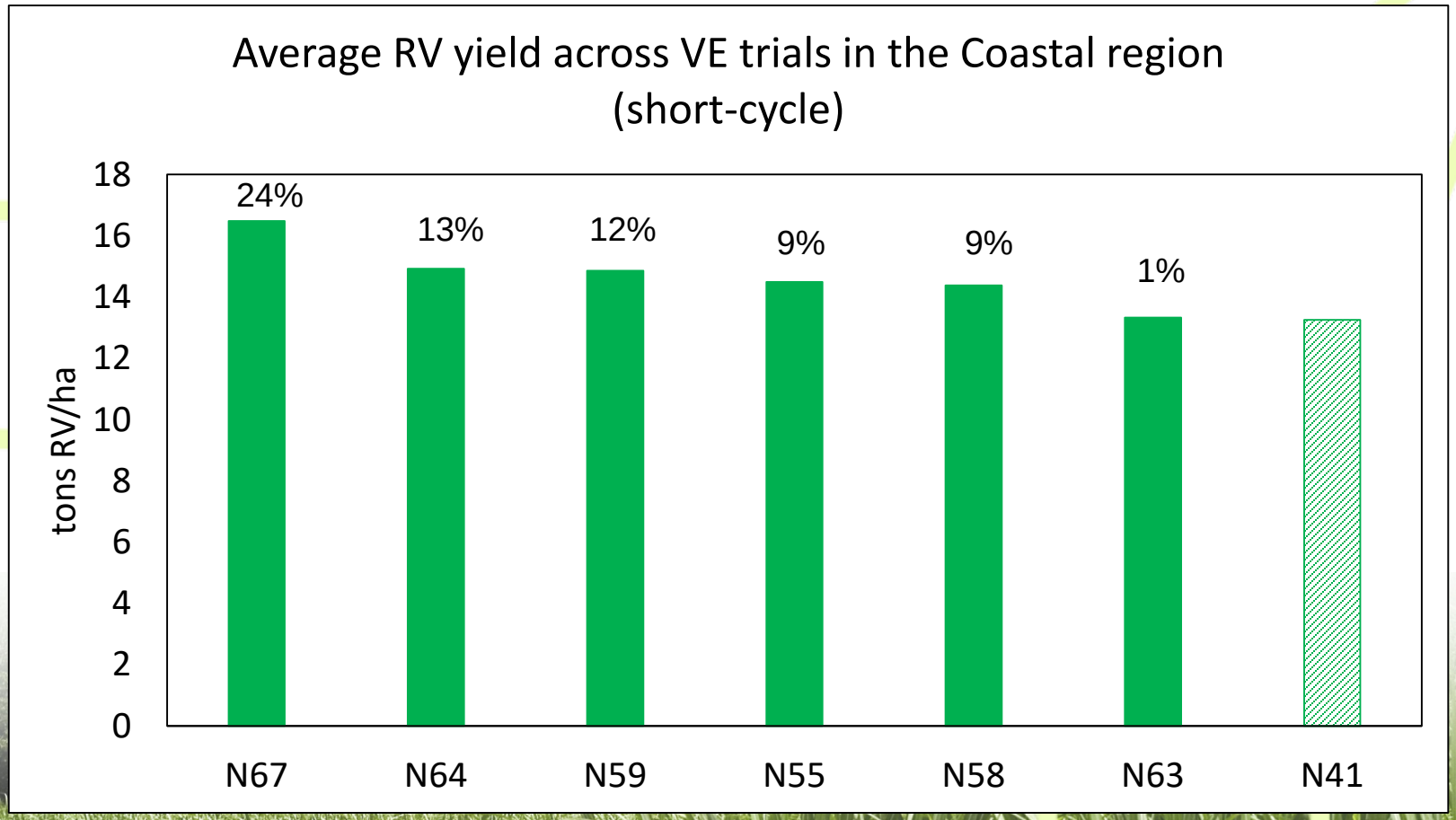

Eston - Average of 5 crops
RV yield (tons/ha)
16
14
12
10
8
6
4
2
0
N50
N36
N16
N12
N45
N48
N31
N39
N41
N37
N35
N47

Coastal regions

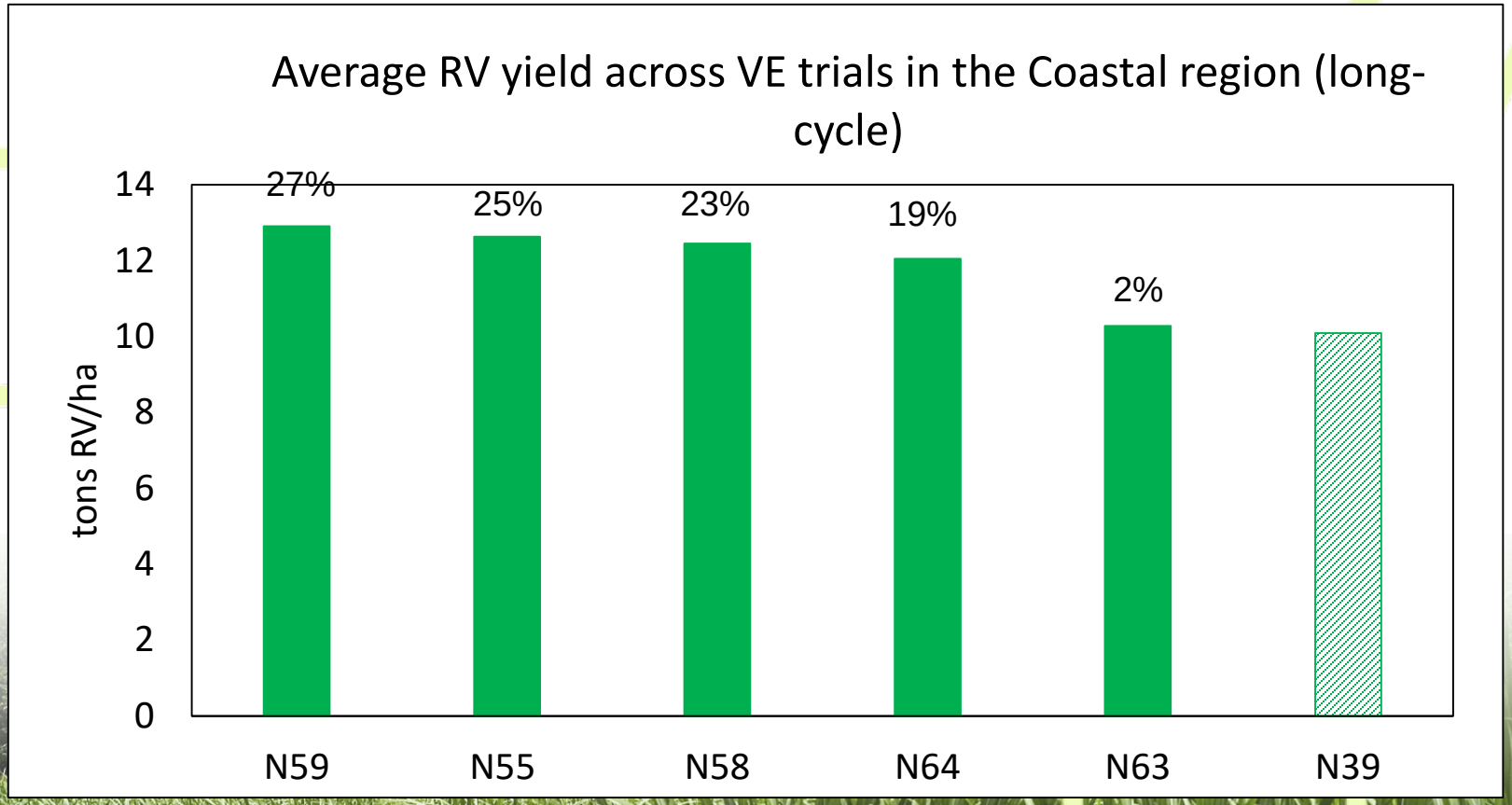
Variety	Year of release	Pest and disease ratings	Plant breeding trials			Post-release trials
			Tons Cane (%Δ Cont)	RV% (%Δ Cont)	Tons RV (%Δ Cont)	Tons RV (%Δ N41)
Coastal Short Cycle						
N64	2017	Smut (I), Mosaic (I), Eldana (IR)	+6	-1	+6	+13
N67	2018	Smut (IR), Mosaic (IR), Eldana (I)	+17	+5	+23	+24
N72	2019	Smut (R), Mosaic (R), Eldana (IR)	+15	-2	+13	NA

Variety	Year of release	Pest and disease ratings	Plant breeding trials			Post-release trials
			Tons Cane (%Δ Cont)	RV% (%Δ Cont)	Tons RV (%Δ Cont)	Tons RV (%Δ N39)
Coastal / Hinterland Long Cycle						
N58	2015	Smut (IR), Mosaic (R), Eldana (R)	+15	+8	+19	+23
N59	2015	Smut (IS), Mosaic (R), Eldana (R)	+14	+5	+17	+27
N63	2017	Smut (I), Mosaic (IR), Eldana (R)	+17	-8	+5	+2
N68	2018	Smut (IR), Mosaic (IR), Eldana (IR)	+29	-6	+21	NA

Coastal – short cycle



Coastal – long cycle

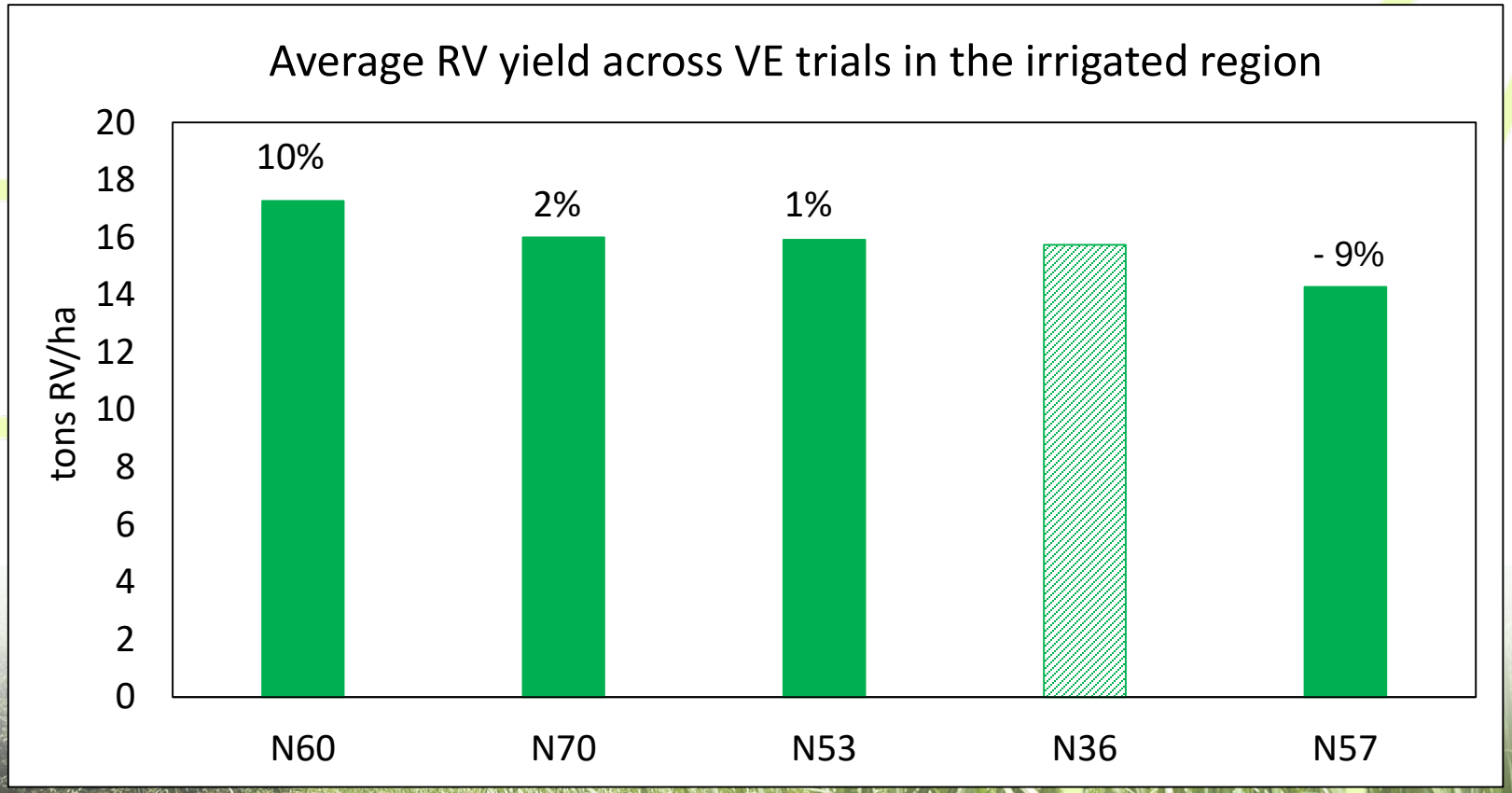


Irrigated region

Variety	Year of release	Pest and disease ratings	Plant breeding trials			Post-release trials
			Tons Cane (%Δ Cont)	RV% (%Δ Cont)	Tons RV (%Δ Cont)	Tons RV (%Δ N36)
N60 (South only)	2016	Smut (I), Mosaic (IR), Eldana (IS)	+3	+6	+10	+10
N70	2019	Smut (R), Mosaic (R), Eldana (R)	+4	+2	+6	+2
N71	2019	Smut (R), Mosaic (R), Eldana (S)	+3	+13	+19	NA
N73	2020	Smut (IR), Mosaic (R), Eldana (S)	+18	0	+19	NA

Late season varieties

Irrigated


Average RV yield across VE trials in the irrigated region
tons RV/ha
20
18
16
14
12
10
8
6
4
2
0
10%
2%
1%
- 9%
N60
N70
N53
N36
N57

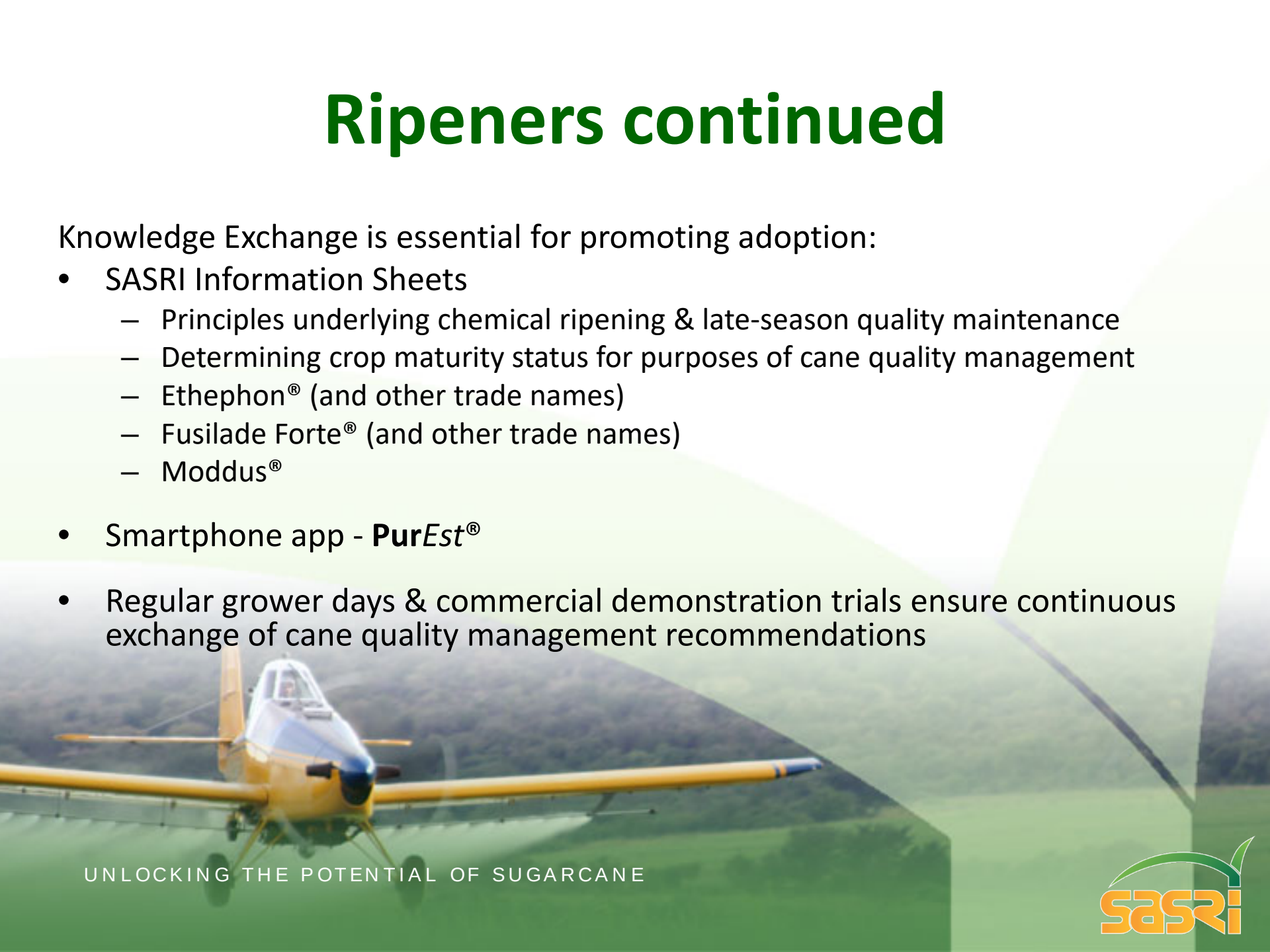
Ripeners

- Ripeners are used for:
  - Improving low cane quality caused by prolonged periods of vigorous growth during summer (chemical ripening)
  - For maintaining late-season quality after winter (late-season quality maintenance)
- Most NB consideration when planning to spray ripeners for chemical ripening is:
  - Crop growth vigour &
  - Crop maturity at time of spraying
- For chemical ripening, spraying must take place when the cane is growing vigorously & crop maturity is low

Ripeners continued

Knowledge Exchange is essential for promoting adoption:

- SASRI Information Sheets
  - Principles underlying chemical ripening & late-season quality maintenance
  - Determining crop maturity status for purposes of cane quality management
  - Ethephon® (and other trade names)
  - Fusilade Forte® (and other trade names)
  - Moddus®
- Smartphone app - **Pur***Est*®
- Regular grower days & commercial demonstration trials ensure continuous exchange of cane quality management recommendations



Varietal response to ripeners

- Profitability outcomes using demo trials
  - Results presented from ten participatory, commercial on-farm demo trials conducted over past 2 years
  - *Dryland conditions (Midlands & South Coast)*
  - Includes an economic analysis factoring in RV yield income, commercial ripening costs & regional harvesting and transport costs

Midlands

Region	Variety	Crop Age	Harvest Month/ year	Treatment	RV (%)	TCH (t/ha)	TRVH (t/ha)	Δ_{GM} (R/ha)
Eston	N31	22	19-May	Control	9	65	5.85	-
				Volley®	11	62.3	6.85	4000
Richmond	N41	24	20-Apr	Control	10.8	96.02	10.4	-
				Volley®	12.3	92.17	11.36	4322
Richmond	N48	23	19-May	Control	9.5	141.6	13.45	-
				Volley®	11.6	131.7	15.27	8818
Dalton	N48	18	20-Apr	Control	11.2	112.3	12.6	-
				Volley®	13.2	102.6	13.6	5373
Richmond	N54	18	19-Apr	Control	9.6	157.7	15.13	-
				Volley®	10.9	153.5	16.73	6692

South Coast

Region	Variety	Crop Age	Harvest Month/ year	Treatment	RV (%)	TCH (t/ha)	TRVH (t/ha)	Δ_{GM} (R/ha)
Park Rynie	N41	18	20-May	Control	12.6	81.4	10.26	-
				Orca®	13.6	83.5	11.4	4579
Park Rynie	N51	19	20-Jul	Control	11.5	91.9	10.6	-
				Orca®	11.7	93.8	11	1496
Jolivet	N52	18	20-Apr	Control	9.6	111.4	10.72	-
				Orca®	10.6	97.4	10.34	541
Jolivet	N52	18	19-Nov	Control	11.2	103	11.53	-
				Volley®	12.2	98.7	12.04	2395
Park Rynie	N58	18	19-Jul	Control	13.4	102.7	13.76	-
				Orca®	14.4	103.1	14.84	3994

Ripener research

- SASRI is at the forefront of ripener research
  - Ethephon® (or other trade names) + Fusilade Forte® (or other trade names) combination (“piggy-back”) treatment was a SASRI innovation

- New combination treatment being tested is another world first

Irrigated region

Var	Treatment	TRVH Income (R/ha)	Ripener cost (R/ha)	Harv & Trans Cost (R/ha)	GM (R/ha)	Δ_{GM} (R/ha)
N43	Control	59 210	0	19 805	39 405	
	Moddus	75 518	1164	19 469	54 884	15 480
	FF	74 482	156	18 916	55 411	16 006
	Comb	81 244	1175	19 424	60 645	21 241
N46	Control	50 242	0	16 793	33 449	
	Moddus	61 013	1164	17 493	42 355	8907
	FF	65 610	156	18 075	47 379	13 931
	Comb	75 651	1175	18 417	56 059	22 611
N57	Control	60 519	0	19 154	41 365	
	Moddus	67 806	1164	17 925	48 717	7352
	FF	59 568	156	18 730	40 683	-682
	Comb	70 355	1175	17 314	51 866	10 501
N60	Control	71 306	0	21 638	49 668	
	Moddus	79 857	1164	22 120	56 572	6904
	FF	72 121	156	19 855	52 111	2442
	Comb	84 289	1175	21 412	61 702	12 034
ALL	Control	60 319	0	19 348	40 972	
	Moddus	71 048	1164	19 252	50 632	9661
	FF	67 945	156	18 894	48 896	7924
	Comb	77 885	1175	19 142	57 568	16 597

Climate trends

- Climate change
  - what happens to the climate itself

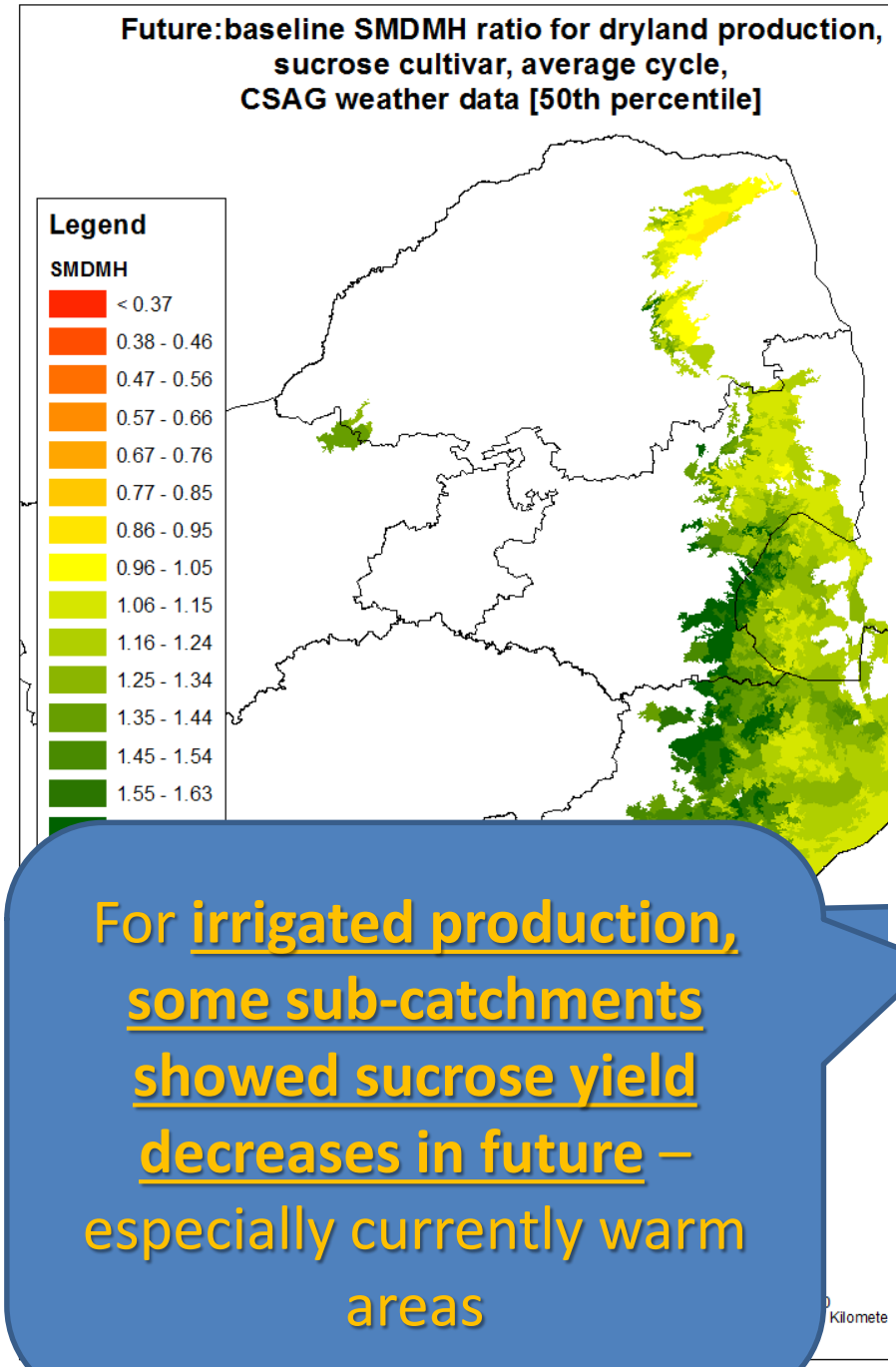
- Climate change impacts
  - what happens to yields due to the change in climate

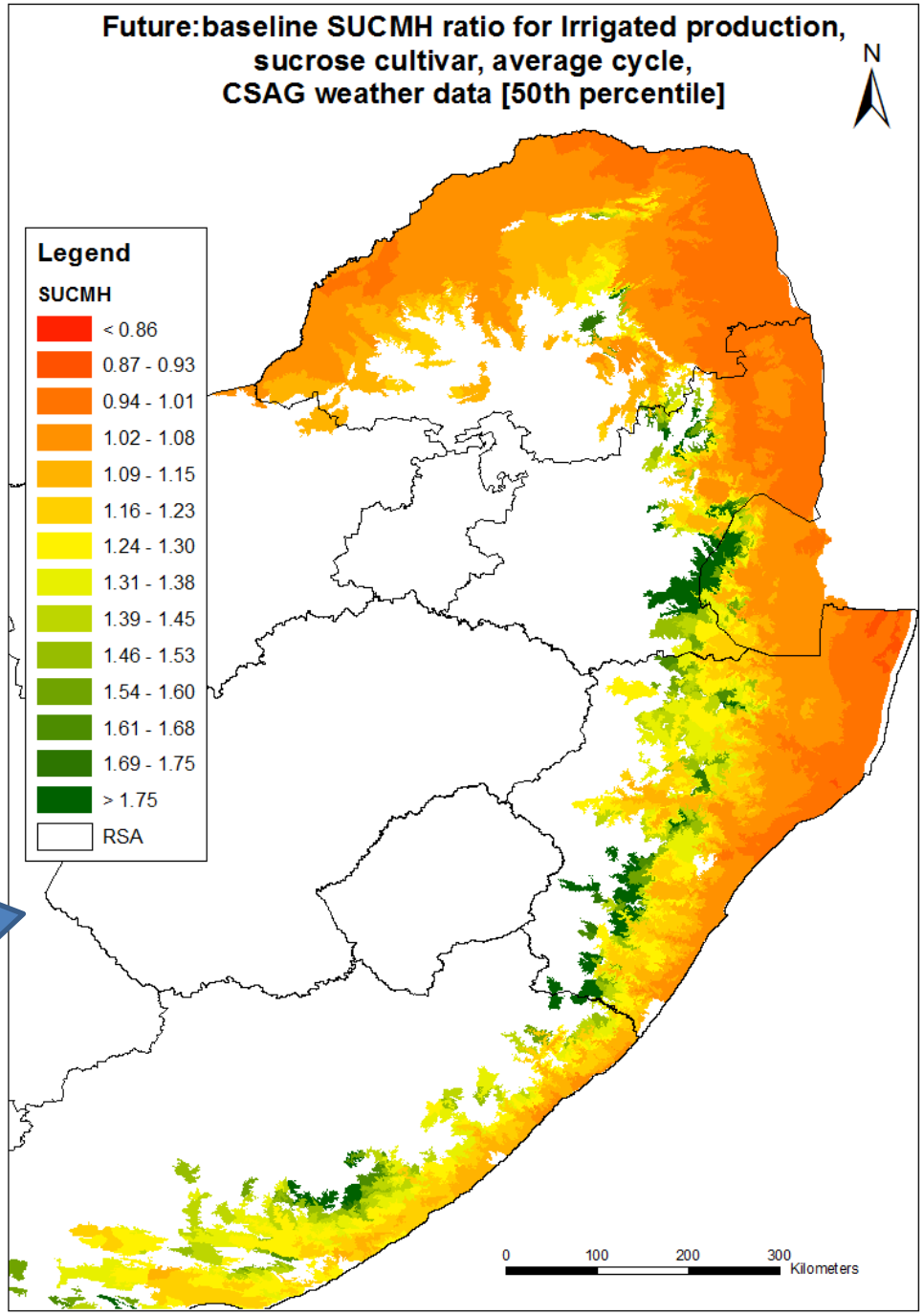
Climate change

- Climate models agree:
  - +2 °C in 2050s compared with 1990s;
  - ~5% increase in rainfall but less consensus
  - Changes in variability / extreme events NOT yet explored
- Refined Canegro model…
  - …used to predict yields, water use & irrigation requirements for period 2046 – 2065 for existing & potential new production areas in South Africa, at a sub-catchment level

Climate change impacts

- **Increased yields (+15% for rainfed, +2% for irrigated cane)** in future (2050s) due to faster canopy development, higher photosynthesis rates in most of SA industry
- Water use / **irrigation 11% higher**
- Currently **cooler regions "benefit"** most
- Sucrose yields and content decrease for some irrigated regions





For **irrigated production, some sub-catchments showed sucrose yield decreases in future** – especially currently warm areas

Future adaptation options

- **Shorter cycles** → increased annualised yields
- **Wider row-spacing** possible (lower costs/yield benefits? with 1.8 m single-row spacing)
- Green-cane harvesting + **mulch blankets** to mitigate additional ET demand in future
- Potential for further +- 10 % increases in yield in future with local-specific adaptations
- **Chemical ripening** / shorter milling season → mitigate sucrose decrease
- Adapted varieties?
- Profitability of adaptations not yet fully explored

Genetic adaptation

- Limited research so far.
- Modelling work underway to simulate genetic effects → explore "ideal" traits under future climate scenarios.
- Are varieties automatically adapted for climate change?
  - **Yes** – selection happens in a changing climate
  - **No** – 10+ years for selection and 10+ years for widespread adoption → varieties lag climate change by 15-20 years!

Conclusions

- SASRI is making significant progress in the development of new varieties to maximise RV yields & to improve pest & disease resistance.
- Income can be increased in dryland and irrigated cane when ripeners are applied correctly (cane must be growing vigorously & crop maturity must be low).
- Current research indicates that climate change will have an impact on sugarcane yields in the future. Further research is required on impacts of climate variability, genetic adaptation and methods of variety selection to ensure optimal adaptation to future conditions.

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