Increase cherry production potential through adaptability indexing of new genotypes in different South African growing areas.

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Introduction & Problem Statement

Sweet cherry (*Prunus avium* L.): Luxury Fruit with Adaptation Challenges

- Origin and spread (Webster, 1996; Faust & Suranyi, 1997)
- Breeding efforts (Iezzoni et al., 2017)
- Adaptability gap

Adaptability Challenges in Mediterranean-like Climates

- Insufficient winter chill (Küden et al., 1996; Dennis, 2000; Mahmood et al., 2000)
- High risk scenario
- Deeper understanding

Improve on current genotype selection

- Chill models and current practices (Luedeling, 2012; Louw et al., 2023)
- Follow the tree (phenotyping)
- Adaptability = performance and stability (Finlay & Wilkinson, 1963; Hill et al., 1998)

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Research Objectives

Investigate sweet cherry adaptability in Mediterranean climates

- Consider both winter and growing season conditions
- Potential influence of rest breaking agents

Quantify the influence of genotype (G), environment (E) and the genotype-environment interaction (GEI)

Identify genotypes for early commercial adoption

- Based on performance and stability

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Timeline

2018

GENOTYPE SELECTION

Low, medium and high chill genotypes

2019

TREES PLANTED IN PRO-HORT SITES

3 Environments with different climates

2020

1ST LEAF DATA

Budbreak and natural growth habits

2021

2ND LEAF DATA

Applied Dormex

Budbreak and tree architecture

2022

3RD LEAF DATA

1st bearing year

Yield

Fruit quality

2023

4TH LEAF DATA

2nd bearing year

Yield

Fruit quality

2024

FINAL REPORT AND FEEDBACK

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Genotype selection

Genotype	Parentage	Chilling classification
‘Royal Lynn' (RL)	Selection ‘91LA460' x ‘Royal Lee'	Low
‘Royal Tioga' (RT)	Selection ‘25Z134' (‘Bing x ‘Royal Lee') x ‘6GM73'	Low
‘Royal Hazel' (RH)	(‘Bing' x ‘Minnie Royal') Selection ‘25Z116' (‘Bing' x Unknown) x Unknown (open pollinated)	Low
‘Royal Dawn' (RD)	Selection ‘32G500' x Unknown (open pollinated)	Low/Medium
‘Sequoia' (SQ)	‘Tulare' x ‘Brooks'	Medium
‘Lapins' (LA)	‘Van' x ‘Stella'	Medium
‘Frisco' (FR)	Unknown	Medium
‘Royal Helen' (RN)	Selection ‘92LB341' (‘Bing' x ‘Royal Dawn') x Unknown (open pollinated)	High
‘Royal Edie' (RE)	Selection ‘92LB341' (‘Bing' x ‘Royal Dawn') x Unknown (open pollinated)	High
‘Sweetheart' (SH)	‘Van' and ‘New Star'	High

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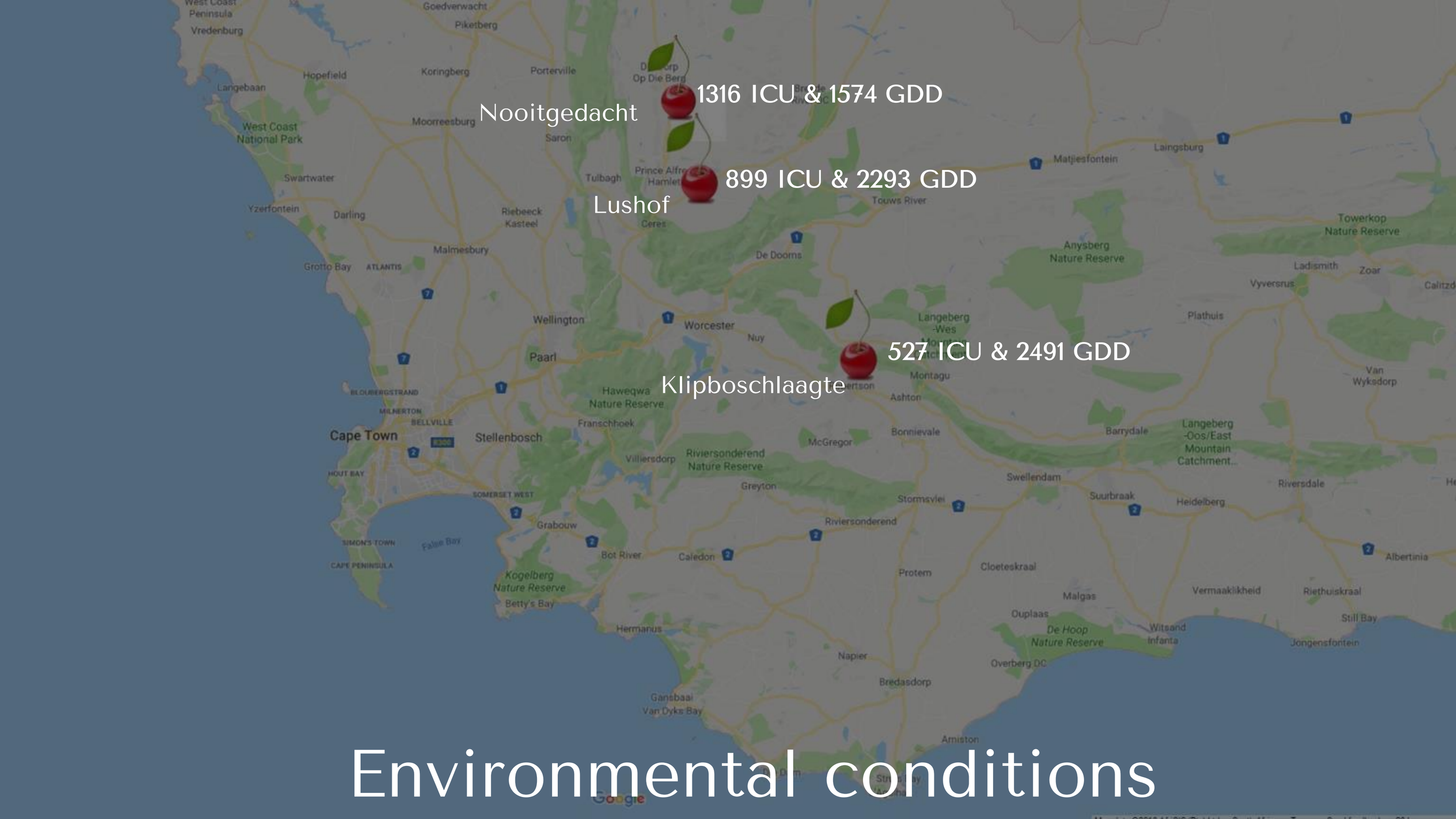

Environmental conditions

What makes an ideal cherry tree?

Minimal prolonged dormancy symptoms

Fill vertical space

Fill horizontal space

Bearing positions

Tree training and maintenance

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Tree establishment

Minimal prolonged dormancy symptoms

- High chill favours bud break, while low chill limits it
- Environment drives bud break synchronisation
- Little evidence for RBA enhance bud break (quicker but not higher)

Filling vertical space

- Not a challenge due to scion genetics or rootstock choice
- Proactive management to reduce vigour
- Dwarfing rootstocks or alternative training systems
- Warmer climate led to increased tapering = problem for central leaders

Lateral branching

- Combined genotype and environment effect
- Superior genotypes – 'Royal Hazel' and 'Sequoia'
- Scoring and Promalin® improved branching

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Bearing positions

Chill accumulation led to more spur formation

'Royal Tioga' adapted for high spur formation

Balance between increased spur formation and yield management

Tree training and maintenance

Warmer conditions requires intensive pruning

Select appropriate genotype or rootstock to reduce labour costs

Tailor training and pruning per genotype and environment

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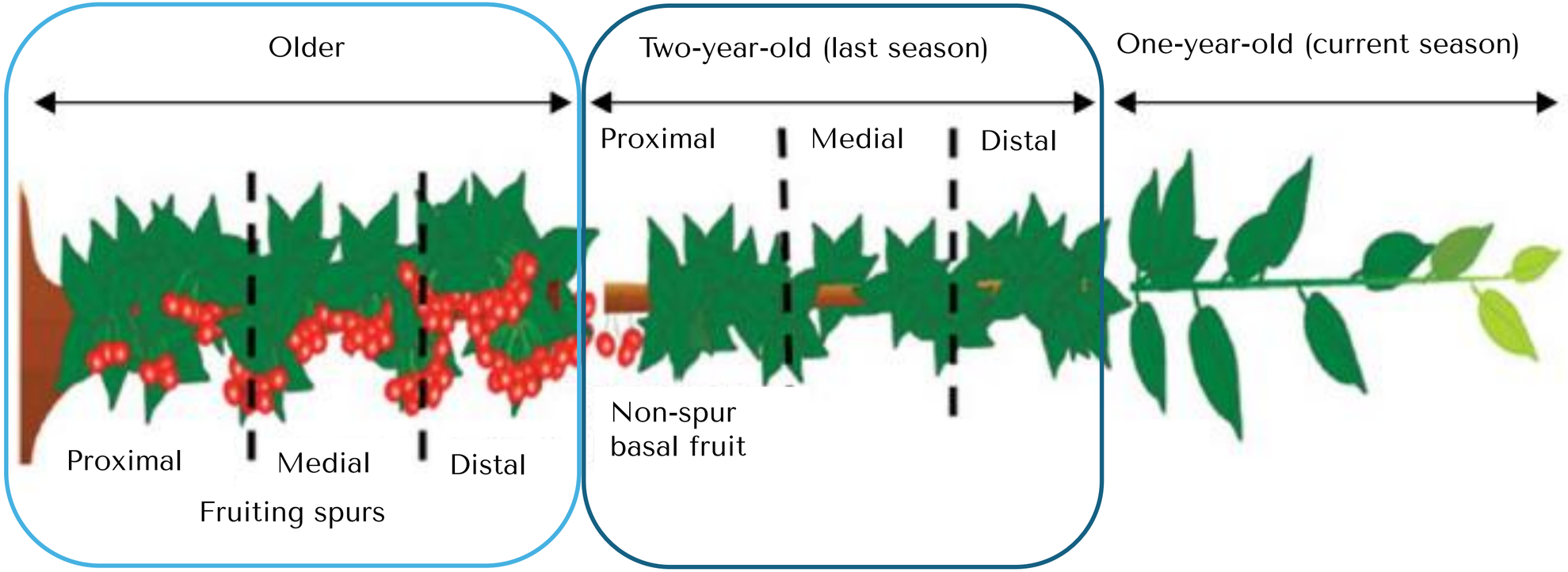
Genotype-by-environment interaction on **early yield** and its relation to **bud break dynamics** and **growth habits** of young sweet cherry (Prunus avium) trees



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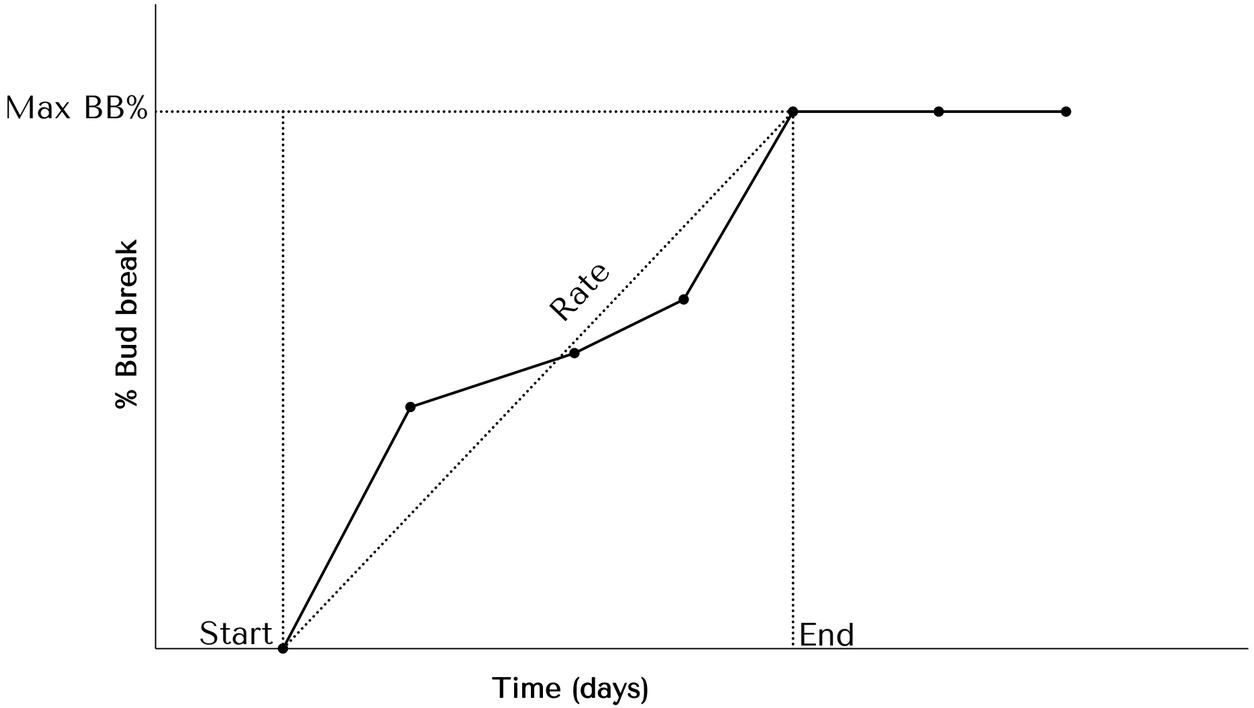
Data collection and objectives



Objectives:

1) Bud break dynamics
2) Growth habit
3) Yield **(Outcome)**

} **Early season events**

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Results

	Site	Genotype	RBA	
			Yes	No
Cluster 1	KLB	'Royal Lynn'	12	11
		'Royal Tioga'		15
		'Royal Hazel'	10	9
		'Royal Dawn'	6	5
		'Sequoia'	20	19
		'Lapins'	4	3
		'Frisco'	2	1
		'Royal Helen'	14	13
		'Royal Edie'	8	7
		'Sweetheart'	18	17
	LHF	'Royal Dawn'	26	
		'Sequoia'		**39**
		'Lapins'	24	23
	NGD	'Royal Dawn'		45
		'Frisco'		41

	Site	Genotype	RBA	
			Yes	No
Cluster 2	KLB	'Royal Tioga'	16	
	LHF	'Royal Lynn'	32	31
		'Royal Tioga'	36	35
		'Royal Hazel'	30	29
		'Royal Dawn'		25
		'Sequoia'	40	
		'Frisco'	22	21
		'Royal Helen'	34	33
		'Royal Edie'	28	27
		'Sweetheart'	38	37
	NGD	'Royal Lynn'	52	51
		'Royal Tioga'	56	55
		'Royal Hazel'	50	49
		'Royal Dawn'	46	
		'Sequoia'	60	59
		'Lapins'	44	43
		'Frisco'	42	
		'Royal Helen'	54	53
		'Royal Edie'	48	47
		'Sweetheart'	58	57

Cluster 1	Cluster 2
1 Year old shoots:	
No difference	
Bearing branches:	
Lower maximum bud break	Higher maximum bud break
Slower rate of bud break	Higher rate of bud break
High extinction	Low extinction
Limited flower positions	Ample flowering positions
Non-flowering spurs	Ample flowering spurs

Cluster	Yield (kg/tree)	Harvest position	
		Non-spur basal fruit (kg)	Fruiting spurs (kg)
1	1.35 a	0.02 ns	0.12 a
2	5.59 b	0.05	0.44 b
p-value	<0.0001	0.0620	0.0005
$LSD_{5\%}$	2.2	-	0.2

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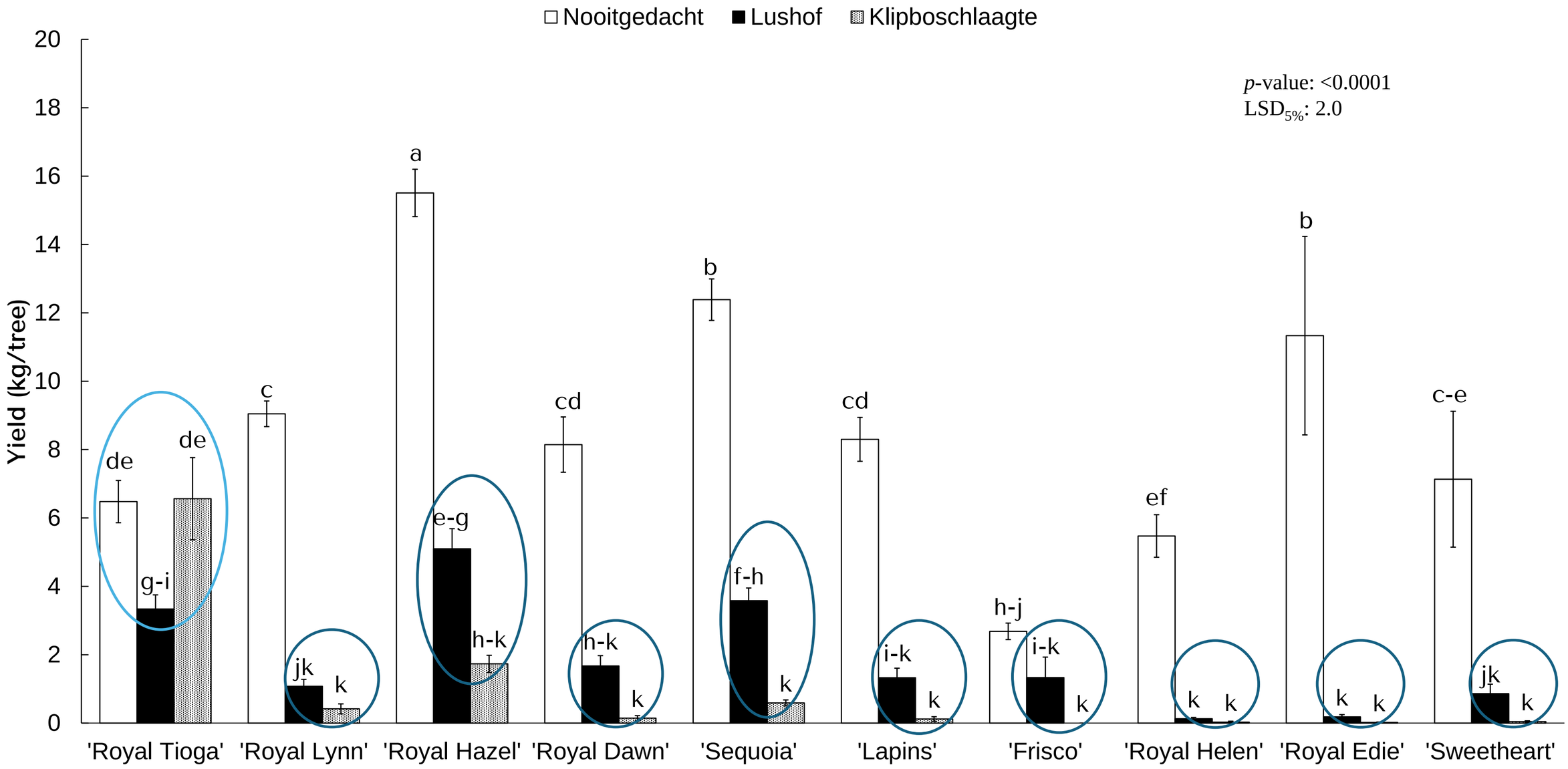
Results


Nooitgedacht
Lushof
Klipboschlaagte
p-value: <0.0001
LSD5%: 2.0
Yield (kg/tree)
0
2
4
6
8
10
12
14
16
18
20
de
g-i
de
c
jk
k
a
e-g
h-k
cd
h-k
k
b
f-h
k
cd
i-k
k
h-j
i-k
k
ef
k
k
b
k
k
c-e
jk
k
'Royal Tioga'
'Royal Lynn'
'Royal Hazel'
'Royal Dawn'
'Sequoia'
'Lapins'
'Frisco'
'Royal Helen'
'Royal Edie'
'Sweetheart'

Discussion

Warm environment

- Low yield?
  - High temperatures during late summer led to higher extinction (Smeets, 1964; Måge, 1975; Sønsteby & Heide, 2019)

Medium chill accumulation environment

- Low yield?
  - Marginal conditions impacted fertilisation, pollination and fruit set (Sanzol & Herrero, 2001; Hedhly et al., 2003; Hedhly et al., 2004; Sheard, 2008)

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Conclusions

Environmental limitations

- Environment dictates market window (genotype choice)
- Climate change adaptation
- Low chill challenges vs early market access
- Warm Bokkeveld as promising alternative
  - Investigate low yields despite bud break/flowering
- High chill favours reproductive potential

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Conclusions

GEI complicates genotype selection

- GEI in all years of the trial
- Science based recommendations
- ‘Royal Tioga’, ‘Royal Hazel’ and ‘Sequoia’
- No single superior genotype
- Genotype adaptability index = unlock full genetic potential

Future research (PHEPP)

- New rootstocks = vigour, yield efficiency and fruit quality
- Pollination and fertilisation (priority)
- Rain induced cracking & fruit doubling

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Acknowledgements

DUTOIT
DEDICATION ALWAYS SHOWS

graaff fruit
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HORTGRO
cherries

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Western Cape Government
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