

The impact of overhead protection and irrigation level on table grape quality of *Vitis vinifera* L. ‘Sultanina H5’ in a semi-arid summer rainfall region of South Africa - at harvest and after post-harvest cold storage

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Introduction

- ▶ This study followed a field trial
 - ▶ conducted over two seasons
 - ▶ to determine the effect of overhead nets on water use of non-stressed table grape vineyards in the Orange River region.

Aim

To establish the impact of

- ▶ overhead protection with nets and plastic covering,
- ▶ combined with three irrigation levels
 - ▶ on table grape quality at harvest and post-harvest



Material and methods

Experimental Vineyards

Location	Newgro, Kanoneiland, Orange River region
Cultivar/Rootstock	Sultanina H5/Ramsey
Trellis system	Pergola
Spacing	3.0 m x 2.5 m
Viticultural treatments	
• Thinning	GA ₃
• Sizing	GA ₃ and Girdling

- ▶ Vineyard managed by the farm
 - ▶ Viticultural practices
 - ▶ Irrigation application
 - ▶ Plastic management

Three trials in 5 ha blocks – each trial consisted of 13 rows

Without nets	With nets	With Nets plus plastic
Plastic installation		
Just before harvest (if rain is expected)	Veraison	Between bud break and before flowering
Removal of plastic – just after harvest		

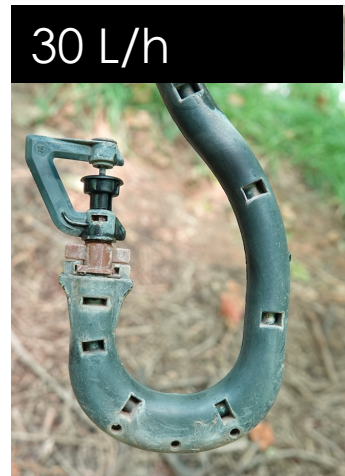
Experimental Lay-out

Design	Randomized block
Treatments	3
Replications	7

Material and methods

Irrigation treatments in each trial site

Treatments	Code	Microjet delivery rate (L/h)
Control	T100	50
20% ↓	T100-20	40
40% ↓	T100-40	30



Example of two irrigation plots (one replicate)

Row Number	Vine number														
	13	1	2	3	4	5	6	7	8	9	10	11	12	13	14
12	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
9	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
7	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Centre row

middle 2 vines = data vines
 2 buffer vines right around data vines

Material and Methods:

Statistical procedures

Plant-based measurements

- ▶ Analysis of variance with Genstats for Windows 22nd Edition
(VSN International, Hemel Hempstead, UK. Web page: Genstat.co.uk)
- ▶ Shapiro & Wilk test to test normality (Shapiro & Wilk, 1965)
- ▶ Student's t-test of least significant difference (5% level) to compare treatment means.

Material and Methods-

Vegetative and reproductive measurements:

- ▶ **Vegetative :**
 - ▶ Cane mass
- ▶ **Reproductive :**
 - ▶ Fertility assessment
 - ▶ Bunch mass
 - ▶ Berry mass
 - ▶ Total soluble solids (TSS)
 - ▶ The titratable acid (TA)
 - ▶ Berry cracking field
- ▶ Macro-climate data obtained from Newgro AWS, 100 m from trials



Effect of storage and time of cold storage on grape quality after cold storage

Seasons (average of 3 seasons)

Cold storage: (2020/21 - 4 weeks at 0.5°C + 1 week at 7.5 °C) 7/2
(2021/22 - 4 weeks at 0.5°C + 1 week at 7.5 °C) 24/2
(2022/23 - 5 weeks at 0.5°C + 0 weeks at 7.5 °C) 14/3

Time in cold storage (2022/23) Oesdatum:3/1/2023

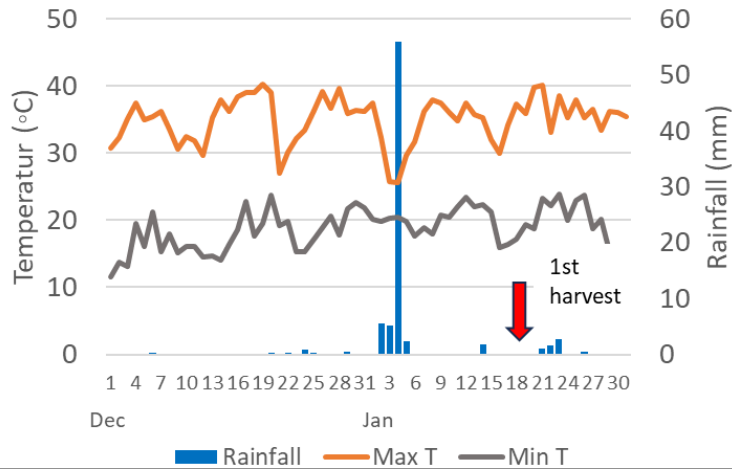
Cold storage: (5 weeks at 0.5°C + 0 weeks at 7.5 °C) 7/2
(8 weeks at 0.5°C + 0 weeks at 7.5 °C) 24/2
(11 weeks at 0.5°C + 0 weeks at 7.5 °C) 14/3

Packing material: 54x4 mm perforated LDPE liner
+ Uvasys® SO₂ generator sheet

Results

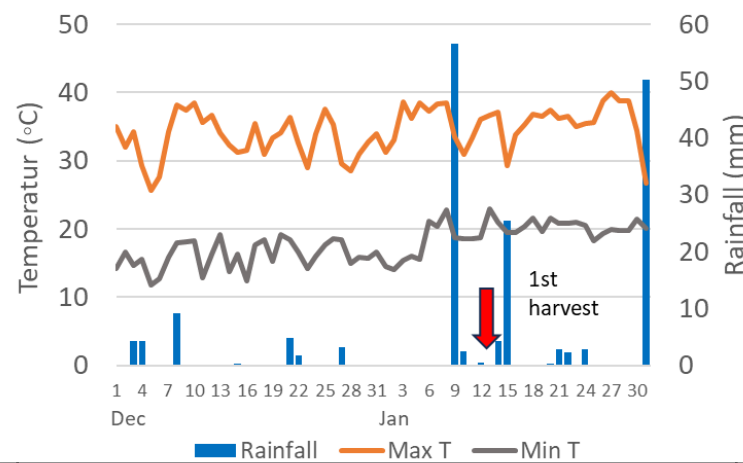
Average of 3 seasons

Climate conditions



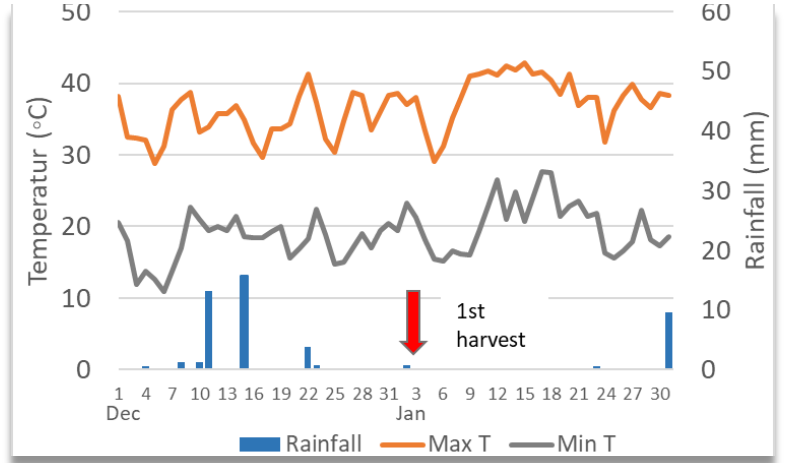
2020/21 season

Trial site Without Nets were not covered with plastic



2021/22 season

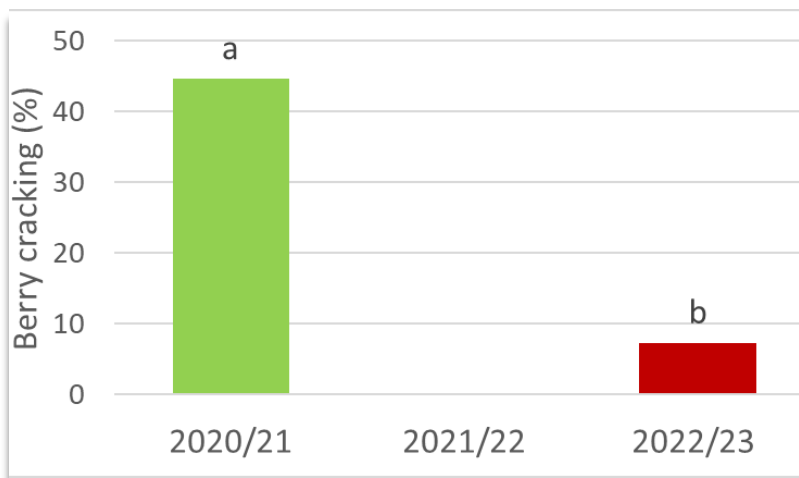
All trials were covered before harvest with plastic at different times



2022/23 season

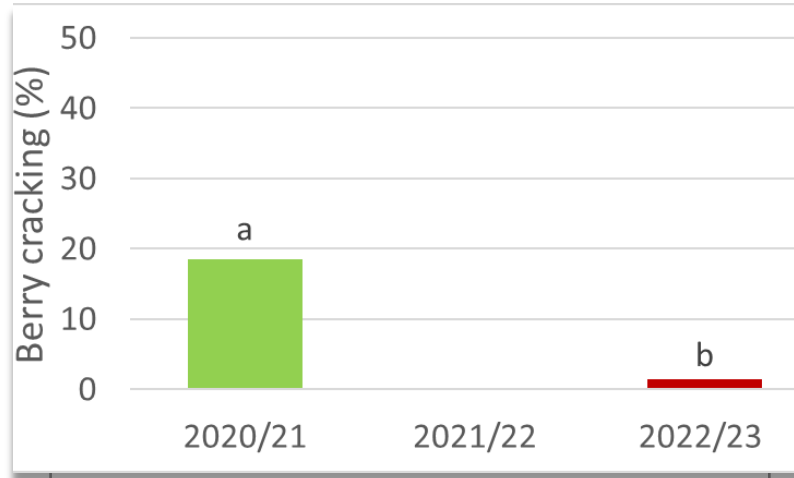
All trials were covered before harvest with plastic at different times

Field berry cracking: Seasons



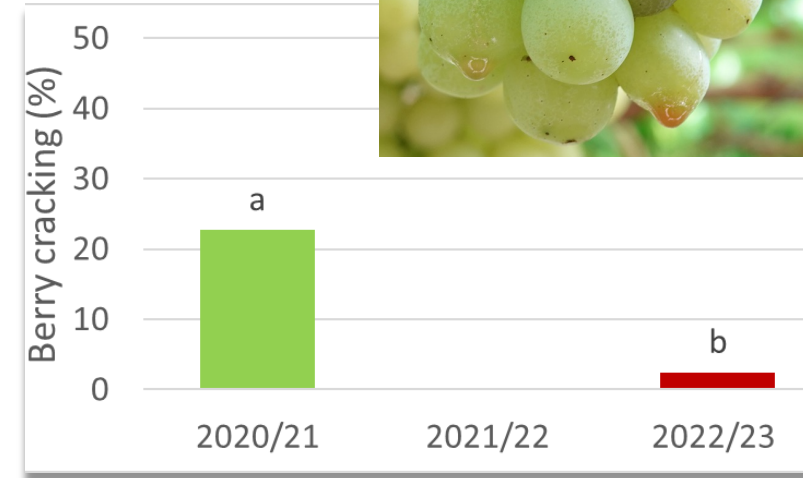
Without Nets

Factors	P-value
Irrigation treatment (I)	0.001
Season (S)	<.001
I x S Interaction	0.001



With nets

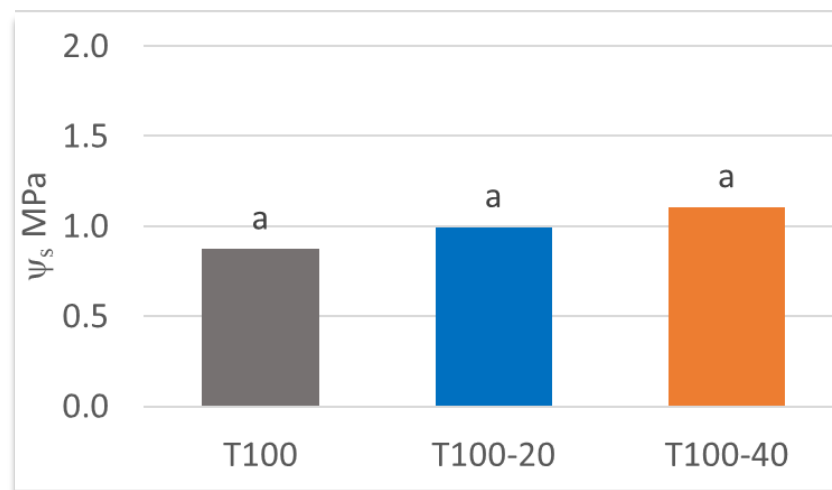
Factors	P-value
Irrigation treatment (I)	0.035
Season (S)	<.001
I x S Interaction	0.013



With nets plus Plastic

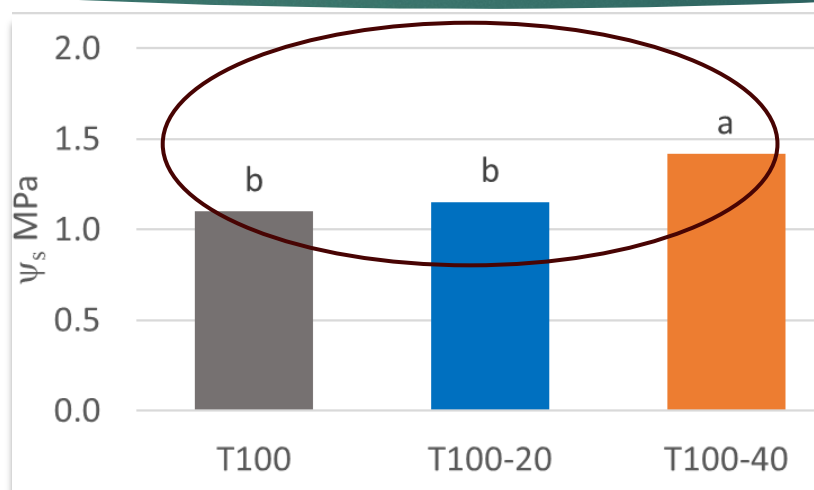
Factors	P-value
Irrigation treatment (I)	0.016
Season (S)	<.001
I x S Interaction	<.001

Midday stem water potential ($-\Psi_s$)



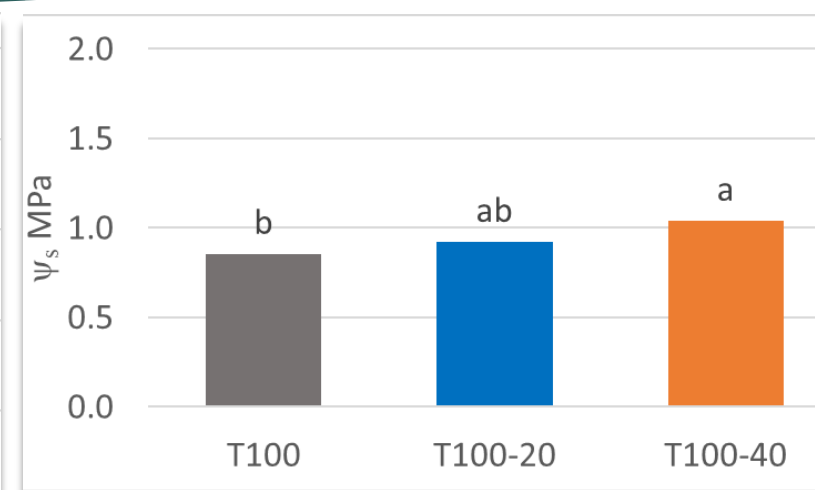
Without nets

Factors	P-value
Irrigation treatment (I)	0.162
Season (S)	0.010
I x S Interaction	0.379



With nets

Factors	P-value
Irrigation treatment (I)	0.002
Season (S)	0.073
I x S Interaction	0.660



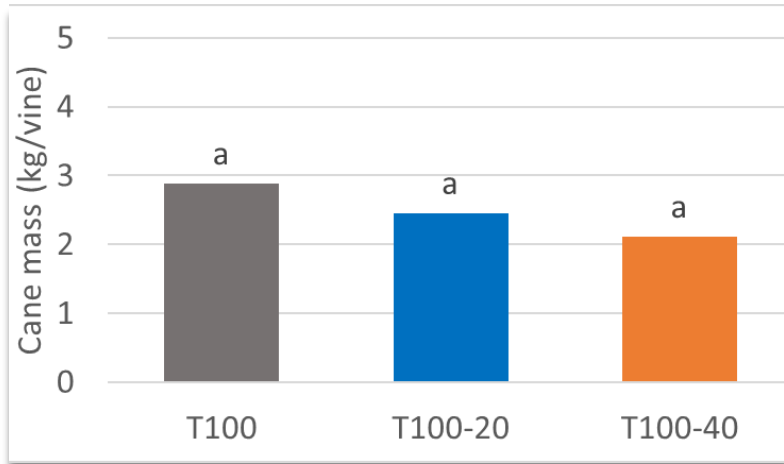
With nets plus plastic

Factors	P-value
Irrigation treatment (I)	0.058
Season (S)	0.533
I x S Interaction	0.355

Water constraint classification according to midday Ψ_s for table grape production (Myburgh & Howell (2022):

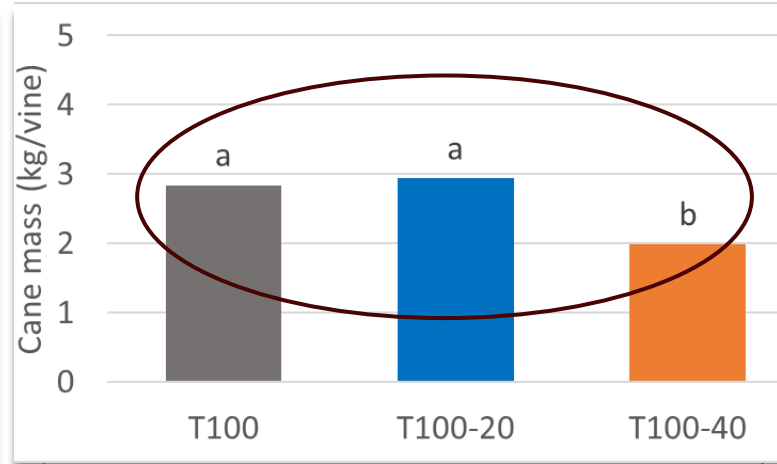
none ($\Psi_s > -0.6$ MPa), weak ($-0.6 \geq \Psi_s > -0.8$ MPa), moderate ($-0.8 \geq \Psi_s > -1.0$ MPa), strong ($-1.0 \geq \Psi_s > -1.2$ MPa) and severe ($\Psi_s \leq -1.2$ MPa).

Cane mass



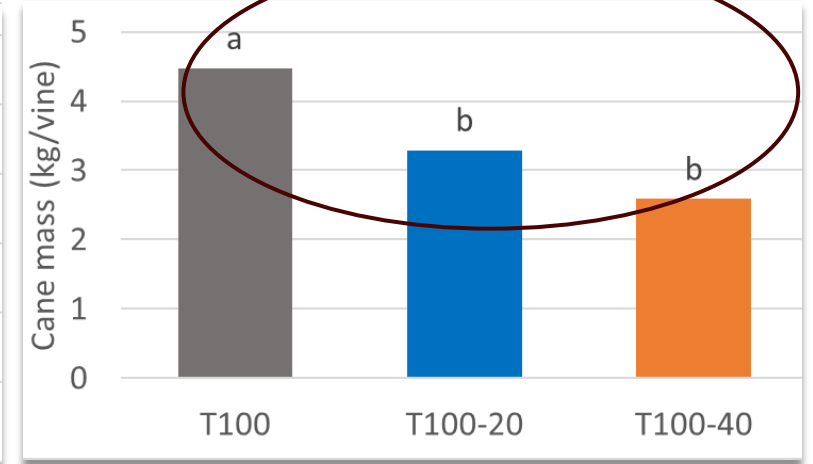
Without nets

Factors	P-value
Irrigation treatment (I)	0.215
Season (S)	0.001
I x S Interaction	0.120



With nets

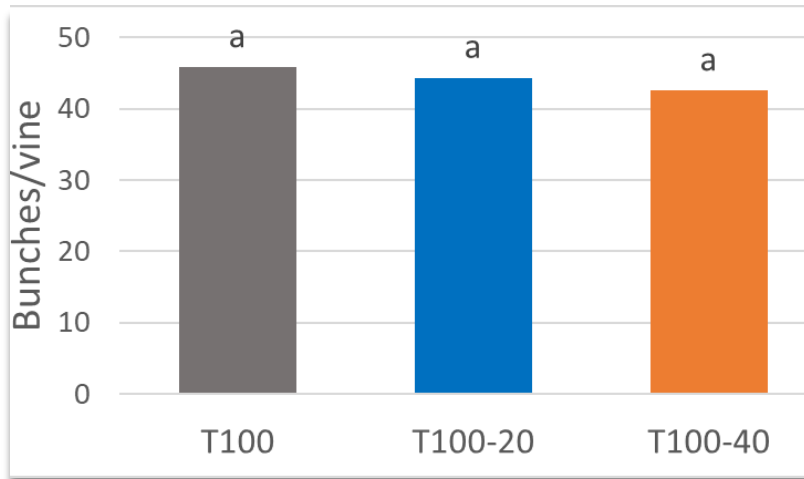
Factors	P-value
Irrigation treatment (I)	0.016
Season (S)	<0.001
I x S Interaction	0.627



With nets plus plastic

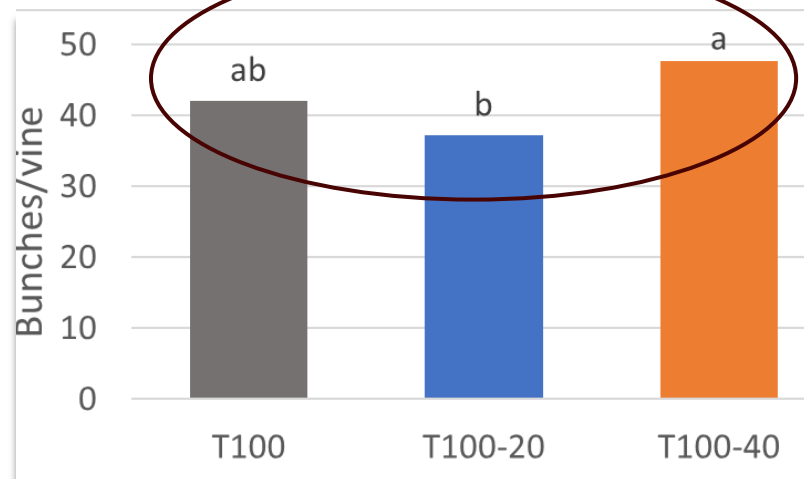
Factors	P-value
Irrigation treatment (I)	0.004
Season (S)	0.002
I x S Interaction	0.062

Bud fertility



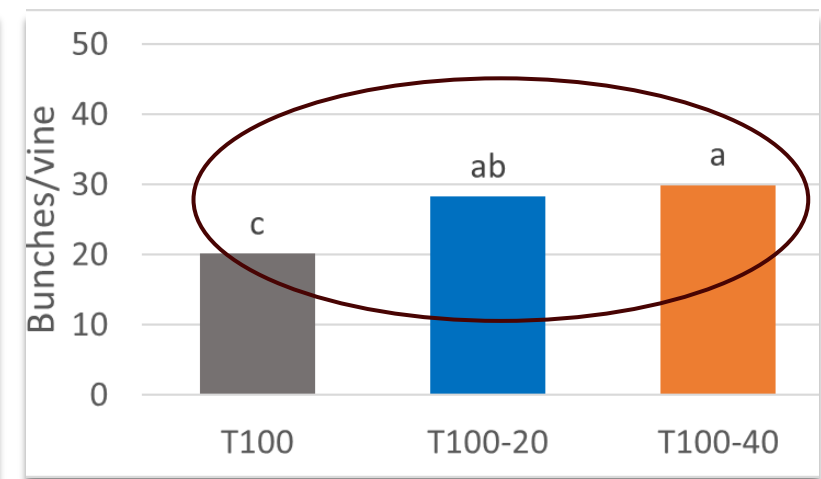
Without nets

Factors	P-value
Irrigation treatment (I)	0.619
Season (S)	<0.001
I x S Interaction	0.229



With nets

Factors	P-value
Irrigation treatment (I)	0.044
Season (S)	<0.001
I x S Interaction	0.776



With nets plus plastic

Factors	P-value
Irrigation treatment (I)	0.048
Season (S)	<0.001
I x S Interaction	0.005

Irrigation treatments ↓

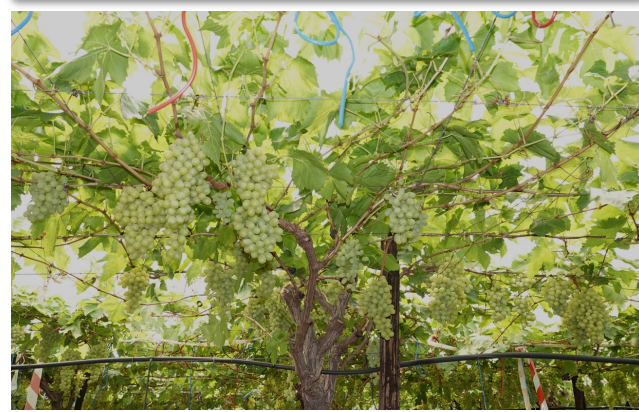
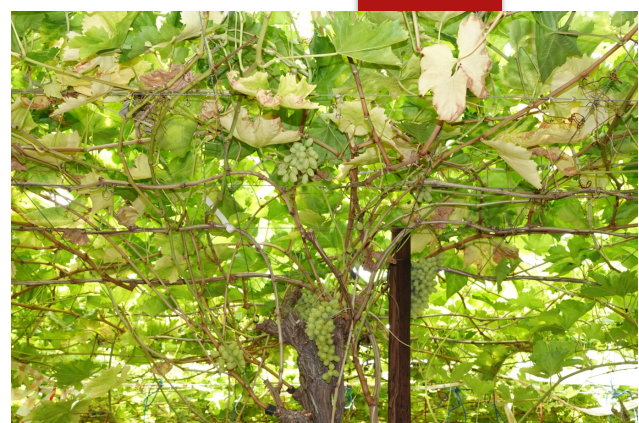
T100

T100-20

T100-40

Trials →

Bud fertility

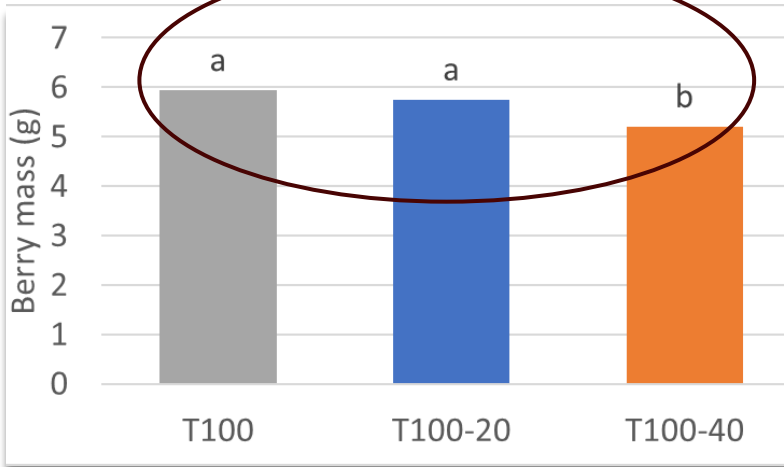


Without nets

With nets

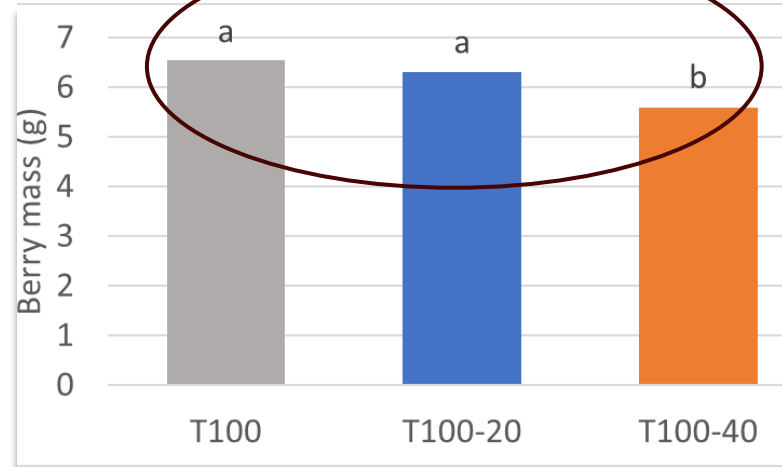
With nets plus plastic

Berry mass



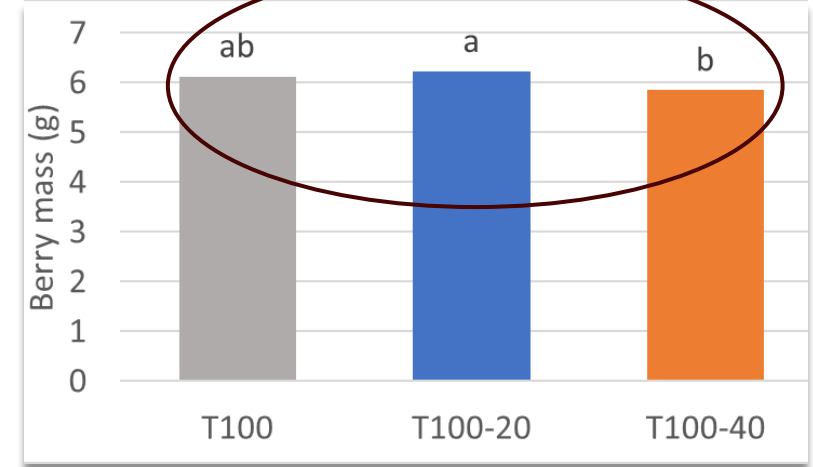
Without nets

Factors	P-value
Irrigation treatment (I)	0.001
Season (S)	<0.001
I x S Interaction	0.018



With nets

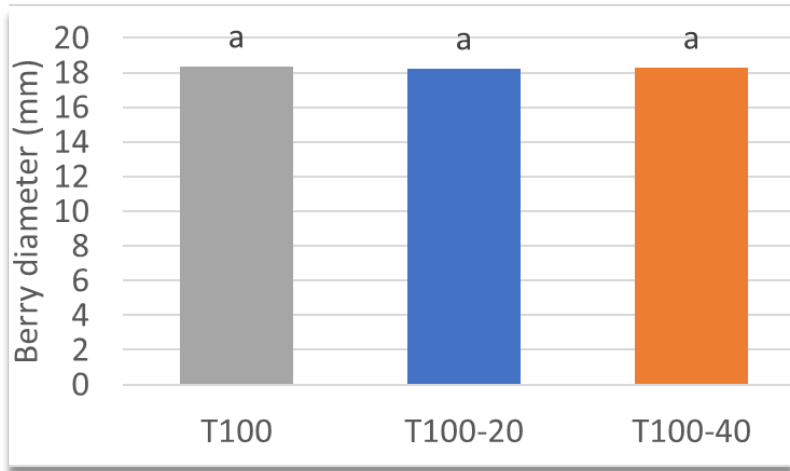
Factors	P-value
Irrigation treatment (I)	0.002
Season (S)	<0.001
I x S Interaction	0.009



With nets plus plastic

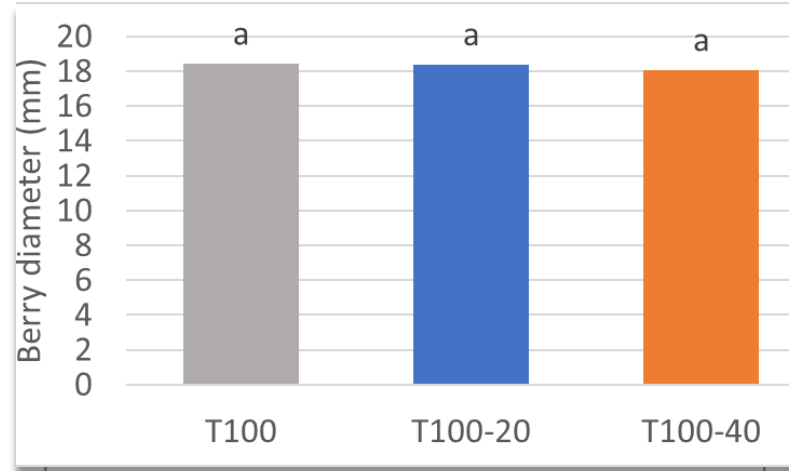
Factors	P-value
Irrigation treatment (I)	0.086
Season (S)	<0.001
I x S Interaction	0.619

Berry diameter



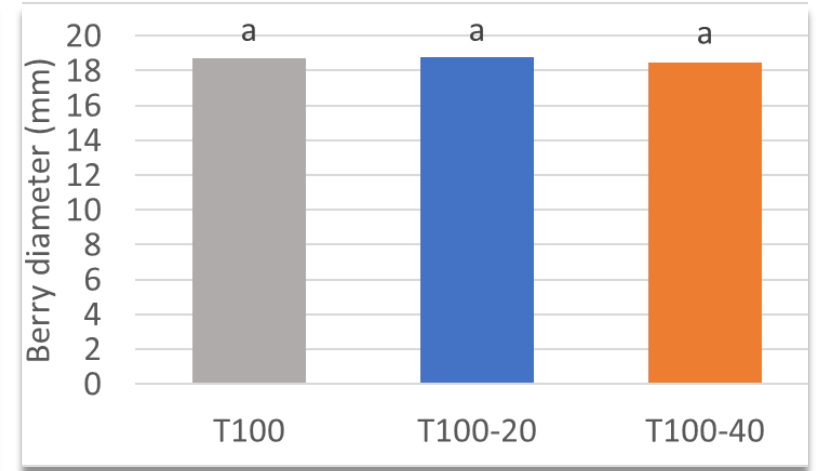
Without Nets

Factors	P-value
Irrigation treatment (I)	0.872
Season (S)	<0.001
I x S Interaction	0.018



With nets

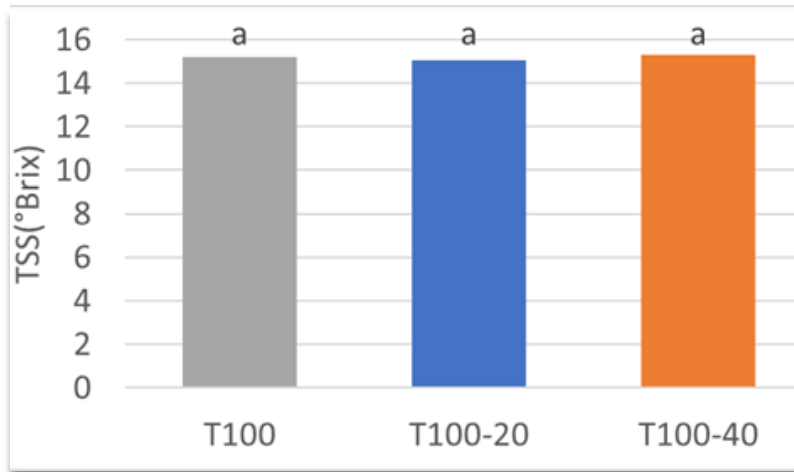
Factors	P-value
Irrigation treatment (I)	0.586
Season (S)	0.082
I x S Interaction	0.353



With nets plus Plastic

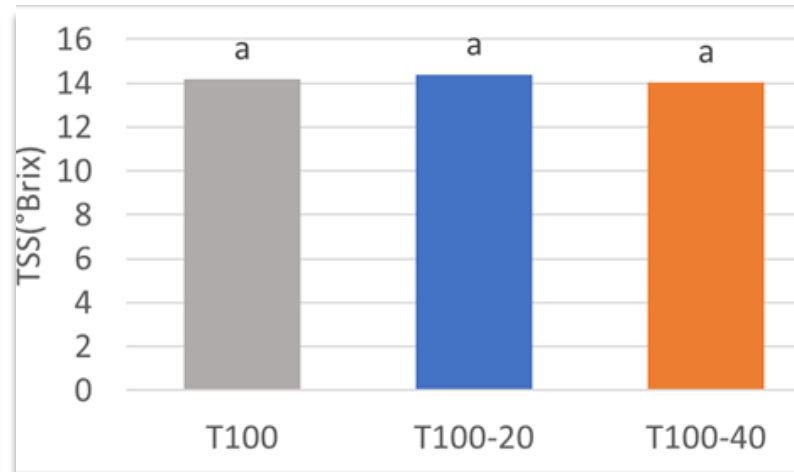
Factors	P-value
Irrigation treatment (I)	0.212
Season (S)	0.011
I x S Interaction	0.114

TSS



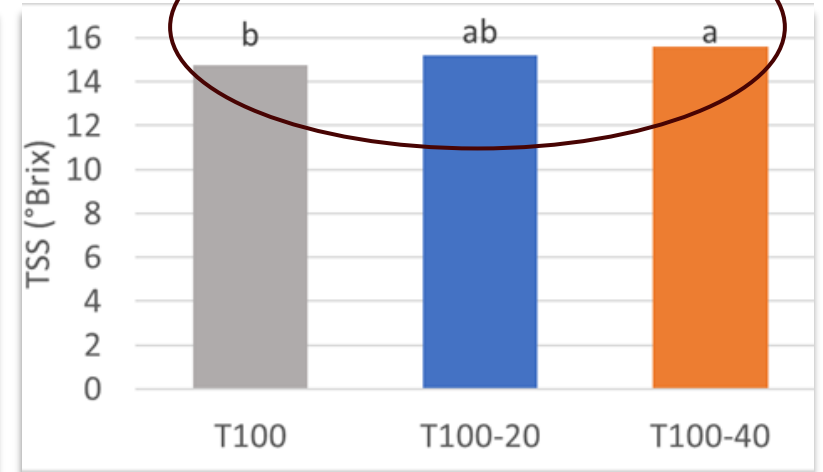
Without nets

Factors	P-value
Irrigation treatment (I)	0.810
Season (S)	0.003
I x S Interaction	0.636



With nets

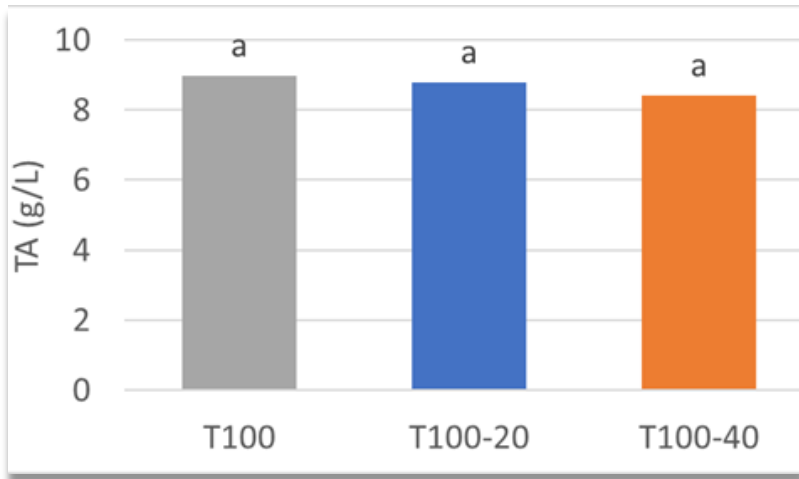
Factors	P-value
Irrigation treatment (I)	0.586
Season (S)	<0.001
I x S Interaction	0.173



With nets plus plastic

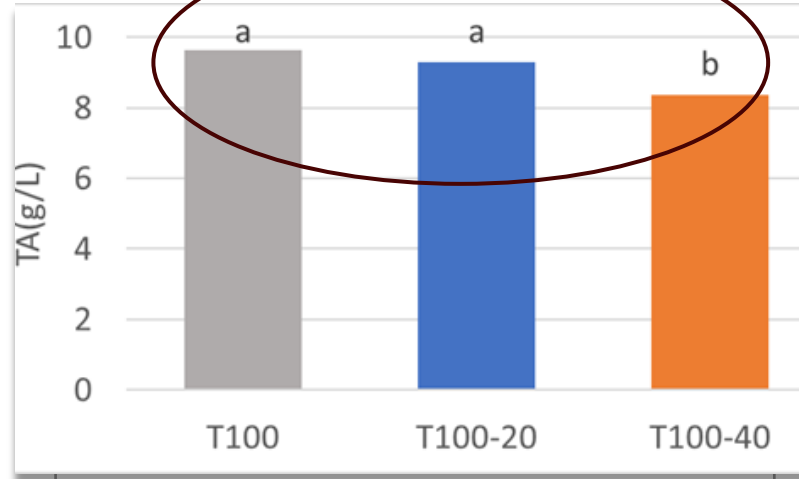
Factors	P-value
Irrigation treatment (I)	0.057
Season (S)	<0.001
I x S Interaction	0.197

TA



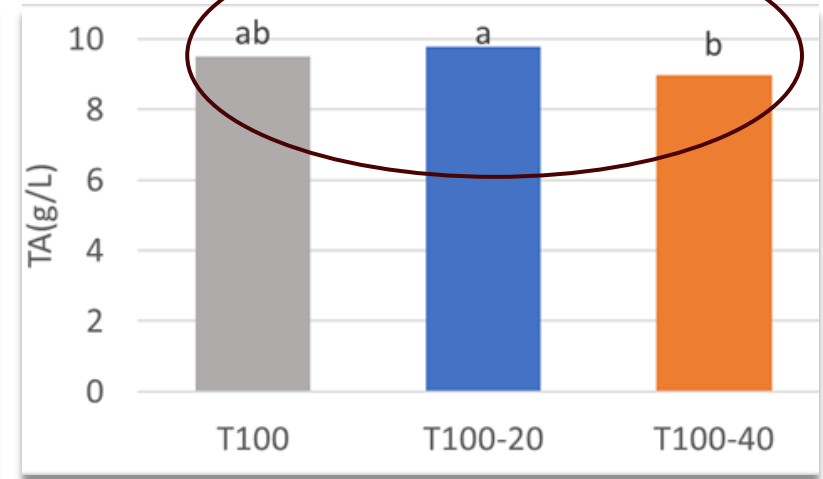
Without Nets

Factors	P-value
Irrigation treatment (I)	0.172
Season (S)	<0.001
I x S Interaction	0.738



With nets

Factors	P-value
Irrigation treatment (I)	<0.001
Season (S)	<0.001
I x S Interaction	0.860



With nets plus Plastic

Factors	P-value
Irrigation treatment (I)	0.080
Season (S)	<0.001
I x S Interaction	<0.001

Irrigation treatments ↓

T100

T100-20

T100-40

Trials →

Grape quality

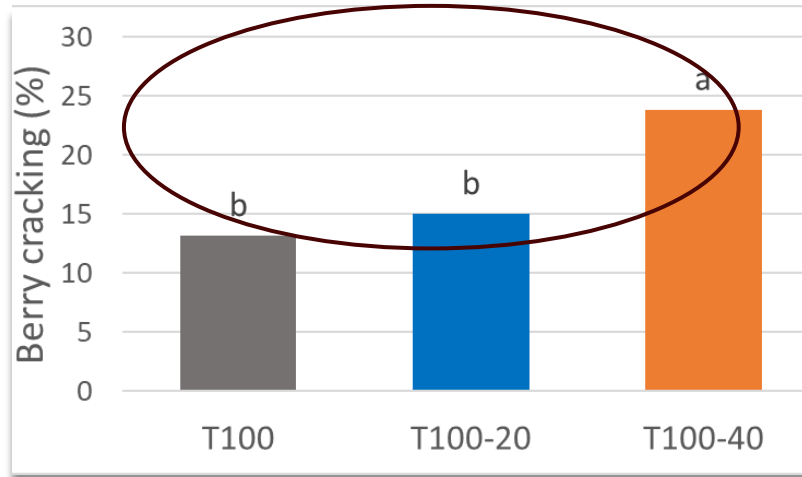


Without nets

With nets

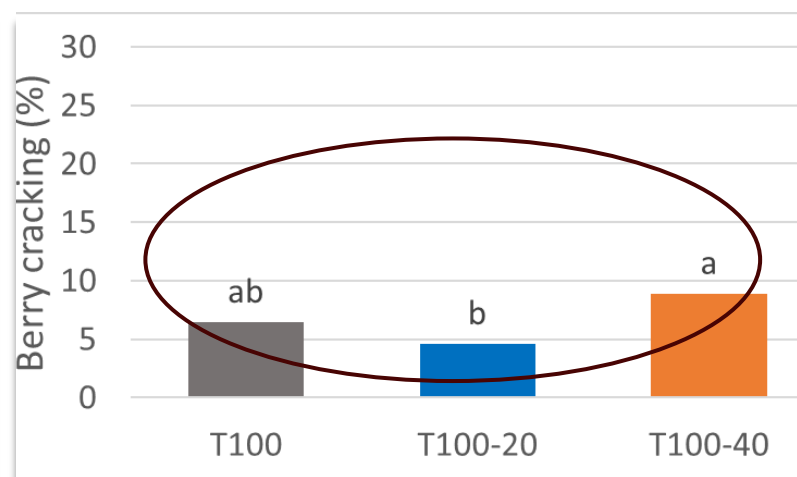
With nets plus plastic

Field berry cracking: Irrigation treatments (average of 2 seasons)



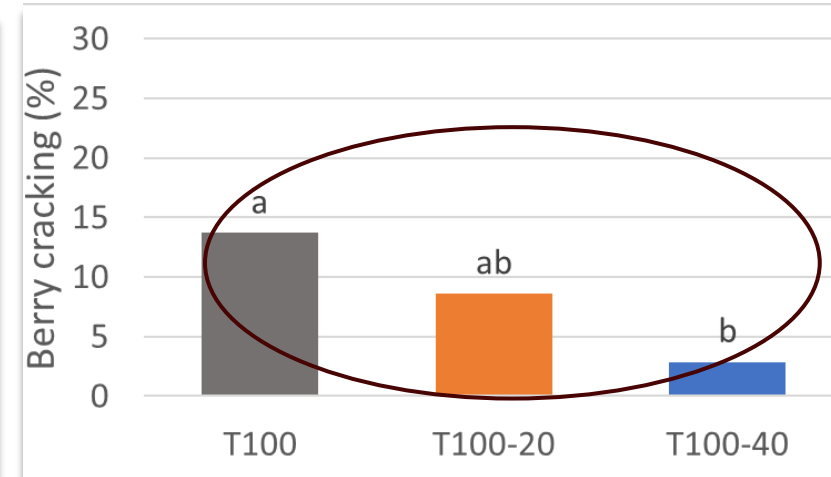
Without nets

Factors	P-value
Irrigation treatment (I)	0.001
Season (S)	<.001
I x S Interaction	0.001



With nets

Factors	P-value
Irrigation treatment (I)	0.035
Season (S)	<.001
I x S Interaction	0.013



With nets plus plastic

Factors	P-value
Irrigation treatment (I)	0.016
Season (S)	<.001
I x S Interaction	<.001

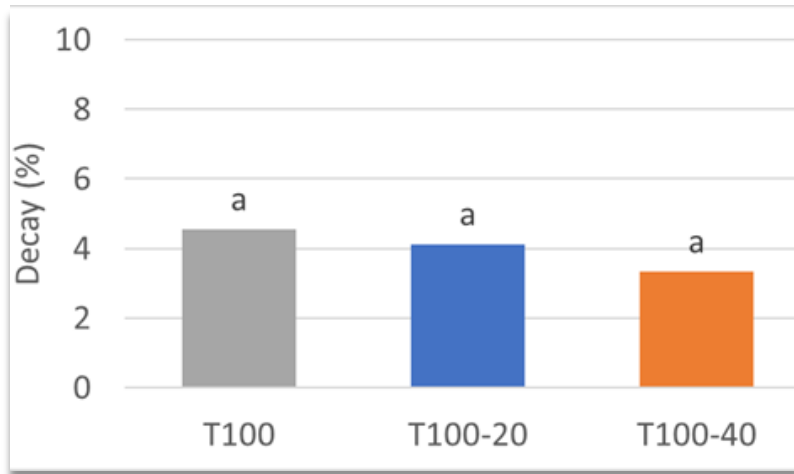
Quality after post-harvest cold storage

Average of 3 seasons

- ▶ 2020/21 - 4 weeks at 0.5°C + 1 week at 7.5 °C
- ▶ 2021/22 - 4 weeks at 0.5°C + 1 week at 7.5 °C)
- ▶ 2022/23 - 5 weeks at 0.5°C + 0 weeks at 7.5 °C)

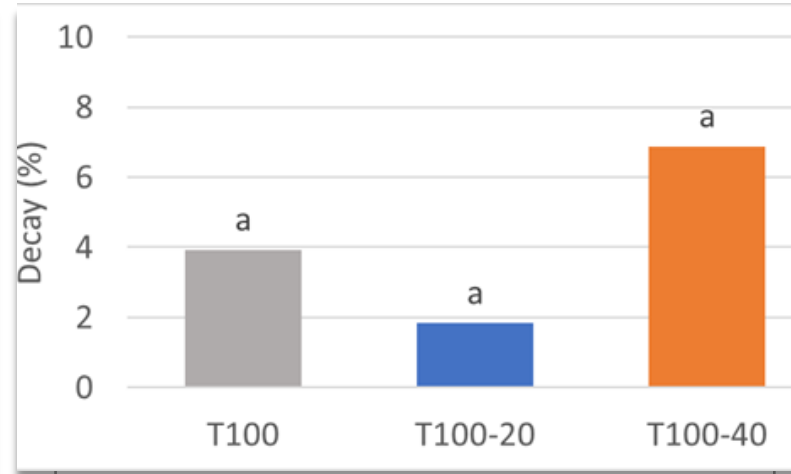


Decay



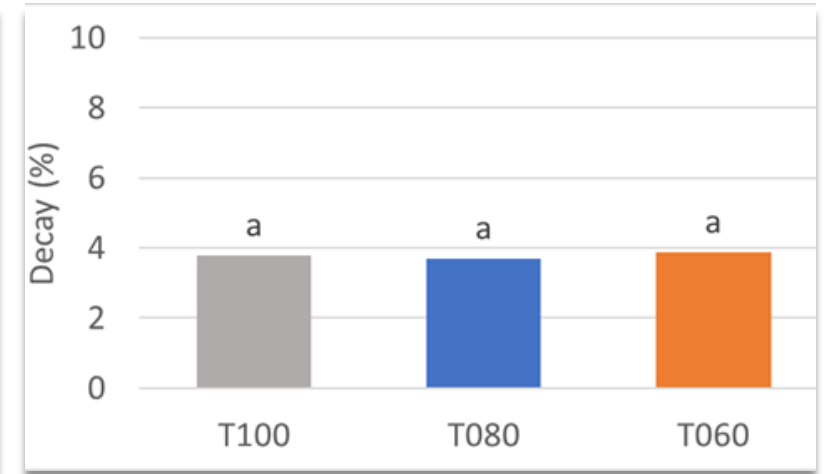
Without nets

Factors	P-value
Irrigation treatment (I)	0.531
Season (S)	<0.001
I x S Interaction	0.386



With nets

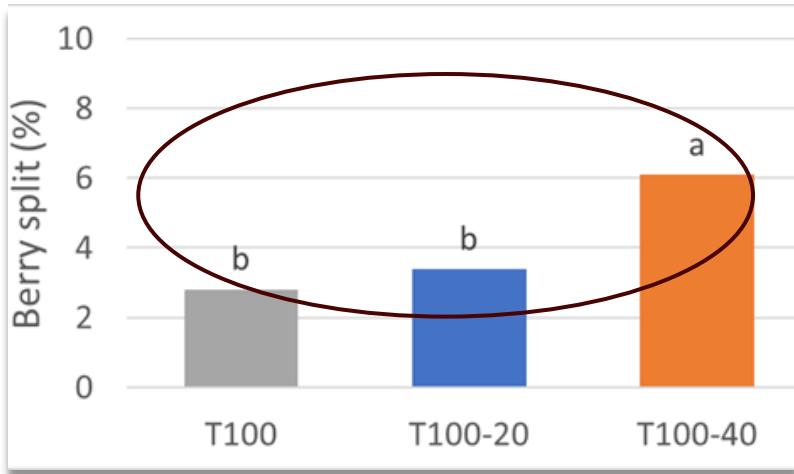
Factors	P-value
Irrigation treatment (I)	0.024
Season (S)	<0.001
I x S Interaction	0.235



With nets plus Plastic

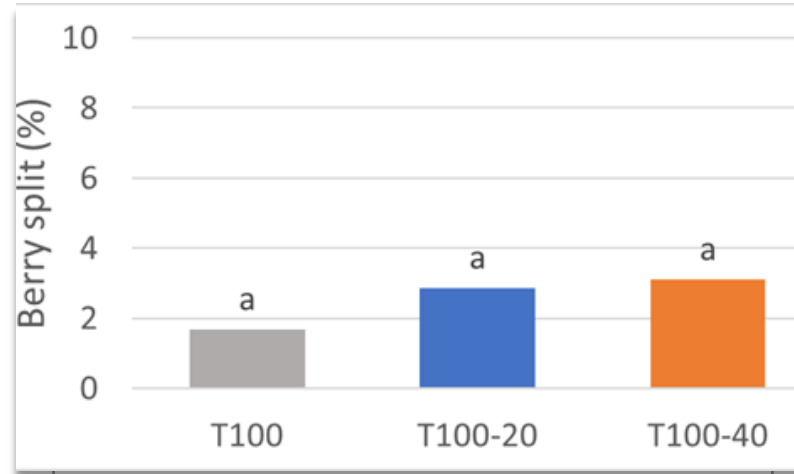
Factors	P-value
Irrigation treatment (I)	0.996
Season (S)	<0.001
I x S Interaction	0.765

Berry cracking



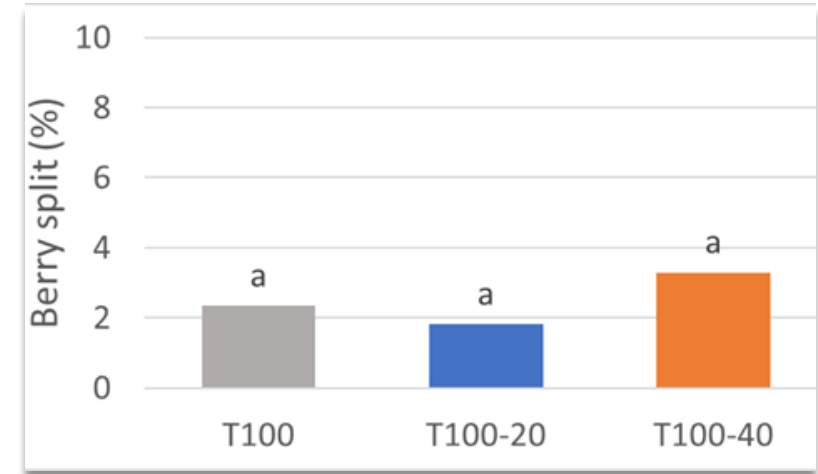
Without nets

Factors	P-value
Irrigation treatment (I)	0.024
Season (S)	<0.001
I x S Interaction	0.235



With nets

Factors	P-value
Irrigation treatment (I)	0.352
Season (S)	<0.001
I x S Interaction	0.126



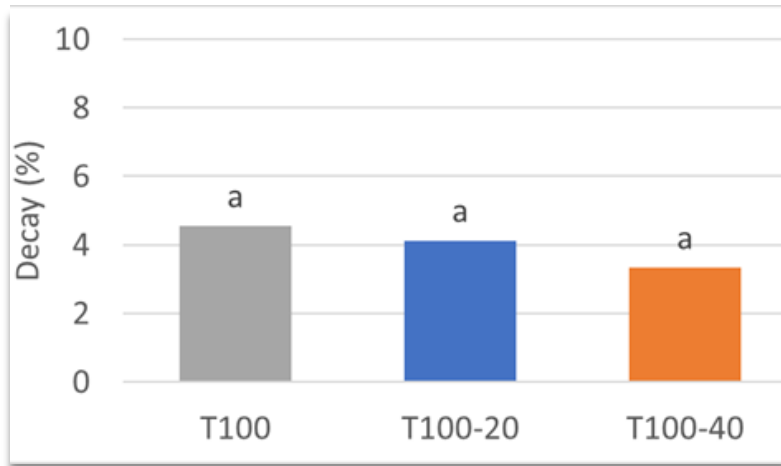
With nets plus Plastic

Factors	P-value
Irrigation treatment (I)	0.395
Season (S)	0.061
I x S Interaction	0.698

Post-harvest cold storage period

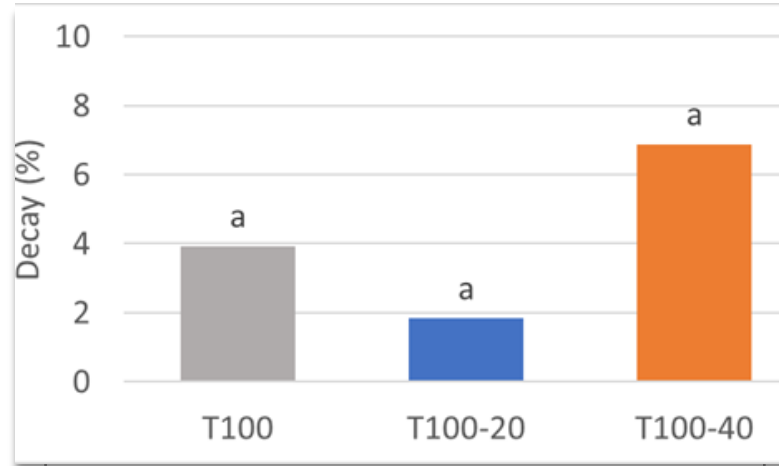
2022/23 season

Decay



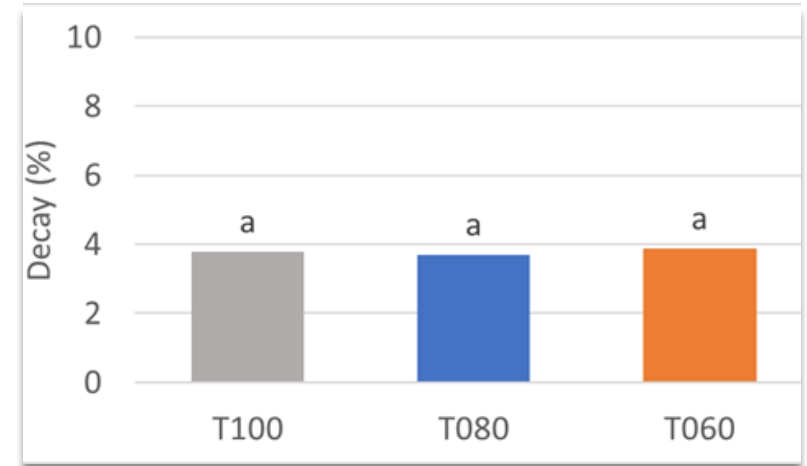
Without nets

Factors	P-value
Irrigation treatment (I)	0.821
Week (W)	<0.001
I x W Interaction	0.885



With nets

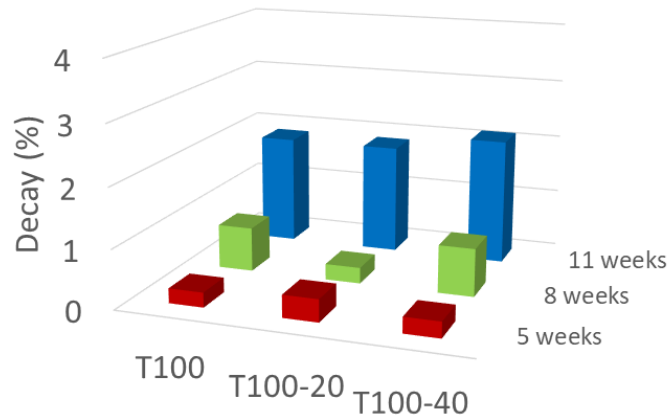
Factors	P-value
Irrigation treatment (I)	0.507
Week (W)	<0.001
I x W Interaction	0.999



With nets plus plastic

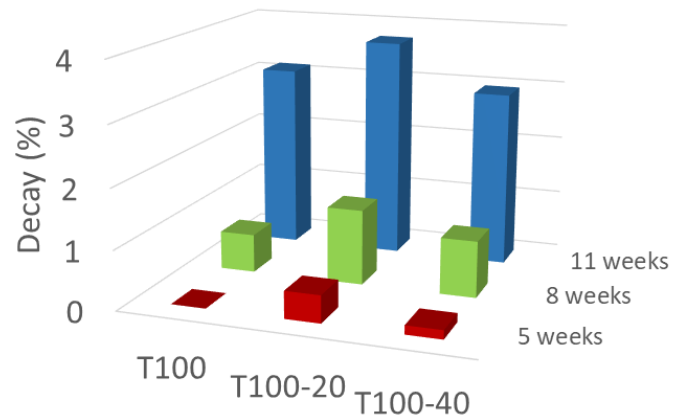
Factors	P-value
Irrigation treatment (I)	0.690
Week (W)	0.002
I x W Interaction	0.812

Decay



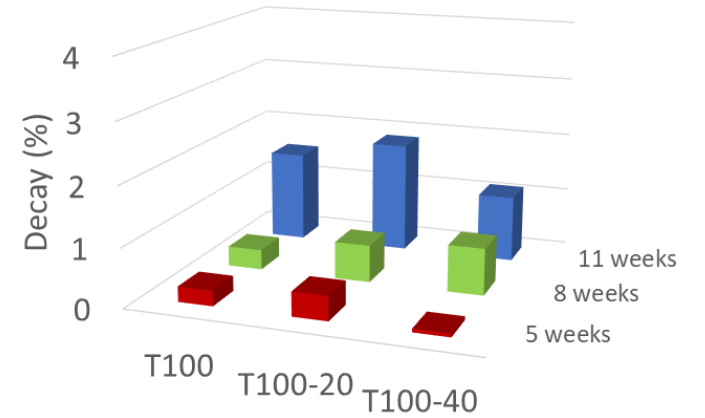
Without nets

Factors	P-value
Irrigation treatment (I)	0.821
Week (W)	<0.001
I x W Interaction	0.885



With nets

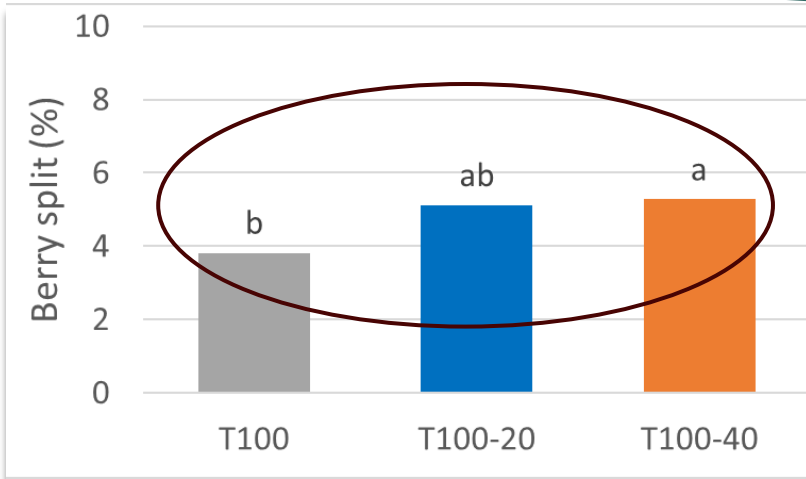
Factors	P-value
Irrigation treatment (I)	0.507
Week (W)	<0.001
I x W Interaction	0.999



With nets plus plastic

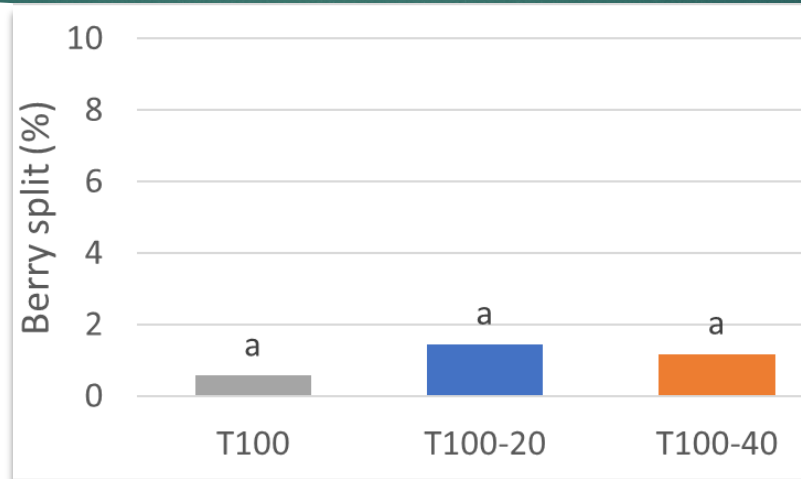
Factors	P-value
Irrigation treatment (I)	0.690
Week (W)	0.002
I x W Interaction	0.812

Berry cracking



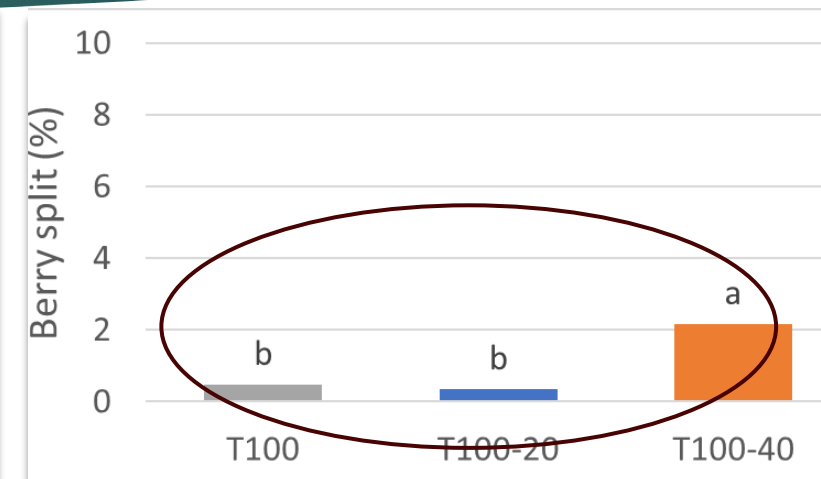
Without nets

Factors	P-value
Irrigation treatment (I)	0.055
Week (W)	0.058
I x W Interaction	0.306



With nets

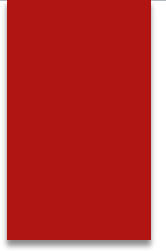
Factors	P-value
Irrigation treatment (I)	0.444
Week (W)	0.045
I x W Interaction	0.293



With nets plus plastic

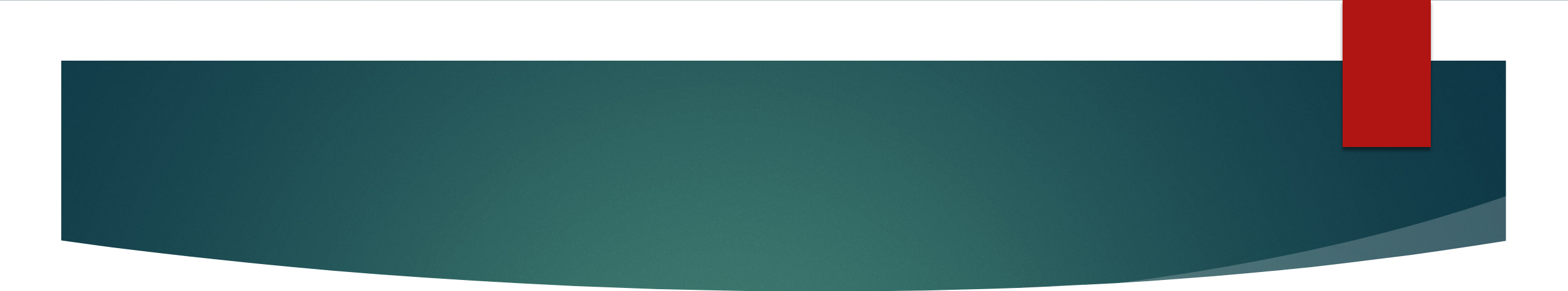
Factors	P-value
Irrigation treatment (I)	0.056
Week (W)	0.071
I x W Interaction	0.076

Summary and recommendations



Summary

- ▶ Cane mass was significantly higher for the T100 and the T100-20 treatments in the With Nets and With Nets+Plastic trials, indicating stronger vegetative growth,
- ▶ Fertility showed a decreasing trend associated with T100 and T100-20.
- ▶ Berry mass of T100-40 was significantly lower in the Open and With Nets trials, while there were no significant differences in the With Nets+Plastic trials.
- ▶ Berry diameter did not differ significantly between irrigation treatments in all three trials.
- ▶ Except for T100 of With Nets+Plastic, where TSS was significantly lower compared to T100-40, no other significant differences regarding TSS were found.

- 
- ▶ In all three trials, decay and berry cracking after post-harvest cold storage did not differ significantly between irrigation treatments.
 - ▶ With the T100-20 treatment, 20% less irrigation was applied without negatively impacting berry mass and TSS at harvest and quality after post-harvest cold storage.
 - ▶ T100-20 should be evaluated further on a semi-commercial scale.

Acknowledgements



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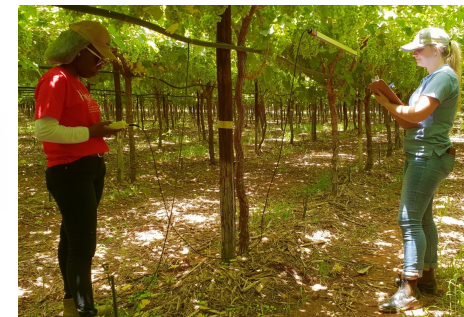
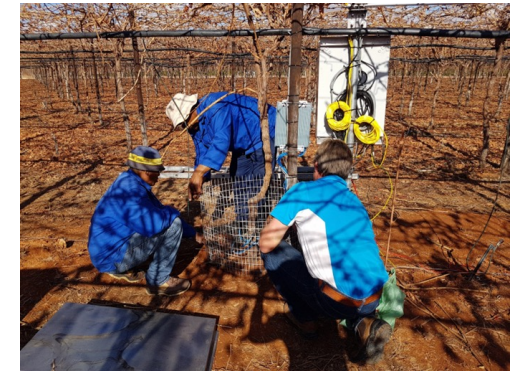
Department:
agriculture, land reform & rural development
NORTHERN CAPE PROVINCE
REPUBLIC OF SOUTH AFRICA

- **Project funding**

- Dept of Agriculture, Land Reform and Rural Development, Northern Cape

- **Technical support**

- Karsten Boerdery
 - Newgro team (Cobus Kies, Brandon Plaatjies)
- ARC Infruitec-Nietvoorbij Viticulture (Upington team)
- SU DVO Viticulture Table grape students



Thank you
Enkosi
Dankie

