

Effect of temperature and humidity during on-farm storage of pecan nuts (*Carya illinoensis* (Wangenh) K. Koch)



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UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
VRYSTAAT
YUNIVESITHI YA
FREISTATA



Honors Project

2023-2024

Sponsored by SAPPA and UFS

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Introduction

- On farm post-harvest handling
- Differ from farm to farm
- Stockpiling
 - storage methods
 - storage conditions
- Quality of nuts



Introduction

- Open
- Bulk
- Bags
- Crates/ bins



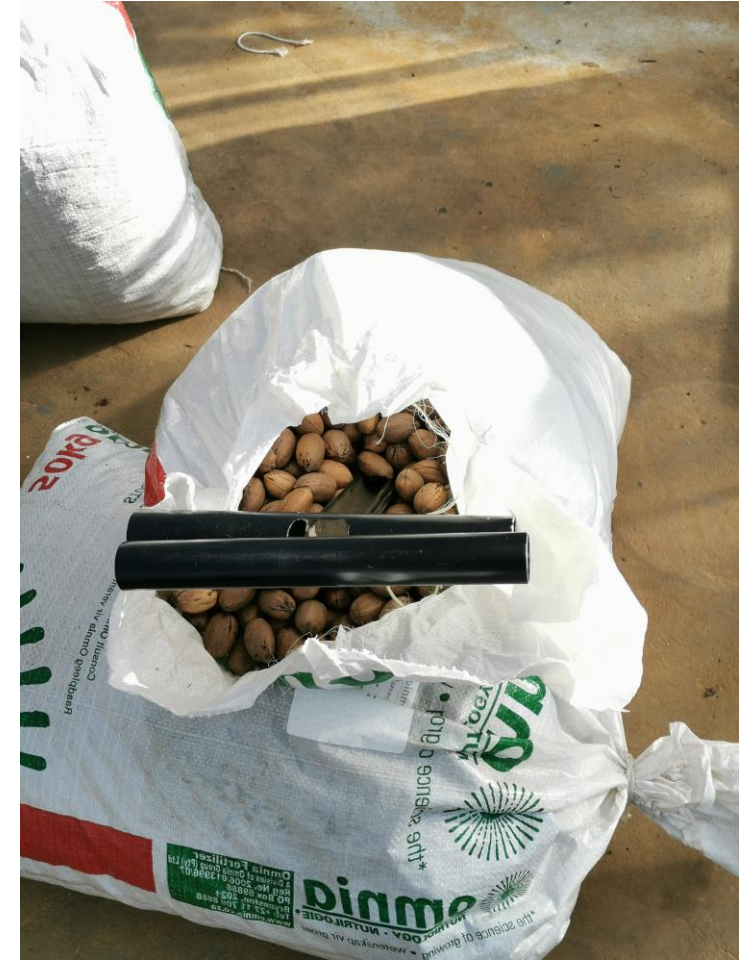
Objective

Investigate the effect of temperatures and relative humidity during on-farm storage on the quality of pecan nuts after harvesting



Material and Methods

- Department of Soil, Crop and Climate Sciences
- University of the Free State
- Cold Room and Greenhouses
- 2023 and 2024
- 'Choctaw'
- Commercial orchard Hartswater
- SAPPA



Material and Methods

Treatment combinations

Three factorial experiment

4 Replications

Nut treatment	Temperature °C	Relative humidity %
Clean	5	40
	5	60
Unclean	5	40
	5	60
Clean	25	40
	25	60
Unclean	25	40
	25	60
Clean	40	40
	40	60
Unclean	40	40
	40	60



Material and Methods

Storage of nuts

- stored in 50 kg polyethylene bags
- bags lifted from the floor pallets
- mini tunnels
- mist sprayers RH
- heater Temp



Material and Methods

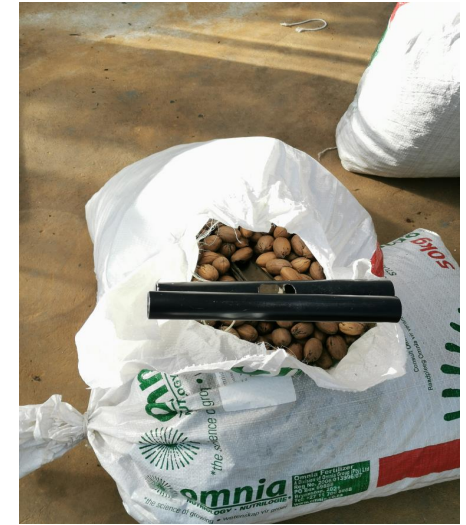
Sampling schedule

Sampling	Week								
	0	1	2 (1 st)	3	4 (2 nd)	5	6 (3 rd)	7	8 (4 th)
2023	7 July		21 July		4 August		18 August		1 September
2024	31 May		14 June		28 June		12 July		26 July

Material and Methods

Sampling method

- random sample
- modified grain auger
- 100 nuts per treatment combination



Material and Methods

Data collection

Uncleaned samples was first cleaned manually

INSHELL FRESH MASS

- laboratory scale
- g nut⁻¹



Bags with unclean nuts



After 8 weeks of storage: 1 September 2023



After 2 weeks of storage: 15 June 2024

Material and Methods

Data collection

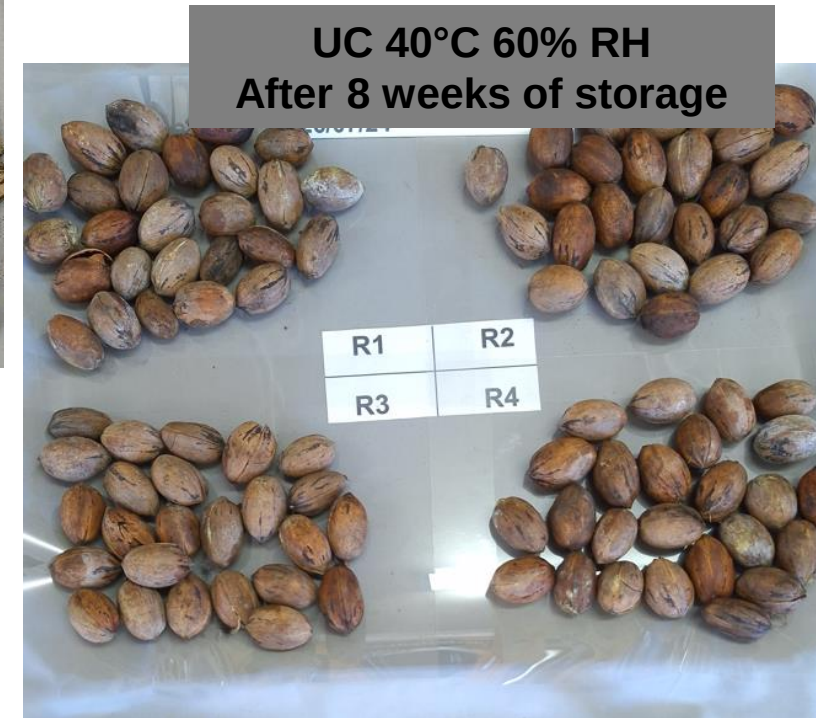
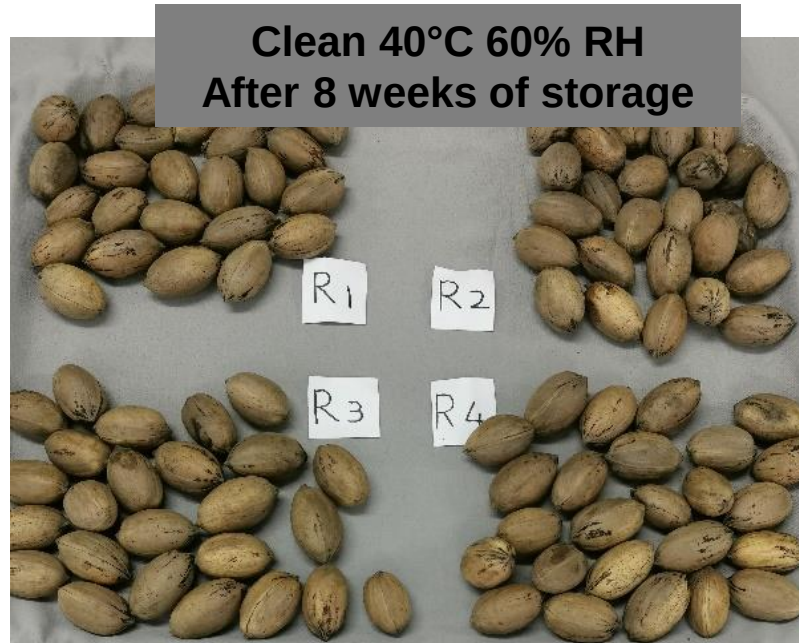
SHELL COLOUR



Light

Medium

Dark



Material and Methods

Data collection

KERNEL FRESH MASS

- nuts were shelled
- kernel mass (g nut^{-1})

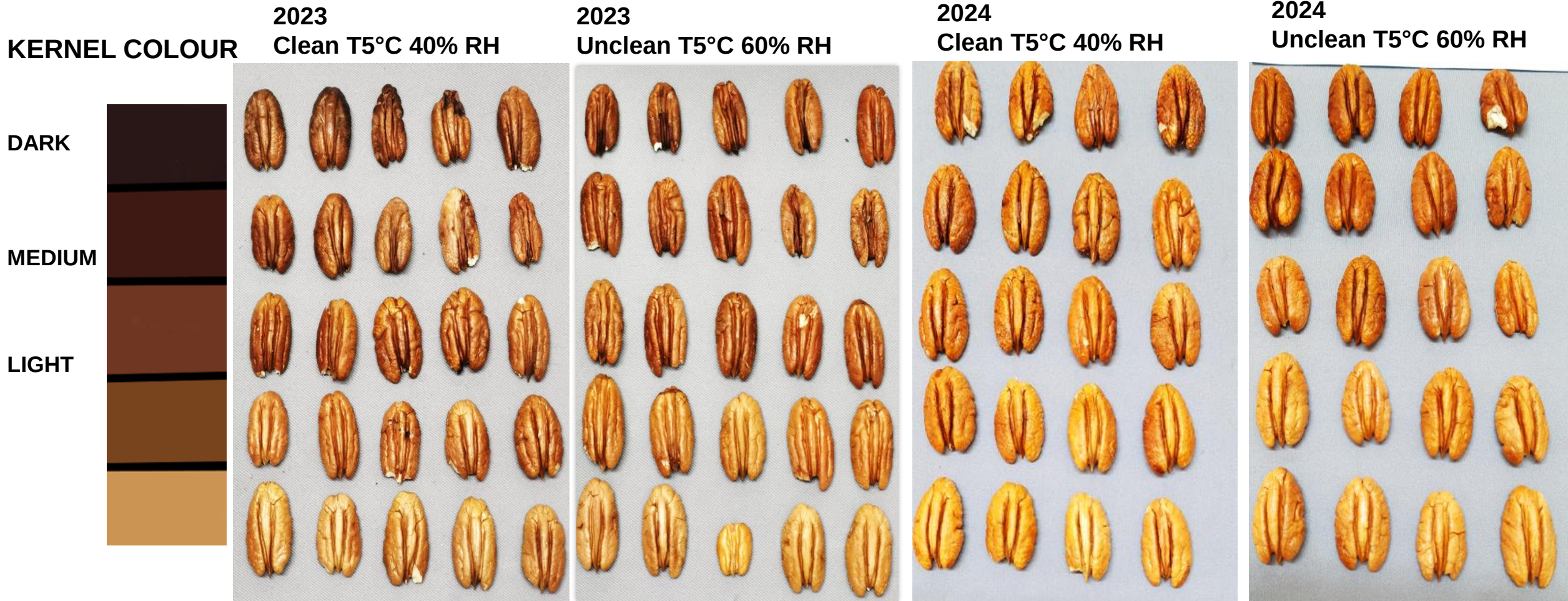


Material and Methods

Data collection

Kernel Colour

First sampling: after 2 weeks of storage



Material and Methods

Data collection

SHELF LIVE

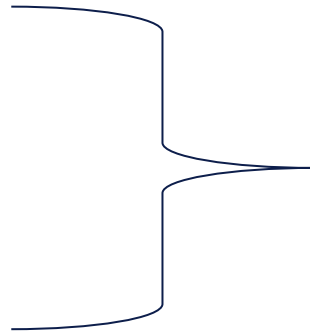
- shelled nuts of all the treatment combinations
- stored in perforated polyethylene bags
- room temperature ($25\pm 2^{\circ}\text{C}$ or 5°C)

Material and Methods

Data collection

SENSORY EVALUATION

- November 2023/ October 2024
- a panel taste the kernels (24 persons)
- stored under different temperatures
 - Appearance
 - Texture
 - Flavour
 - Overall satisfaction



1. like it very much
2. like it moderately
3. like it slightly
4. neither like nor dislike it

Material and Methods

Statistical analysis

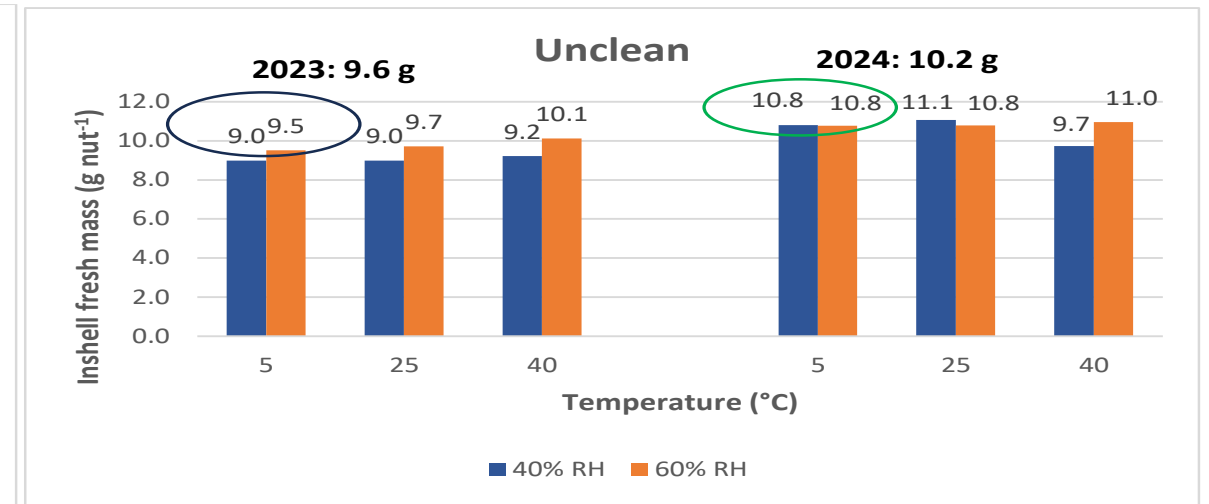
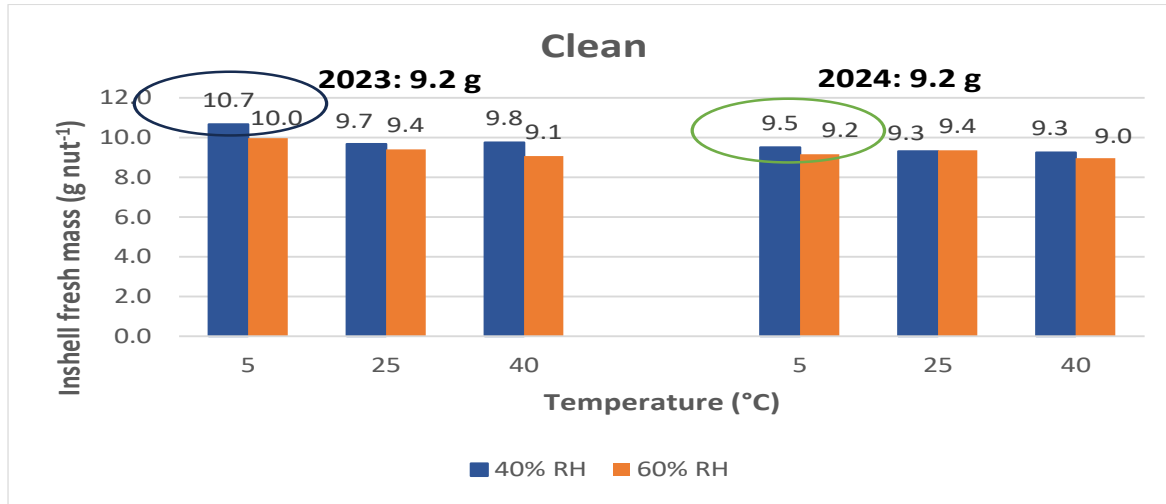
- ANOVA
- significance of the difference between means of treatment combinations
- NCSS 2011
- Tukey's test for the $p < 0.05$



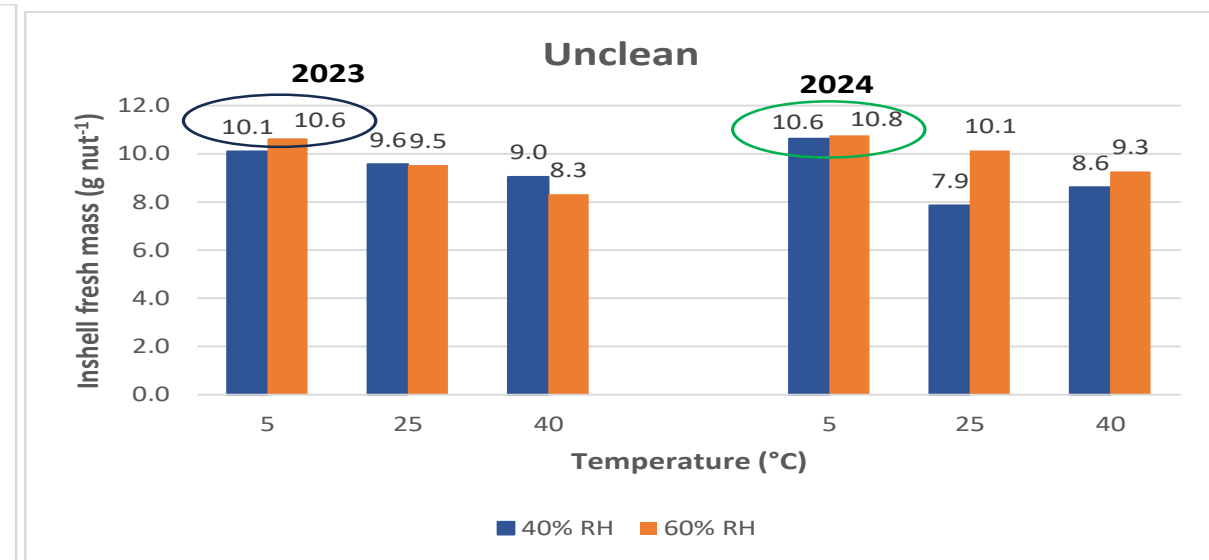
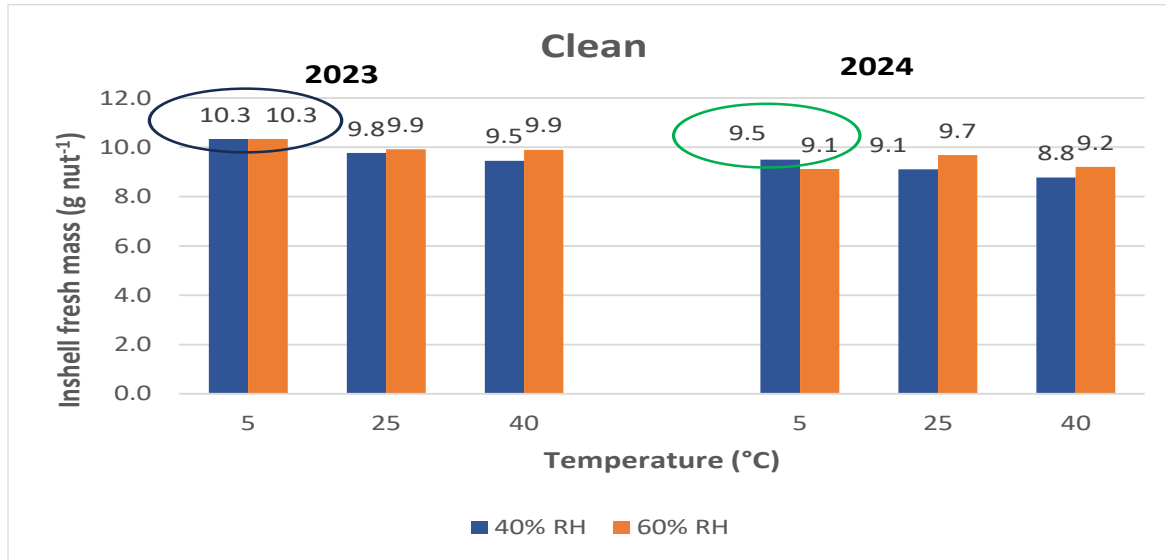
Results



Inshell Fresh Mass (g nut^{-1}) After 2 weeks of storage



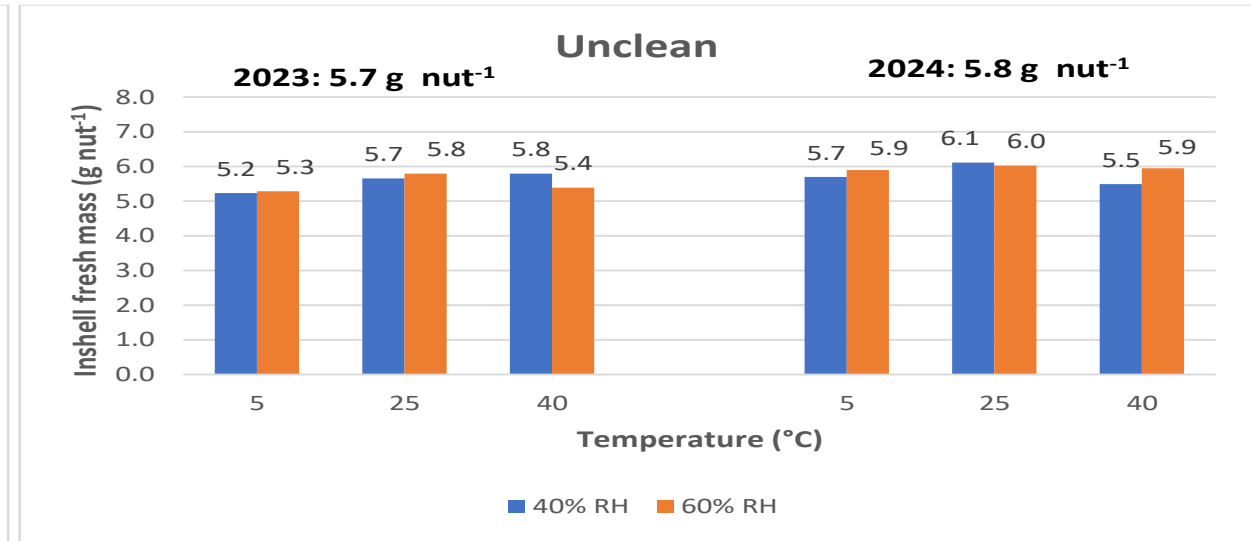
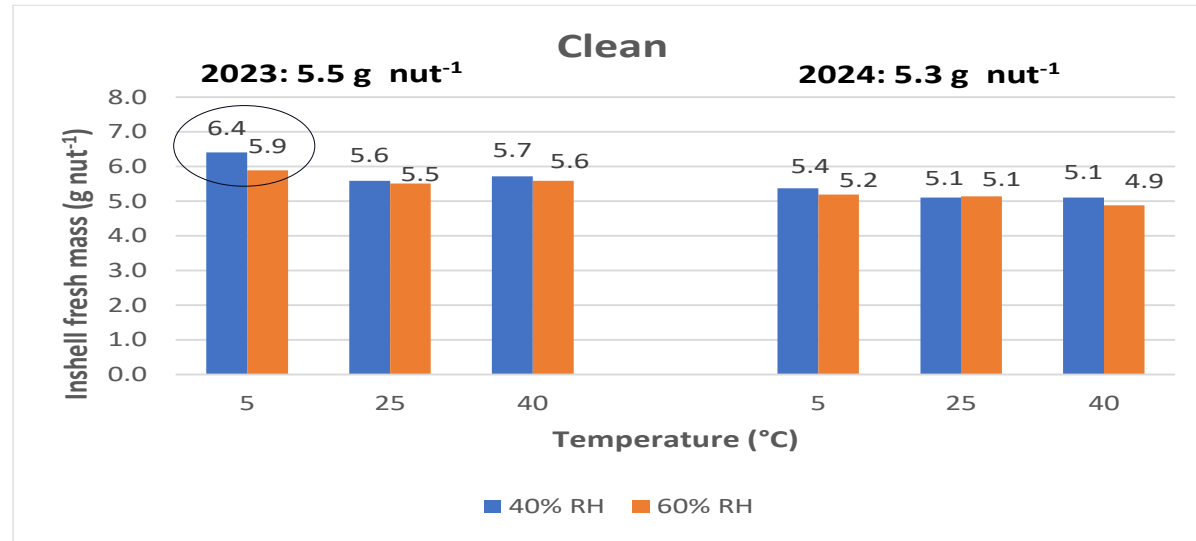
After 8 weeks of storage



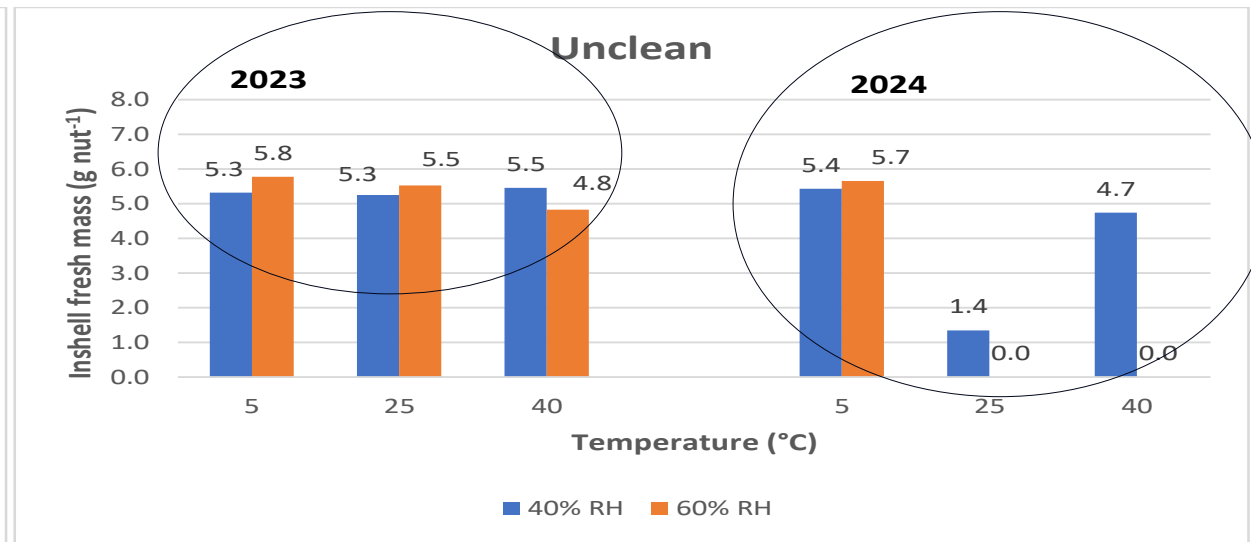
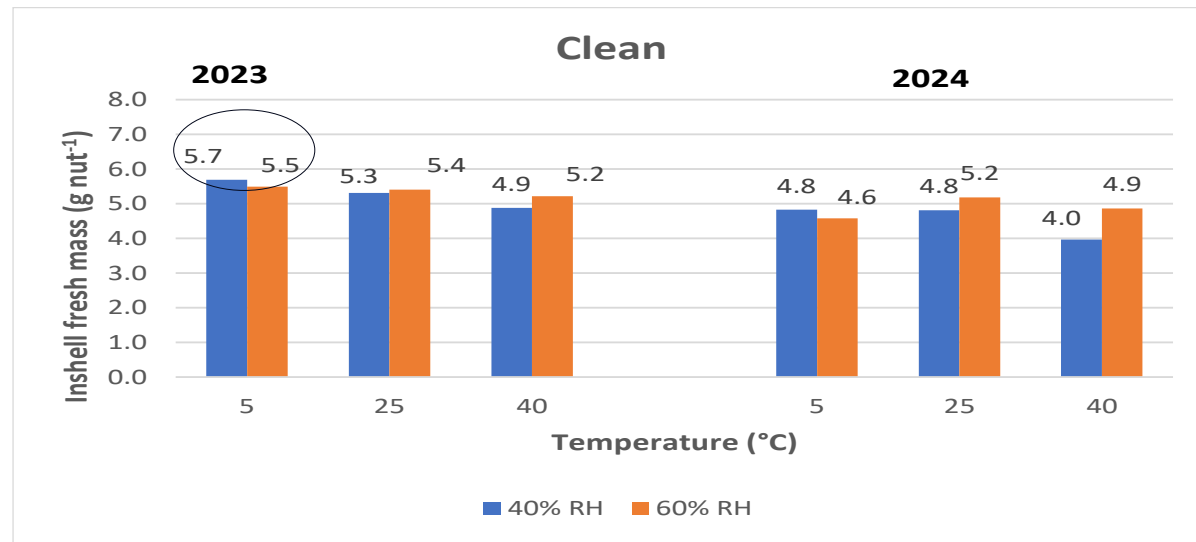
Inshell fresh mass change over the 8 weeks of storage

Temperatur e °C	RH %	2023					2024				
		Weeks of storage									
		0	2	CM	8	CM	0	2	CM	8	CM
		Clean nuts									
5	40	9.2	10.7	+1.5	10.3	+1.1	9.2	9.5	+0.4	9.5	0
	60	9.2	10.0	+0.8	10.3	+1.1	9.2	9.2	0.0	9.1	-0.1
25	40	9.2	9.7	+0.5	9.8	+0.6	9.2	9.3	+0.1	9.1	-0.2
	60	9.2	9.4	+0.2	9.9	+0.7	9.2	9.4	+0.2	9.7	+0.3
40	40	9.2	9.8	+0.6	9.5	+0.3	9.2	9.3	+0.1	8.8	-0.5
	60	9.2	9.1	-0.1	9.9	+0.6	9.2	9.0	-0.2	9.2	+0.2
		Unclean nuts									
5	40	9.6	9.0	-0.6	10.1	+0.5	10.2	10.8	+0.6	10.6	0
	60	9.6	9.5	-0.1	10.6	+1.0	10.2	10.8	+1.6	10.8	0
25	40	9.6	9.0	-0.6	9.6	0	10.2	11.1	+0.9	7.9	-3.2
	60	9.6	9.7	+0.1	9.5	-0.1	10.2	10.8	+0.6	10.1	-0.7
40	40	9.6	9.2	-0.4	9.0	-0.6	10.2	9.7	-0.5	8.6	-1.1
	60	9.6	10.1	+0.5	8.3	-1.3	10.2	11.0	+0.8	9.3	-1.7

Kernel Fresh Mass (g nut⁻¹) After 2 weeks of storage



After 8 weeks of storage

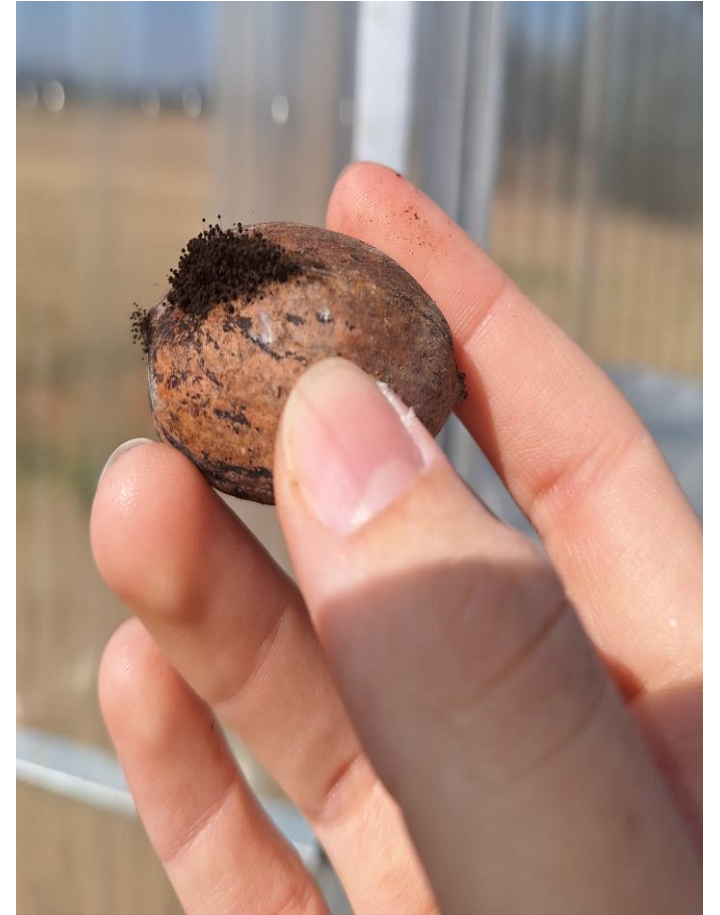


Kernel fresh mass change over the 8 weeks of storage

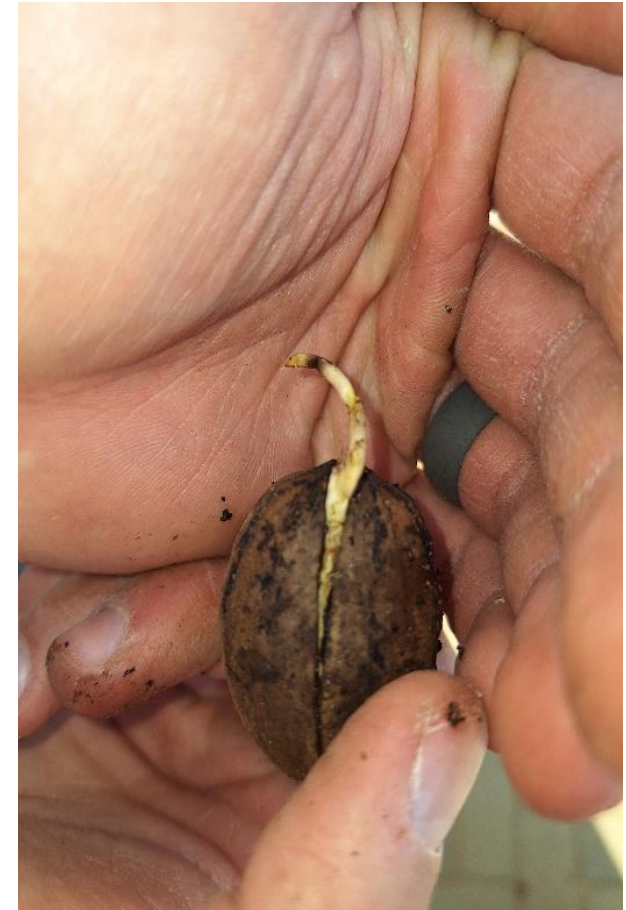
Temperatur e °C	RH %	2023					2024				
		Weeks of storage									
		0	2	CM	8	CM	0	2	CM	8	CM
		Clean nuts									
5	40	5.5	6.4	+0.9	5.7	+0.2	5.3	5.2	-0.1	5.3	0.0
	60	5.5	5.9	+0.4	5.5	+0.0	5.3	5.3	0.0	5.8	+0.5
25	40	5.5	5.6	+0.1	5.3	-0.2	5.3	5.7	+0.4	5.3	0.0
	60	5.5	5.5	0.0	5.4	-0.1	5.3	5.8	+0.5	5.5	+0.2
40	40	5.5	5.7	+0.2	4.9	-0.6	5.3	5.8	+0.5	5.5	+0.2
	60	5.5	5.6	+0.1	5.2	-0.3	5.3	5.4	+0.1	4.8	-0.5
		Unclean nuts									
5	40	5.7	5.4	-0.3	4.8	-1.1	5.8	7.3	+1.5	5.4	-0.4
	60	5.7	5.2	-0.5	4.6	-1.1	5.8	5.9	+0.1	5.7	-0.1
25	40	5.7	5.1	-0.6	4.8	-0.9	5.8	6.1	+0.3	1.1	-4.7
	60	5.7	5.1	-0.6	5.2	-0.5	5.8	6.0	+0.2	-	-
40	40	5.7	5.1	-0.6	4.0	-1.7	5.8	5.5	-0.3	4.7	-1.2
	60	5.7	4.9	+0.8	4.9	-0.8	5.8	5.9	+0.1	-	-

% Marketable and Unmarketable Nuts

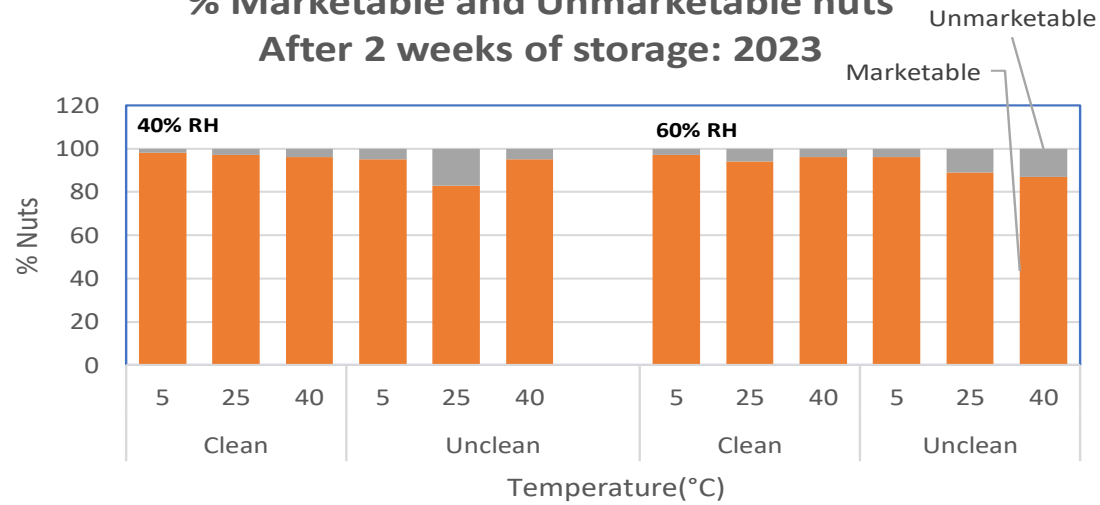
2 weeks after storage: 2024



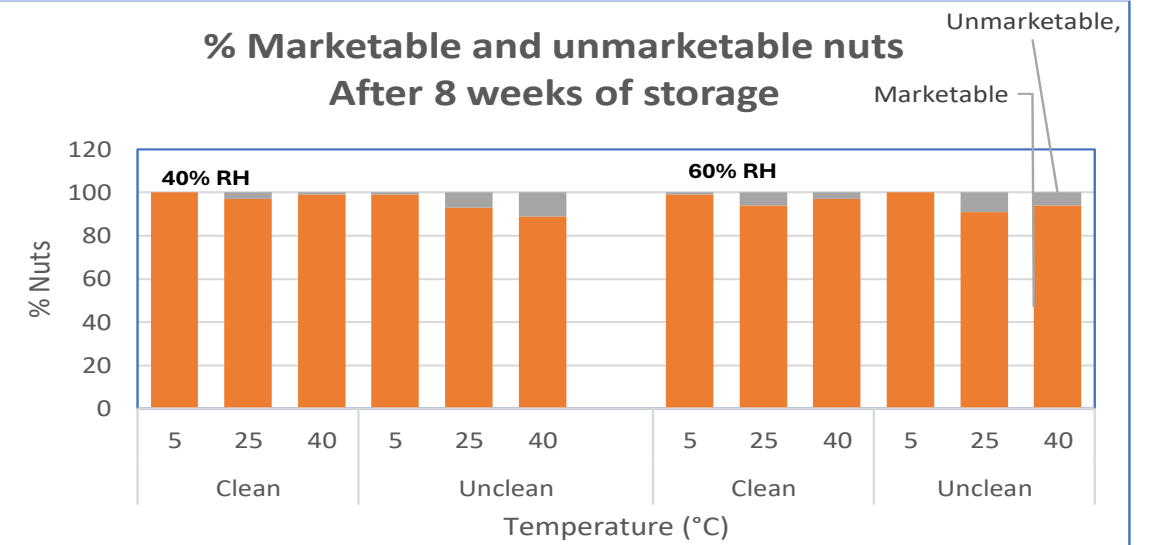
4 weeks after storage:2024



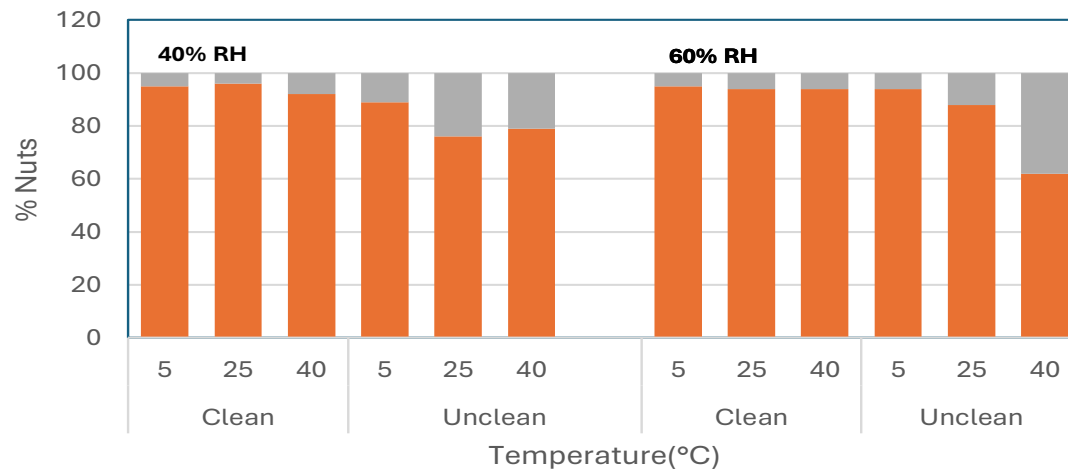
**% Marketable and Unmarketable nuts
After 2 weeks of storage: 2023**



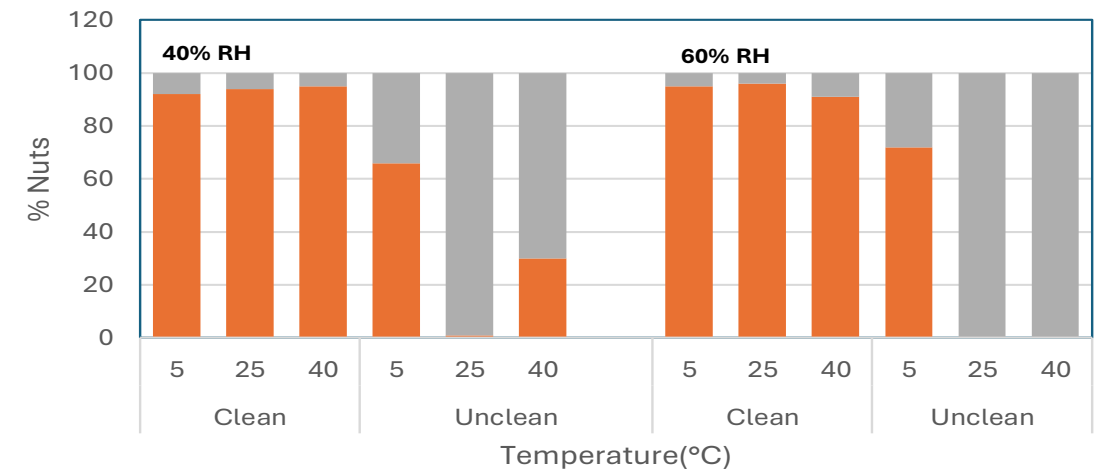
**% Marketable and unmarketable nuts
After 8 weeks of storage**



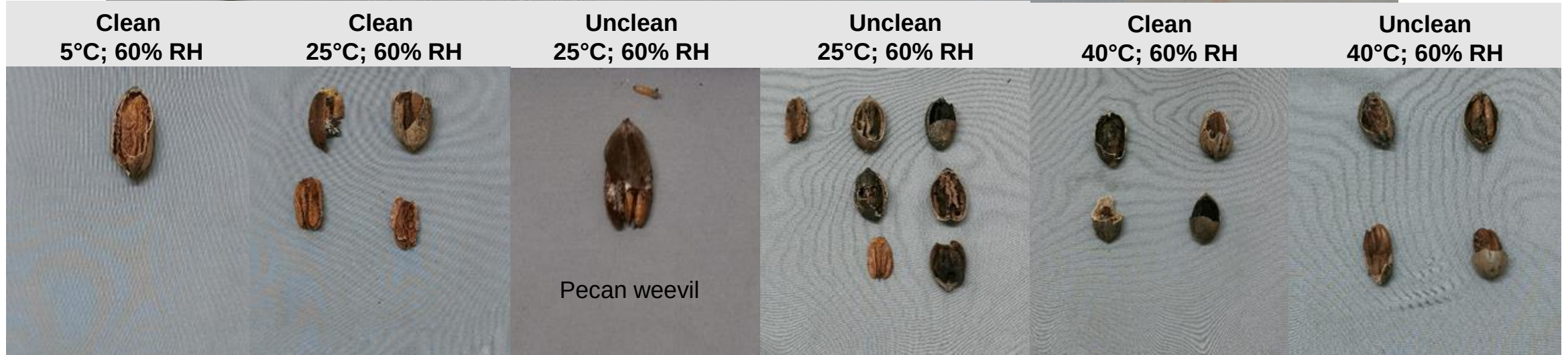
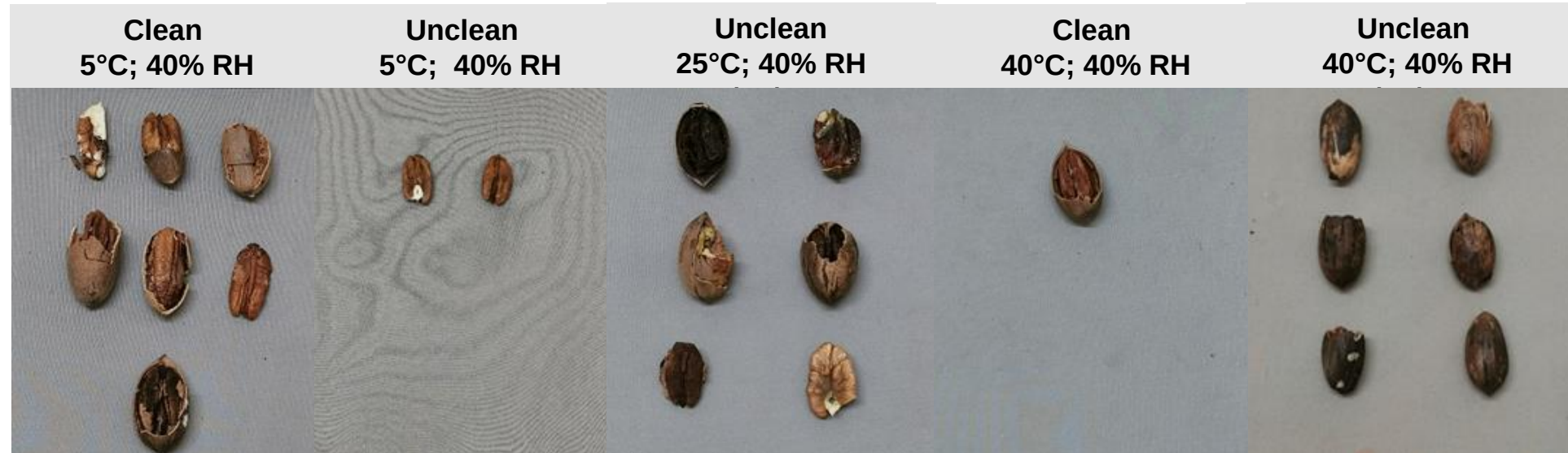
**% Marketable and Unmarketable nuts
After 2 weeks of storage: 2024**



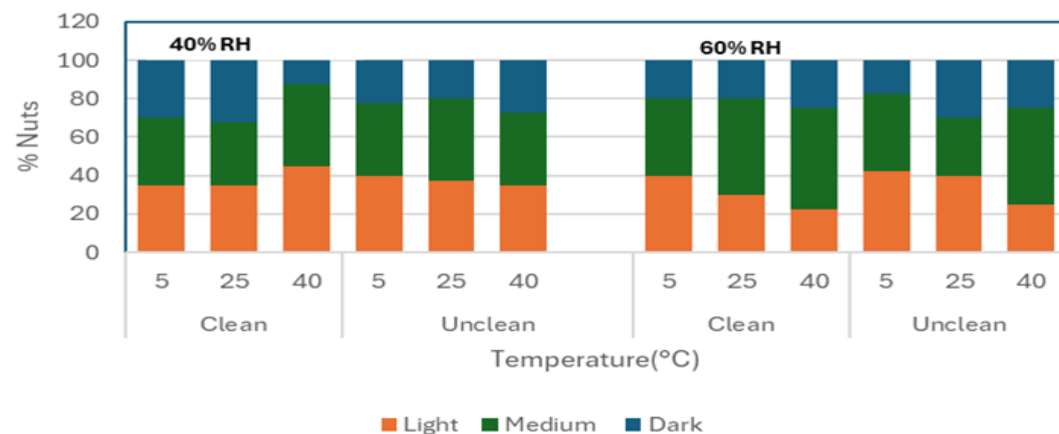
**% Marketable and Unmarketable nuts
After 8 weeks of storage: 2024**



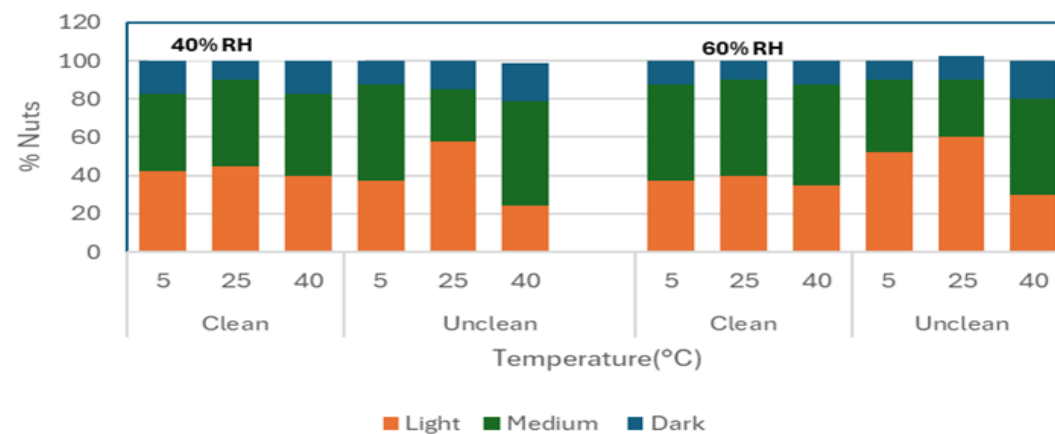
Unmarketable Nuts: 2023



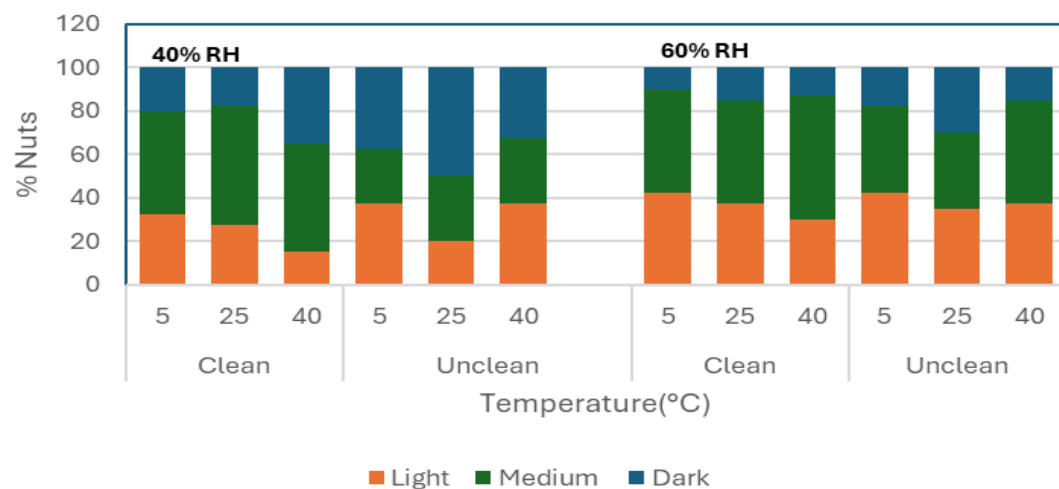
Shell colour
After 2 weeks of storage: 2023



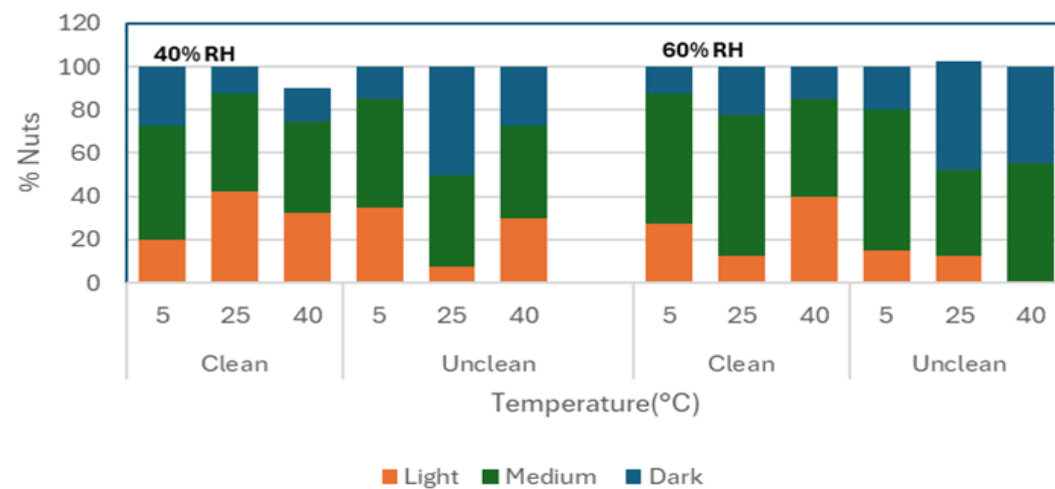
Shell colour
After 2 weeks of storage: 2024



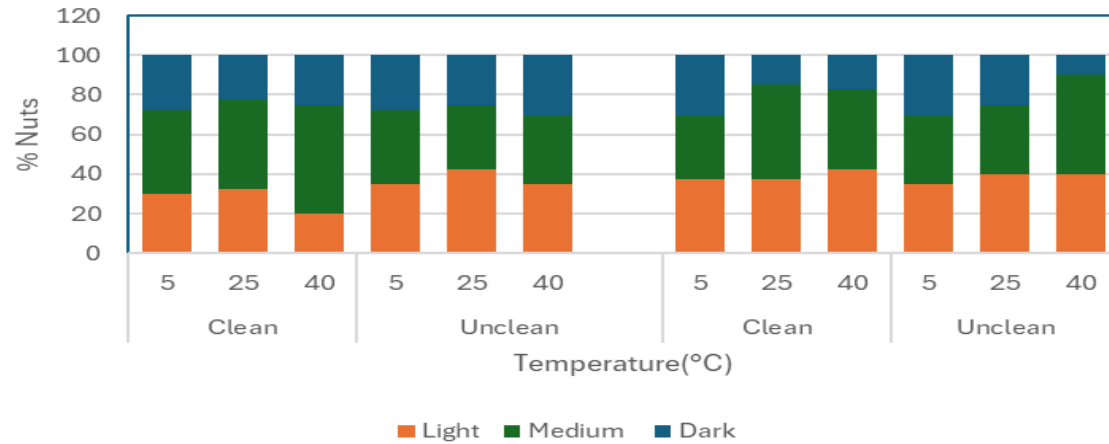
Shell colour
After 8 weeks of storage: 2023



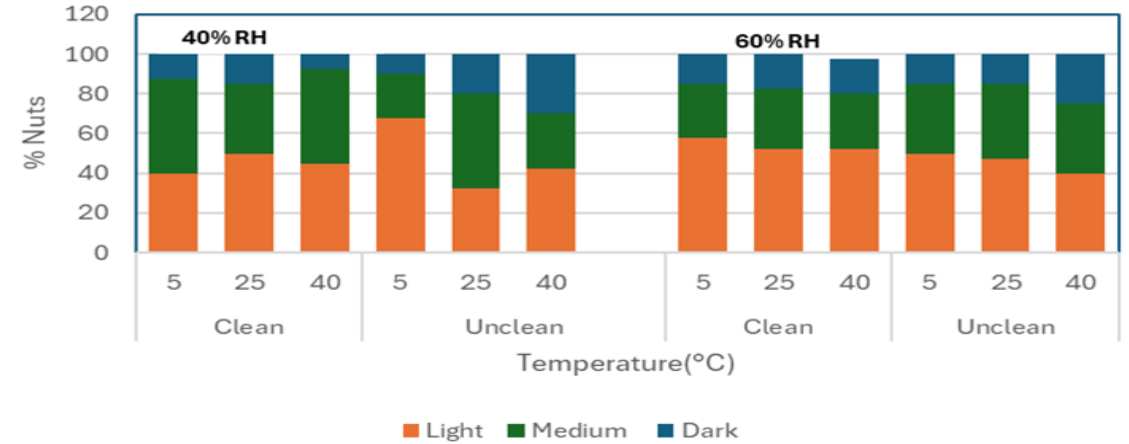
Shell colour
After 8 weeks of storage: 2024



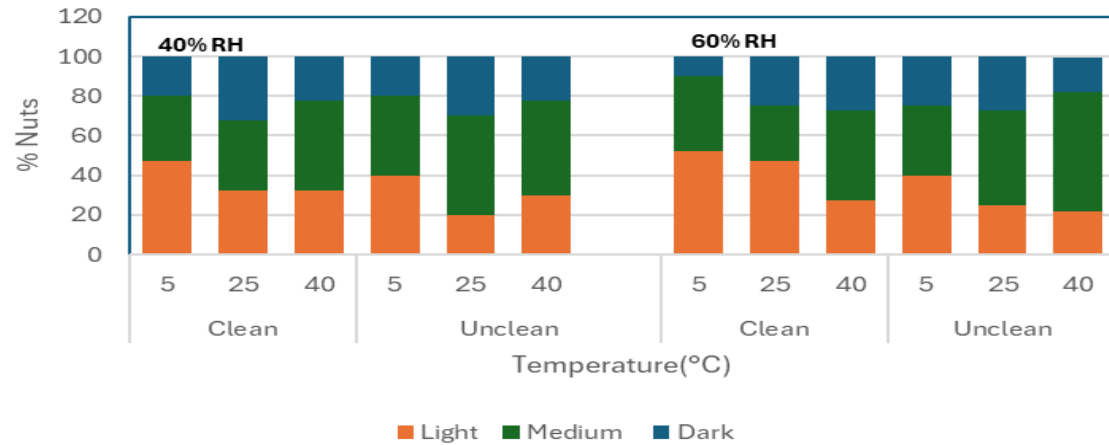
**Kernel colour
After 2 weeks of storage: 2023**



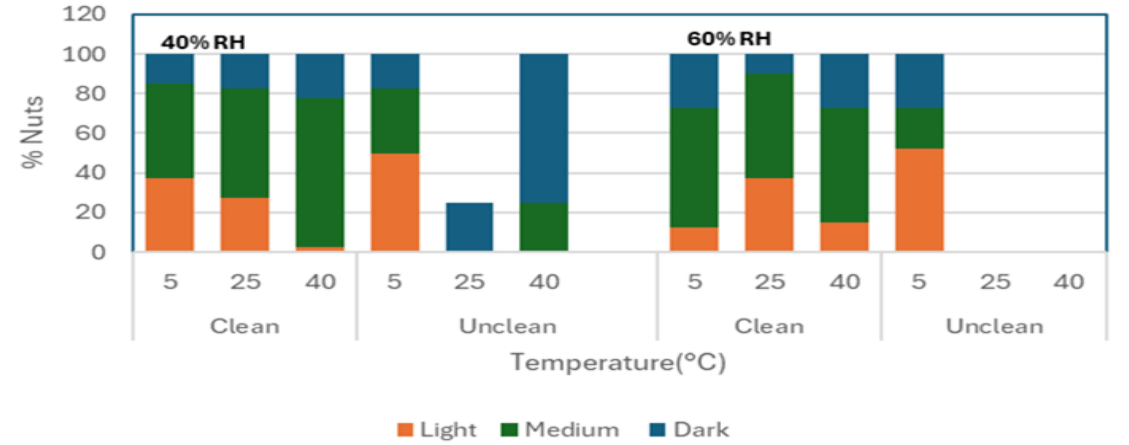
**Kernel colour
After 2 weeks of storage: 2024**



**Kernel colour
After 8 weeks of storage: 2023**

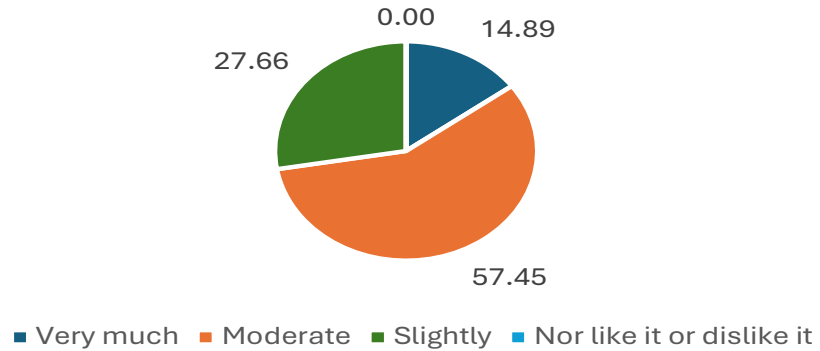


**Kernel colour
After 8 weeks of storage: 2024**

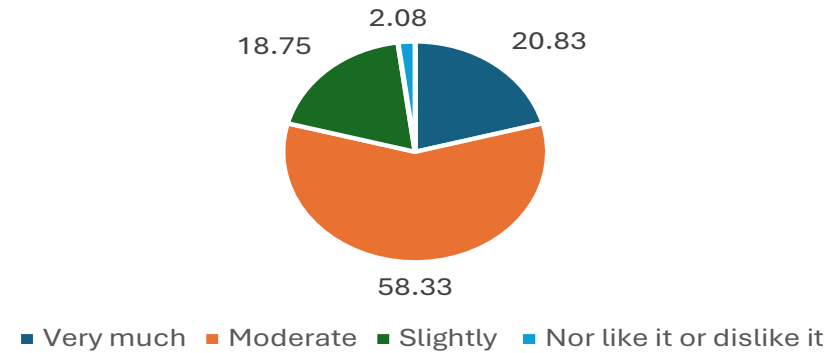


Sensory data 2023

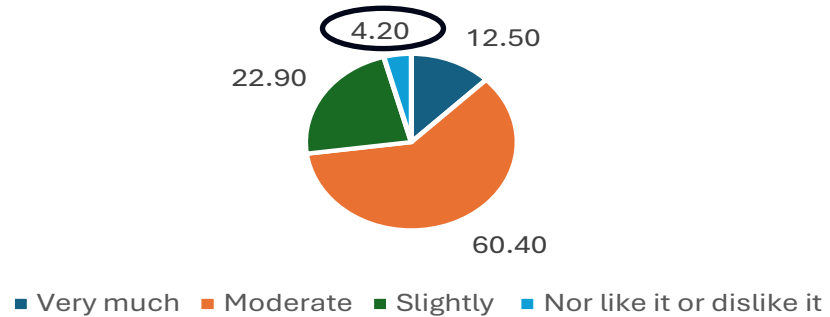
**Appearance
Room Temperature**



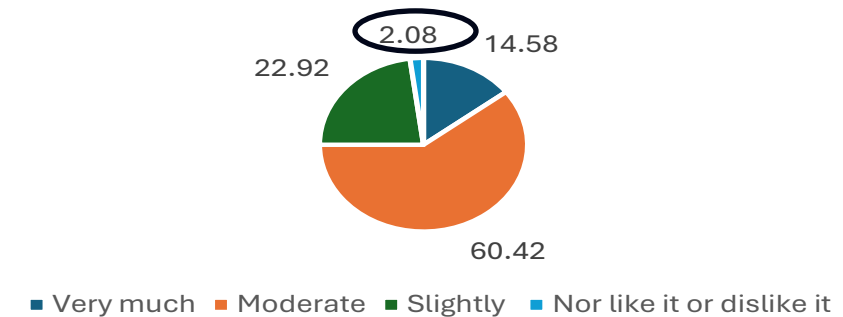
**Appearance
Cold Room**



**Texture
Room Temperature**

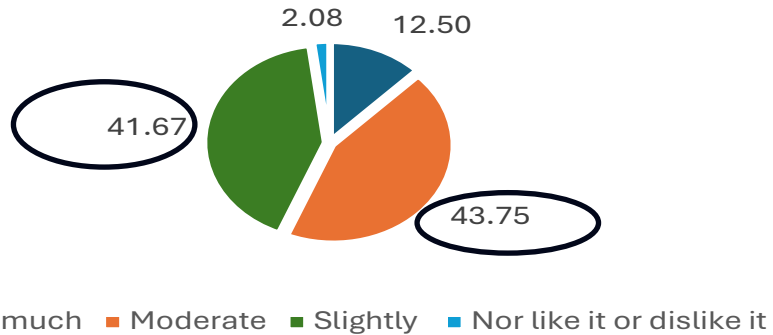


**Texture
Cold Room**

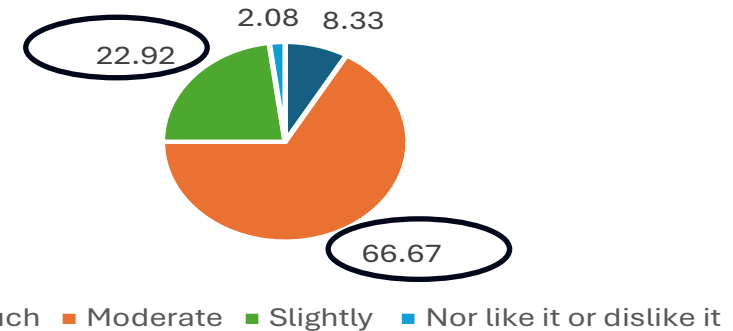


Sensory data 2023

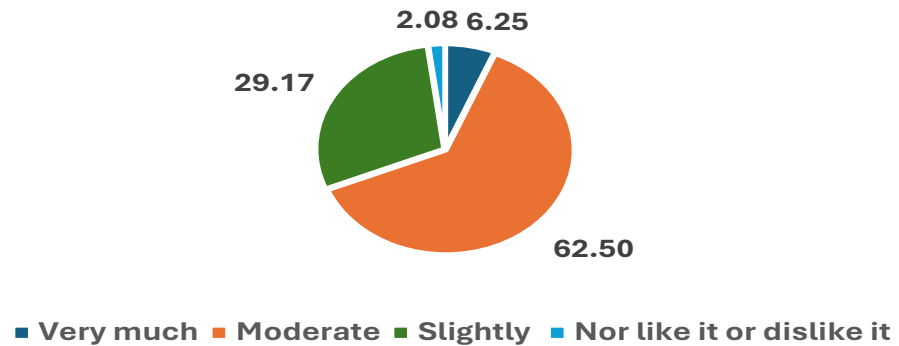
**Flavour
Room Temperature**



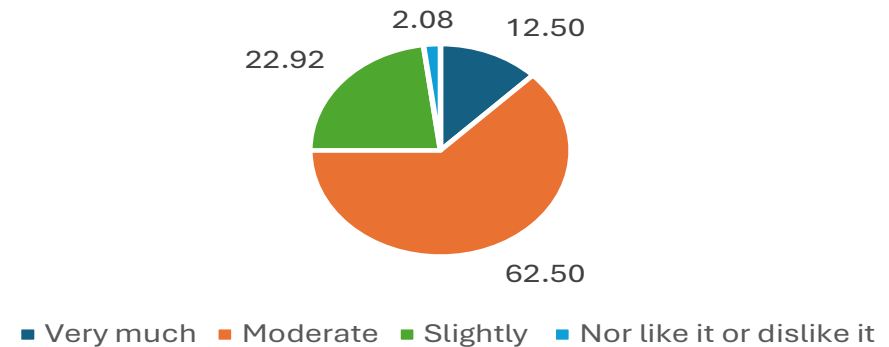
**Flavour
Cold Room**



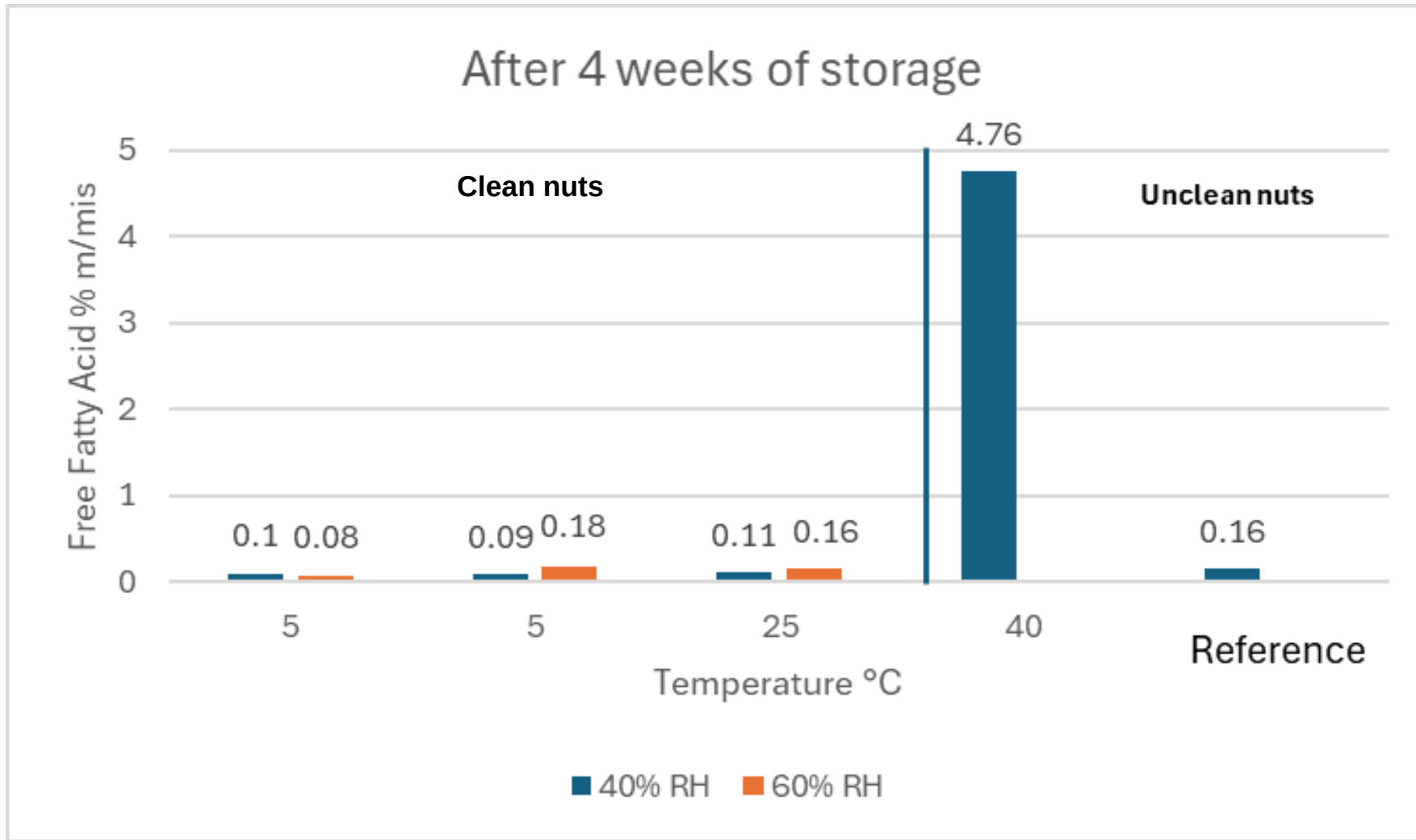
**Overall satisfaction
Room Temperature**



**Overall satisfaction
Cold Room**



Free Fatty Acid 2024



Conclusion

- Clear difference between seasons
- Clean vs Unclean nuts
- Clean nuts as quickly as possible
- Bring down field temperature
- Best results 5°C and 40-60% RH

Acknowledgement

- SAPPA
- UFS

*Thank
you!*

