Integration of Chitosan Emulsion and Silicon To Extend the Shelf-Life of Blackberry Fruit

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Blackberry

- Family Rosaceae
- Deciduous crop that grows best in temperate climates.
- Several blackberry species are native to Florida.
- In Florida, blackberries typically ripen during May and June.
- Extremely perishable.
- Major production areas in the United States are the Pacific Northwest, Michigan, and Arkansas.

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Health benefits of blackberries

- Blackberries are rich in

✓Antioxidants, that prove beneficial to prevent many types of cancer.

✓Vitamin C content, which improves skin health.

✓Vitamin K that promotes bone health.

✓Dietary fiber that reduces blood sugar levels.

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Chitosan

- Non-toxic, eco-friendly, and biocompatible natural polymer.
- Maintain the quality and extend the shelf life of postharvest fruits and vegetables.
- Chitosan coating can help maintain fruit quality by preventing loss of

✓weight,

✓firmness

✓vitamin C

✓titratable acidity

- Reduce the incidence of decay, such as that caused by Botrytis cinerea

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Silicon

- Potential bio-stimulant--enhance the yield and quality of plant products.
- Application through foliar, incorporation into the soil, or fertigation.
- Increase plant resistance against diseases, insect attacks, and unfavorable environmental conditions.
- Very little research has been done on the effect of Silicon on the postharvest quality.

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Objective of the study

Pre-harvest spray application

1. Chitosan (0.25 %)

2. Silicon (150 ppm)

3. Chitosan (0.25 %) + Silicon (150 ppm)

Time of spray application = 24 h before harvest

on physio-chemical characteristics of blackberry cultivars Osage, stored at 1°C for 7, 14, and 21 days.

Material and Methods

- Plant Material

➢ The Blackberry cultivar Osage was selected for experimentation purposes.

- Site location

➢ Blackberry farm was located in Havana Quincy, North Florida (30.6238° N, 84.4146° W).

- Spraying activity

➢ Blackberry trees were sprayed with chitosan, Silicon, and a combination of both. Control trees were sprayed with just normal water.

- Harvesting

- Fruit was randomly harvested around the tree canopy on 7 July 2023.

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Material and Methods…cont.

- Packaging and Storage

➢ Fruit were packed in 12 oz, vented clamshells with the dimensions of 5.68 x 7.3 x 1.88, containing a single absorbance pad.

➢ Fifty fruit were packed in each clamshell.

➢ Following the harvest, the fruit was transferred to cold storage (1°C for 7, 14, and 21 d) with RH (85-90 %).

Experimental layout

- **Factor A:** — **Factor B:**
- **Main Treatments** — **Storage duration**
- **Control** — **0, 7, 14 and 21 days**
- **Chitosan (0.25 %)**
- **Silicon (150 ppm)**
- **Chitosan + Silicon**
- **Storage temperature = 1°C**
- Two-factor factorial CRD design, 3 replications, 1 box per replication= 4 x 3 = 12
- Total of 12 boxes for 0-day analysis
- We analyzed 7, 14, and 21 days = 12x 3= 36
- So total no of boxes required = 48
- Each box will have 50 fruits and was considered the experimental unit.

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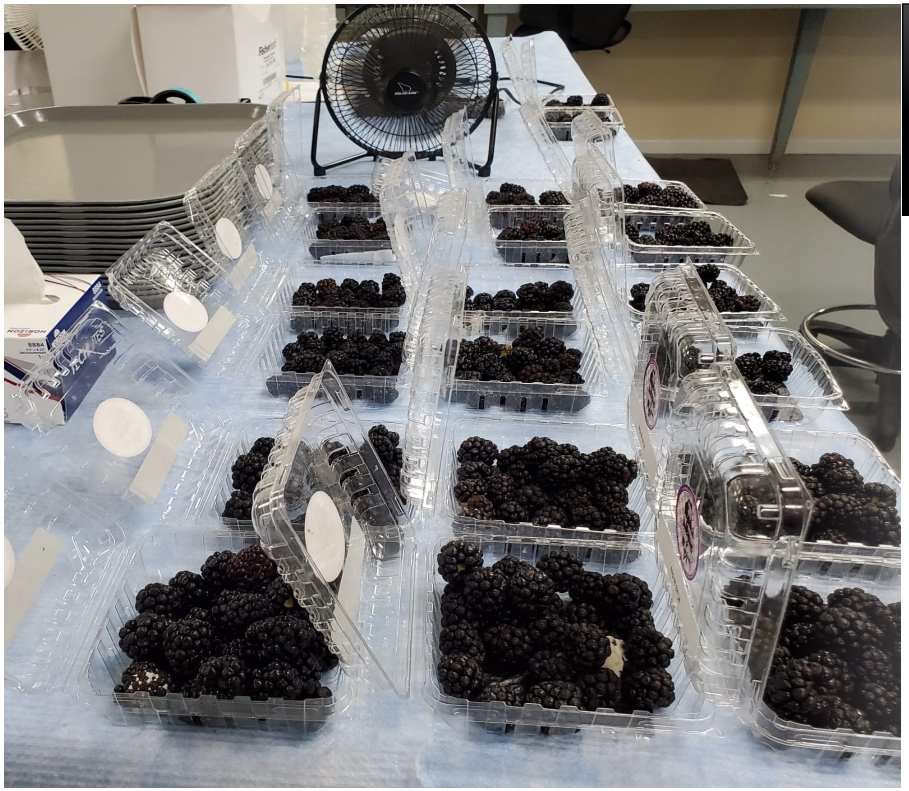
Assessments

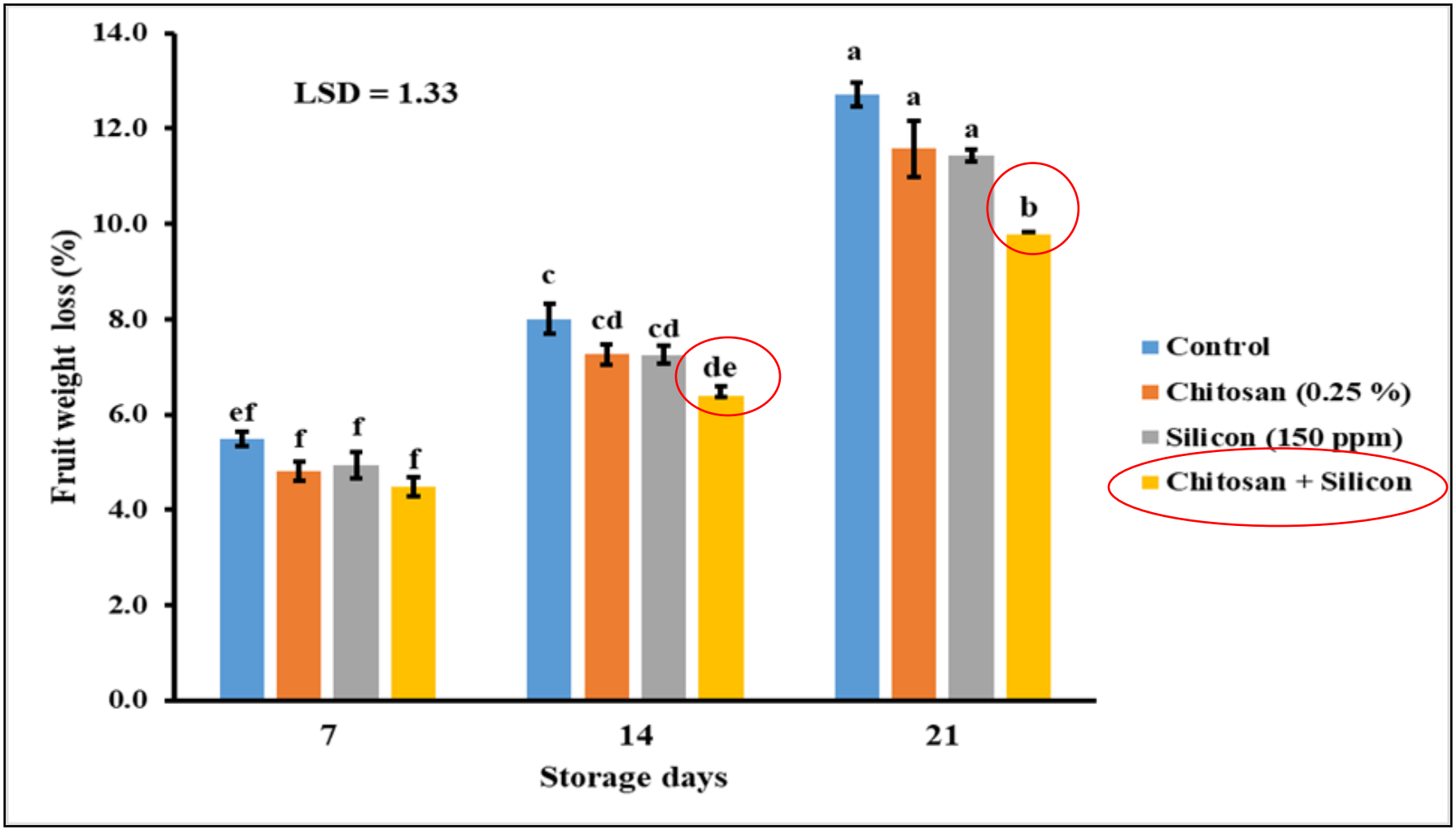
1. Fruit weight
2. Fruit color (L*, a* , Hue angle and Total Color)
3. SSC %
4. TA %
5. Leakage (%)
6. Mycelium growth (%)
7. Red drupelet reversion RDR (%)
8. Market index (MI)



Fruit weight loss (%)

- Weight loss percentage = $\frac{\text{(Initial weight- Final weight)} \times 100}{\text{(Initial weight)}}$

Fruit weight loss (%)



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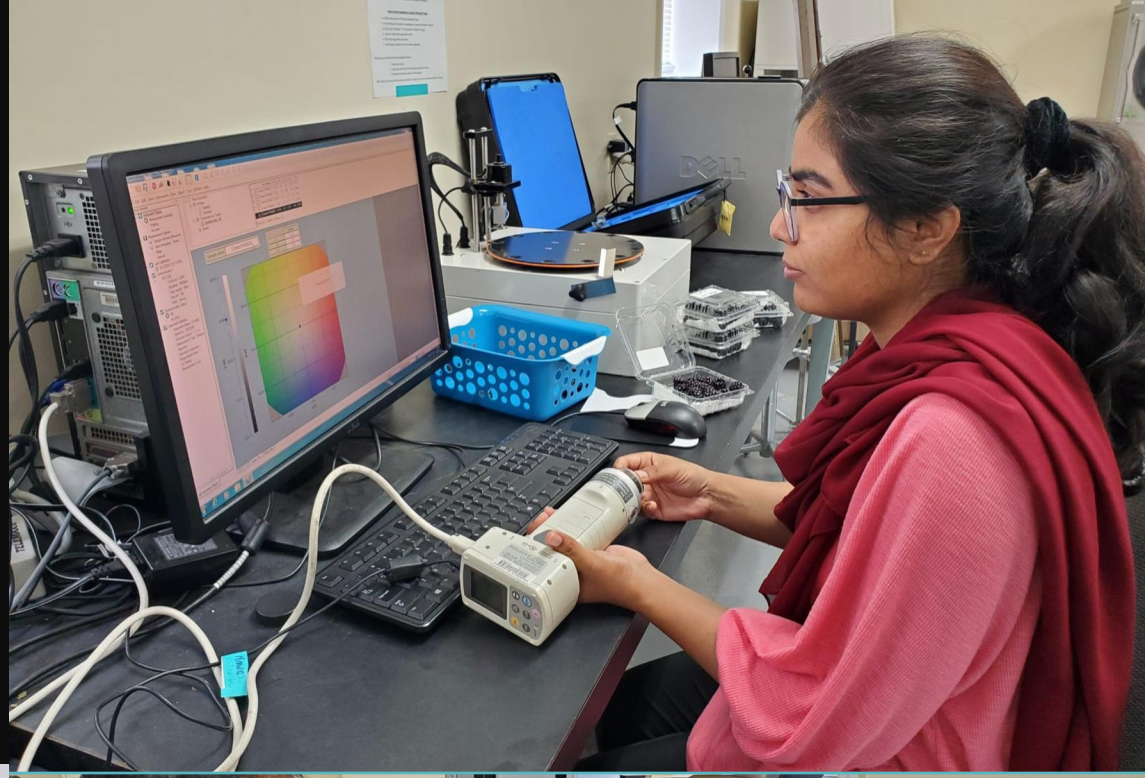
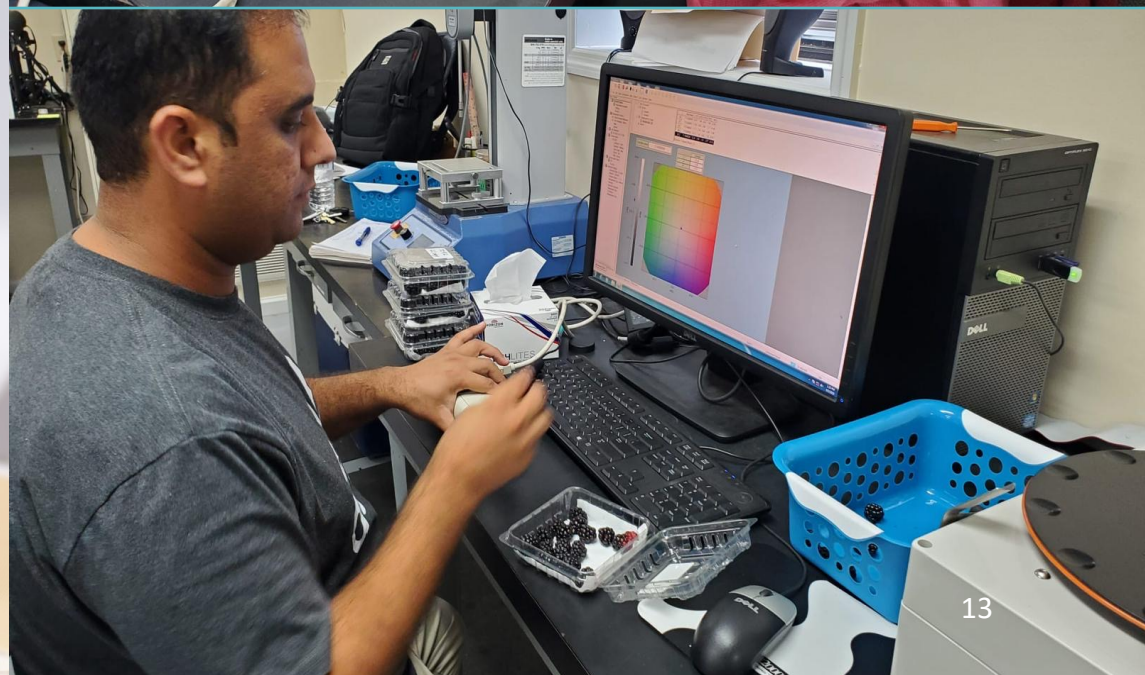
Fruit Color

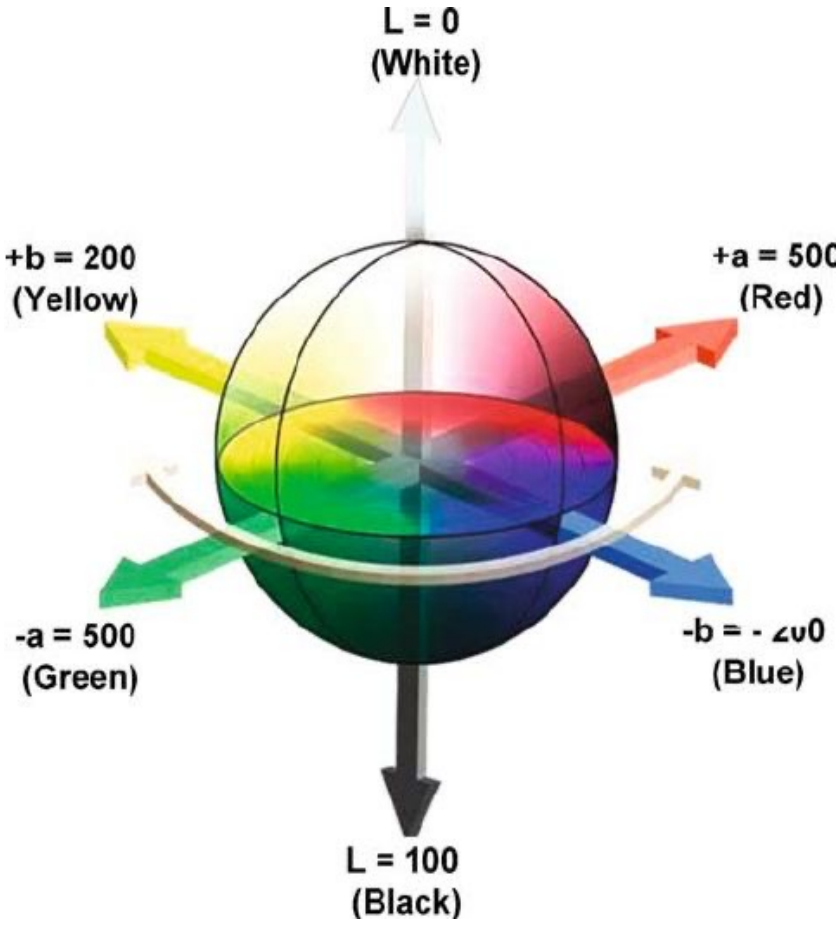

KONICA MINOLTA
SPECTROPHOTOMETER
CM-700d
KONICA MINOLTA
SAMPLE
TARGET
SAVE SEL
CAL
MENU
READY
OPTION





Color coordinate (Color scale)

- L* represents the lightness (0 white to 100, dark black).
- a* specifies the redness (+a*) or greenness (-a*).
- b* indicates the yellow (+b*) or blue (-b*) colour of fruit skin.
- $TCD = \sqrt{\Delta L* + \Delta a* + \Delta b}$



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Total Color

Total Color					
		Storage days (SD)			
Treatments (T)	**0**	**7**	**14**	**21**	**Mean (T)**
Control	4.30ab	4.27 a-c	4.13 d-f	4.09 f	**4.20**
Chit (0.25%)	4.32 a	4.29 a-c	4.26 a-d	4.07 f	**4.23**
Si (150 ppm)	4.26a-d	4.18 b-f	4.22 a-e	4.10 ef	**4.19**
Chit + Si	4.31 ab	4.25 a-d	4.17 c-f	4.10 ef	**4.21**
Mean (SD)	**4.30 a**	**4.25 b**	**4.19 c**	**4.09 d**	
LSD ($P \leq 0.05$)	**T = 0.12**		**SD =0.04**	**T X SD = 0.12**	

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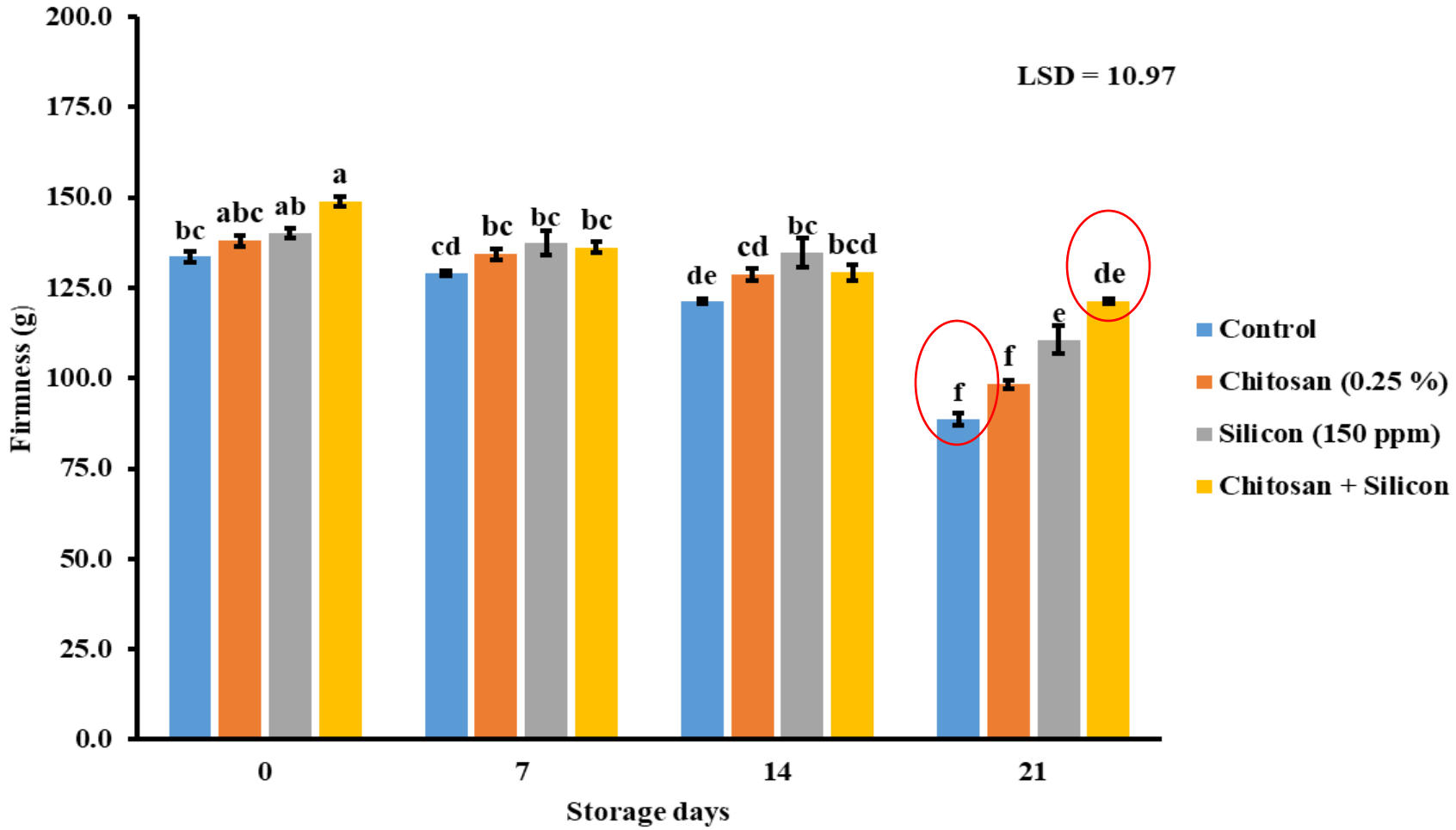
Fruit Firmness

Fruit firmness



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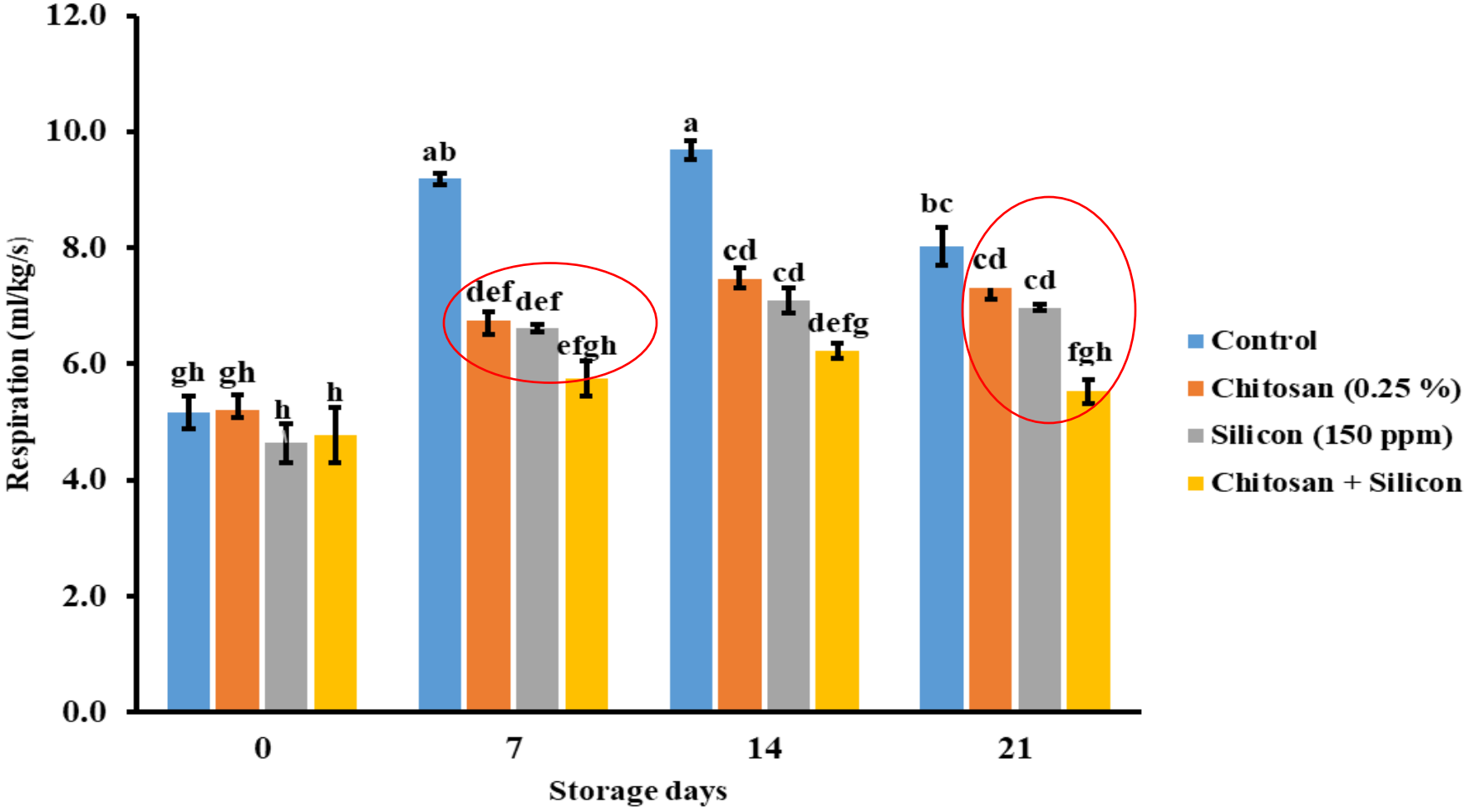
Respiration rate

Respiration rate



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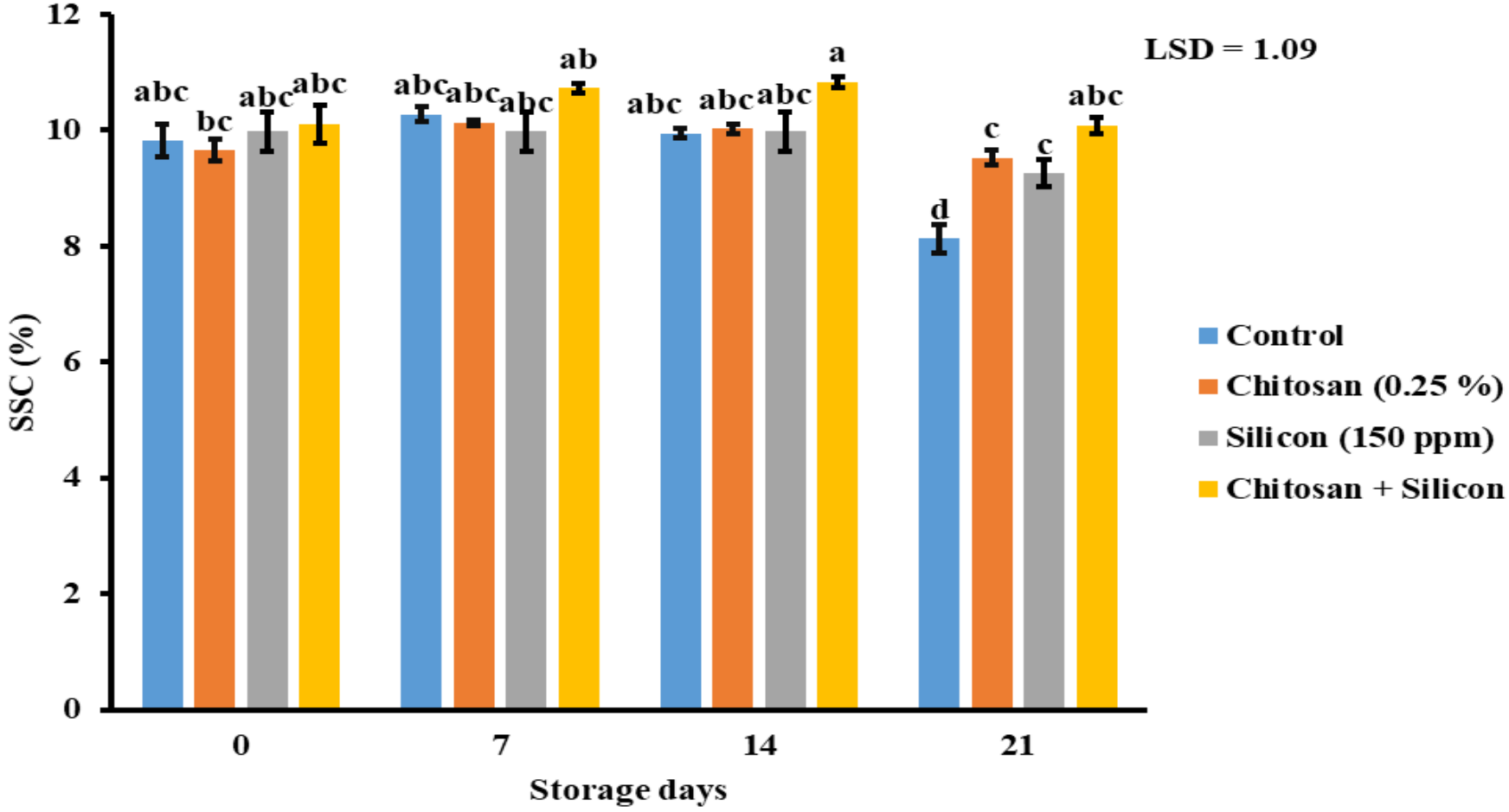
Soluble solid content (SSC %)



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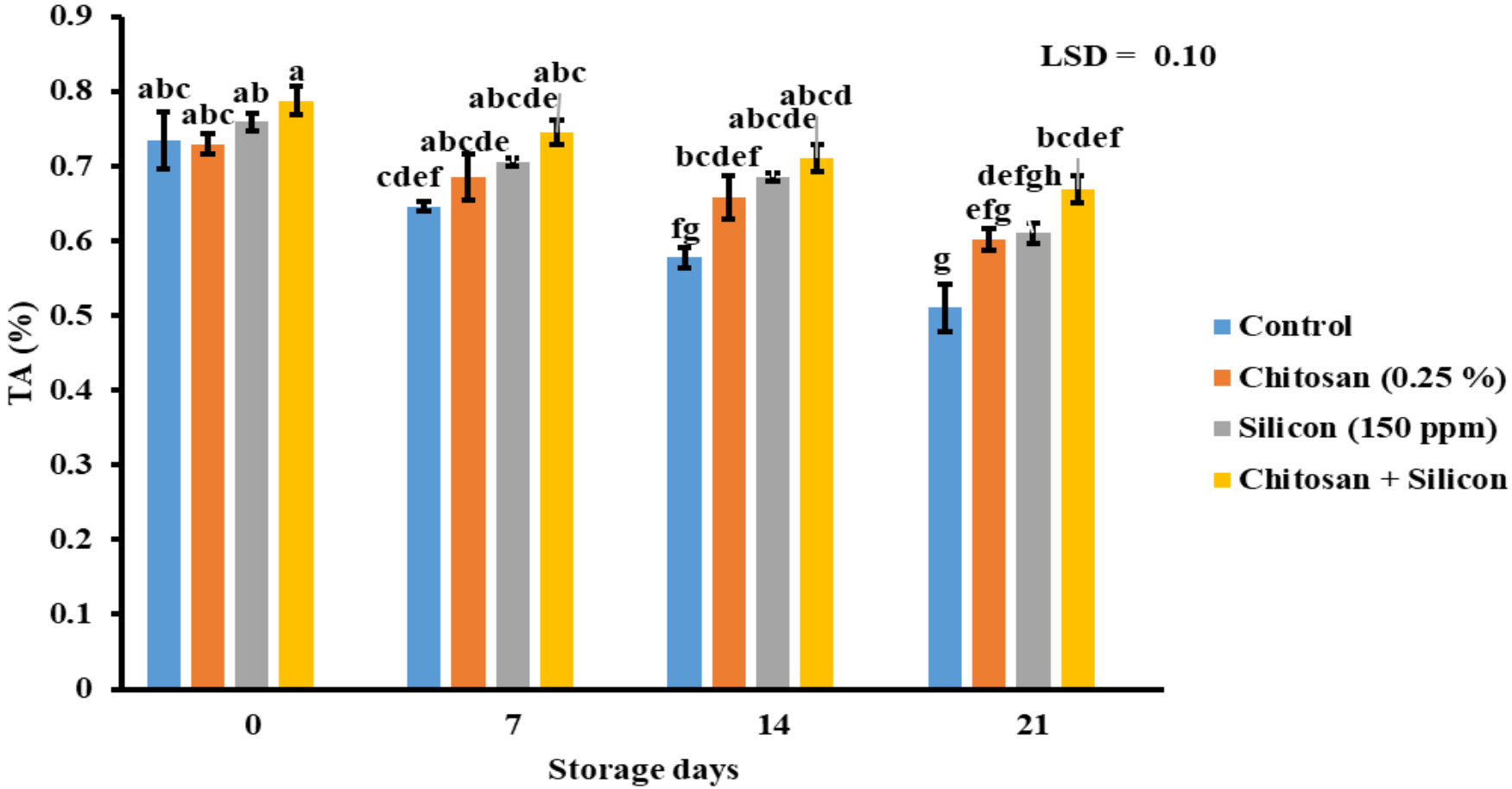
Titratable acidity (TA %)



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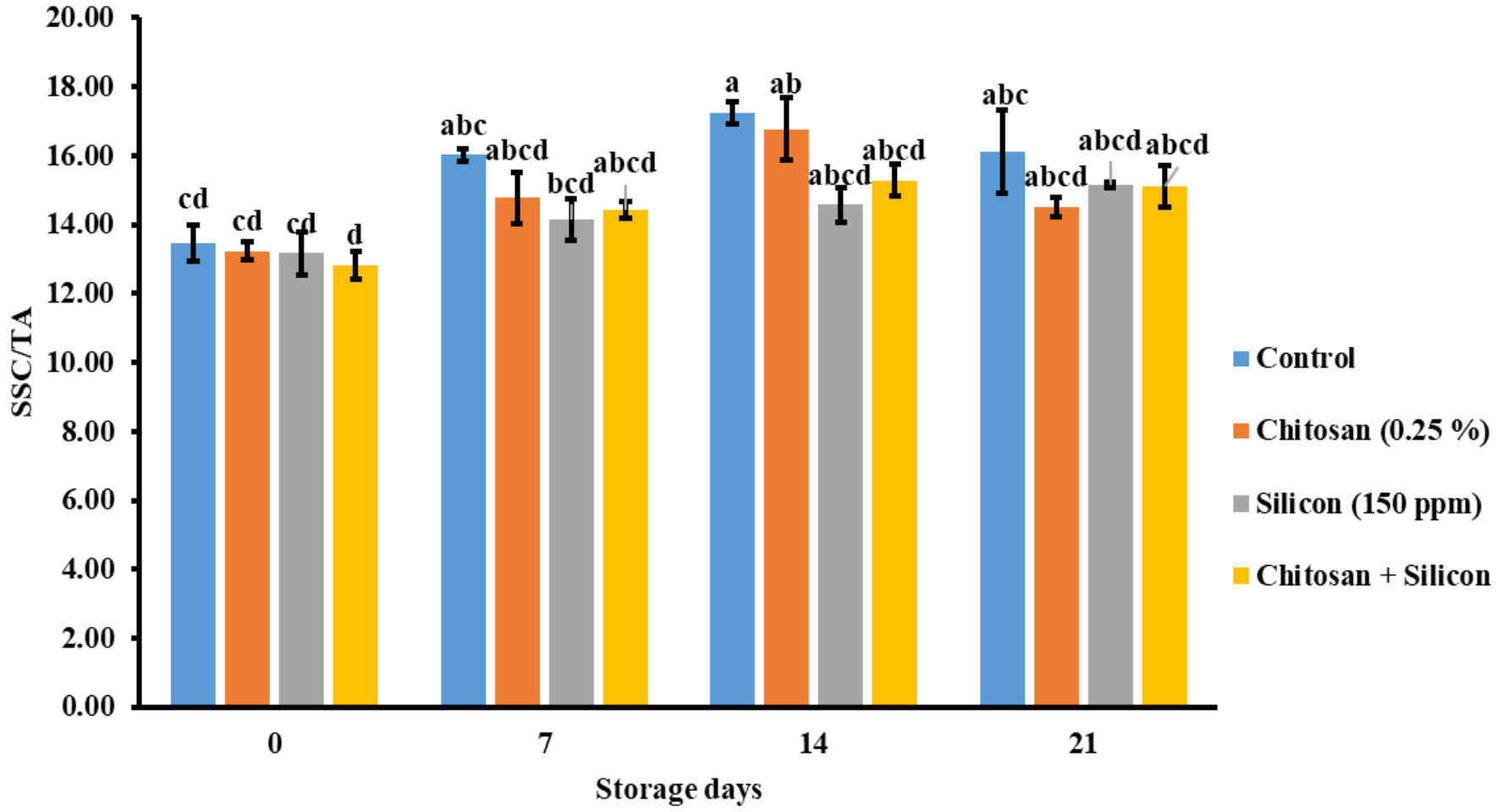
SSC/TA



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Leakage (%)

- Leakiness can determine the post-harvest storage shelf life of blackberries.
- Leakiness in blackberries can be caused by several factors.

1. Exposure to high temperatures
2. Compression
3. Bugs

- Ripe fruit impacted by heavy rains will be soft leaky, and un-marketable

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Leakage (%)

	Storage days (SD)			
Treatment (T)	**7**	**14**	**21**	**Mean (T)**
Control	10.50 d	23.50 c	49.0 a	**27.66 a**
Chi (0.25%)	2.50 ef	5.50 e	28.50 b	**12.16 b**
Si (150 ppm)	2.0 f	3.50ef	24.75 c	**10.08 c**
Chit + Si	3.0 ef	9.0 d	23.75 c	**11.91 b**
Mean (SD)	**4.50 c**	**10.37 b**	**31.50 a**	
LSD ($P \leq 0.05$)	**T =1.36**	**SD = 1.07**	**T x SD = 3.06**	

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Mycelium growth

- ✓ Blackberries stored in cold storage showed signs of mycelium growth.

- ✓ Blackberries develop mold in storage due to

1. Moisture
2. Temperature fluctuation
3. Damaged berries
4. Spore contamination

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Mycelium growth (%)

	Storage days (SD)			
Treatments (T)	**7**	**14**	**21**	**Mean (C)**
Control	4.0 d	8.0 c	12.0 a	**8.0 a**
Chit (0.25%)	1.0 e	1.0 e	10.25 ab	**4.08 b**
Si (150 ppm)	1.0 e	1.50 e	9.50 bc	**4.00 b**
Chit + Si	0.0 e	3.75 d	9.50 bc	**4.41 b**
Mean (SD)	**1.50 c**	**3.56 b**	**10.31 a**	
LSD ($P \leq 0.05$)	**T= 0.81**	**SD = 0.63**	**T x SD = 1.82**	

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Red Drupelet Reversion RDR (%)

- Physiological disorder that causes blackberries to turn red after harvest.
- It occurs when blackberries are damaged during harvest or shipping, such as by bruising or compression.
- Studies have shown that blackberries with temperatures over 72.5 degrees Fahrenheit before cooling are most likely to show reddening symptoms.

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RDR (%)

	Storage days (SD)			
Treatments (T)	**7**	**14**	**21**	**Mean (C)**
Control	8.0 d	10.0 cd	22.50 a	**13.50 a**
Chit (0.25%)	2.50 f	3.0 f	14.50 b	**6.66 b**
Si (150 ppm)	2.50 f	3.25 f	15.50 b	**7.08 b**
Chit + Si	2.50 f	5.50 e	11.75 c	**6.58 b**
Mean (SD)	**3.87 c**	**5.43 b**	**16.06 a**	
LSD ($P \leq 0.05$)	**T = 0.91**	**SD = 0.72**	**T x SD = 2.06**	

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Market index (MI)

- The following formula estimated the marketability index (MI) of the blackberry. The lowest possible value of 85 percent was considered for a clamshell suitable for marketing (Clark and Perkins-Veazie, 2011).

  - **MI (%) = 100− [(% RDR + % Leakage + % Mycelium)/3]**

Market index (MI)

	Storage days (SD)			
Treatment (T)	**7**	**14**	**21**	**Mean (C)**
Control	92.50 b	86.16 c	72.16 e	**83.61 b**
Chit (0.25%)	98.0 a	96.83 a	82.25 d	**92.36 a**
Si (150 ppm)	98.16 a	97.25 a	83.41 d	**92.42 a**
Chit + Si	98.16 a	93.91 b	85.00 c	**92.36 a**
Mean (SD)	**96.70 a**	**93.54 b**	**80.70 c**	
LSD ($P \leq 0.05$)	**T = 0.49**	**SD = 0.49**	**T x SD = 0.63**	

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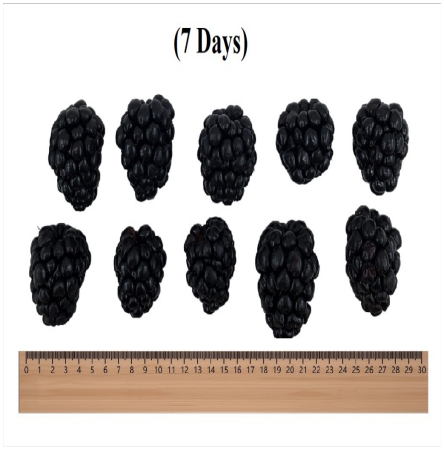
(0 Day)

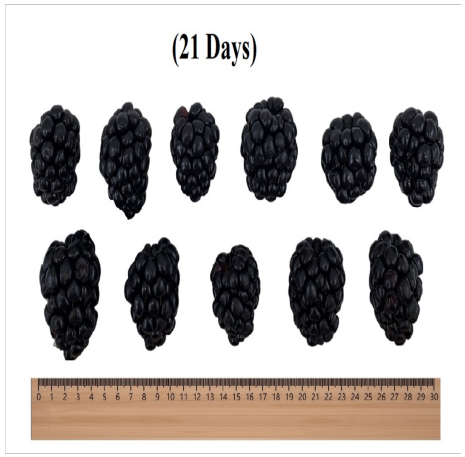
(7 Days)

(14 Days)

(21 Days)

Silicon-150 ppm

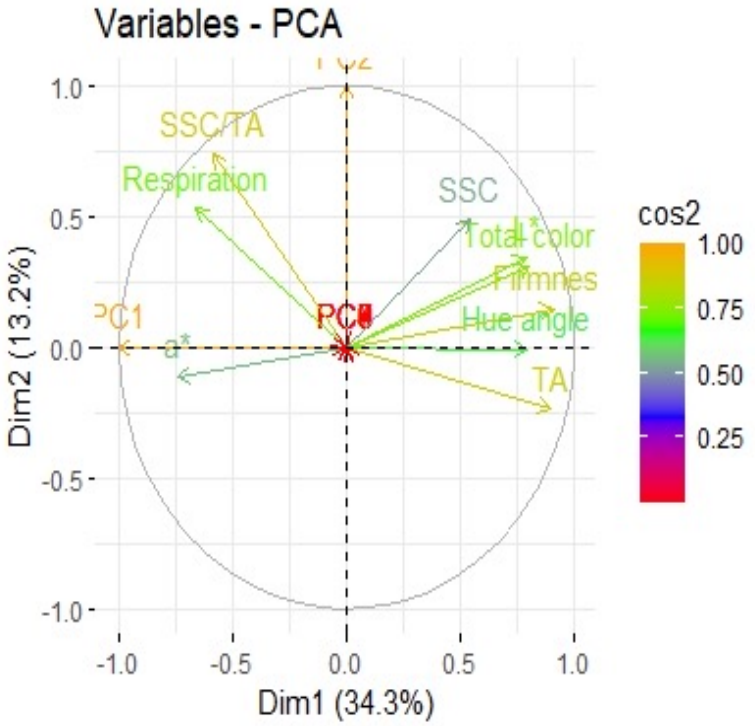


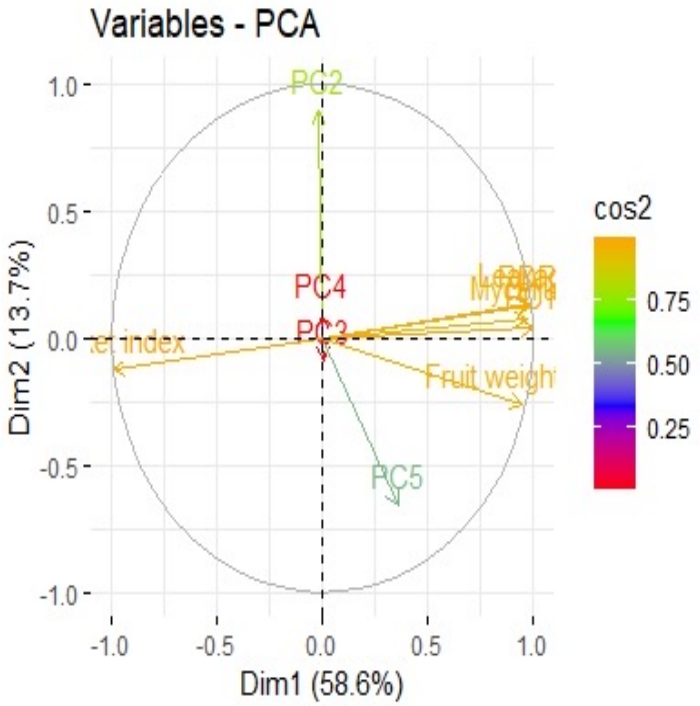


Chitosan- 0.25%

Chitosan + Silicon

Principal Component Analysis (Statistical software (R)





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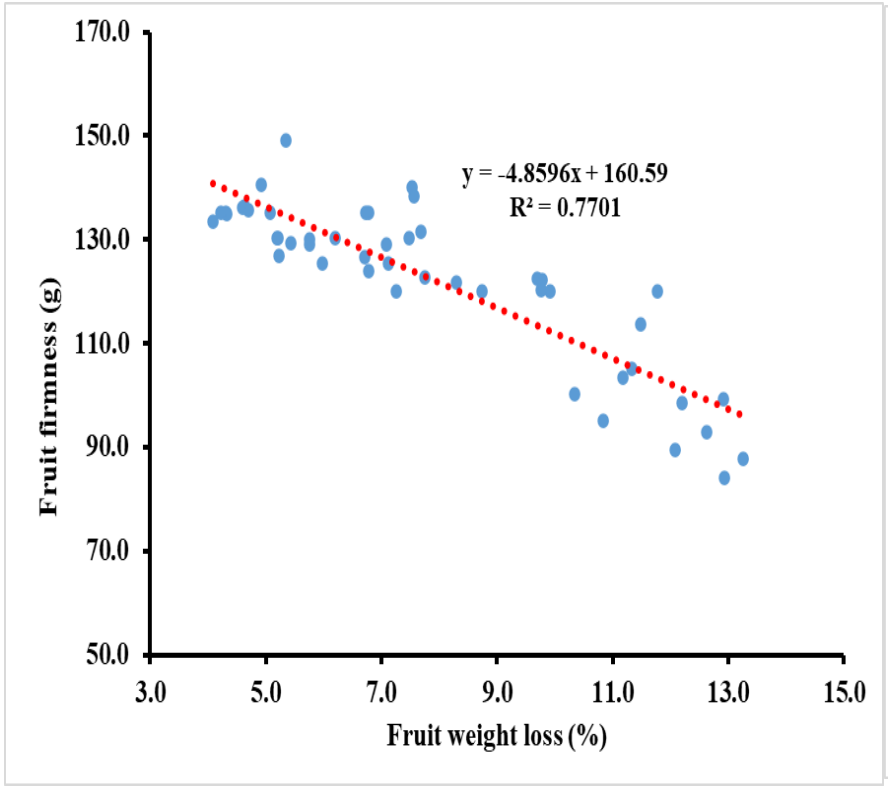
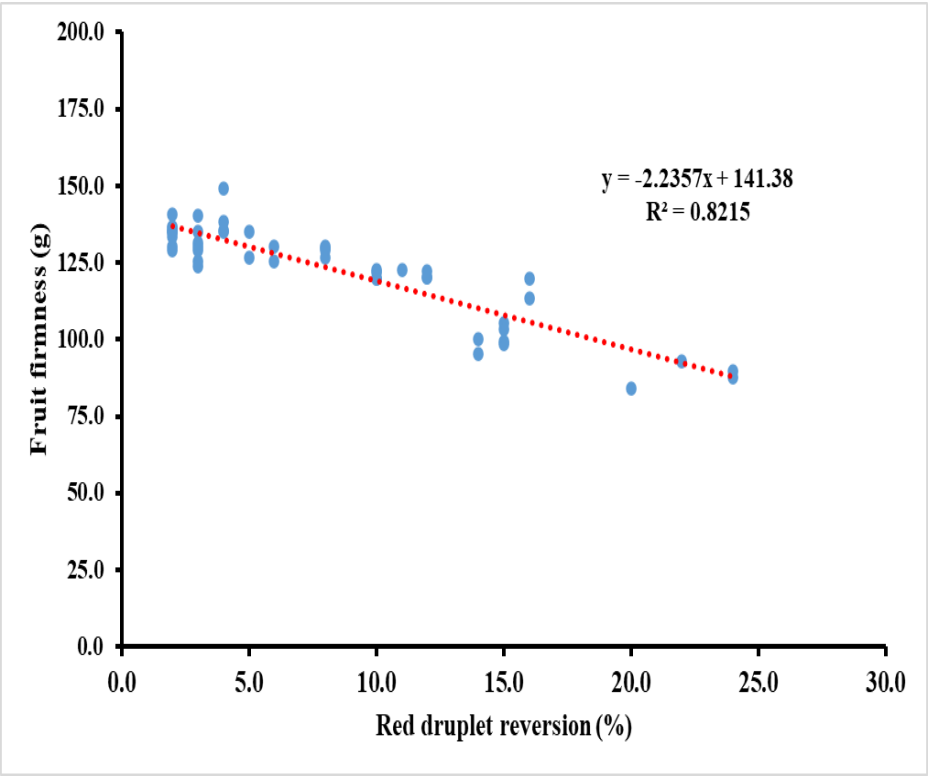
Correlation





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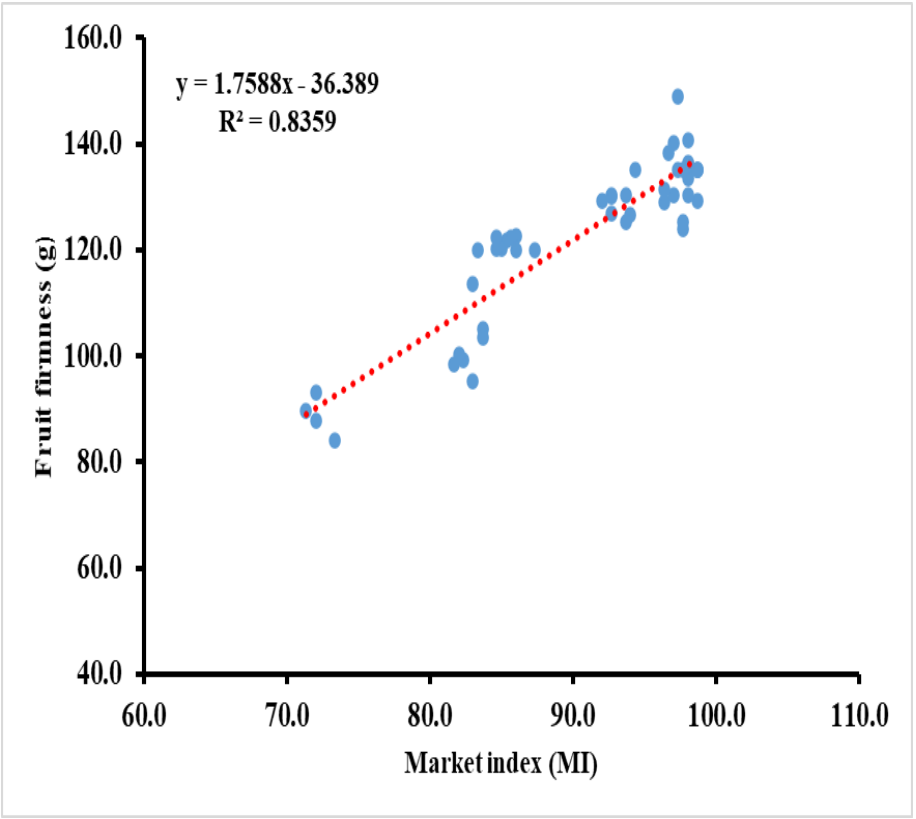

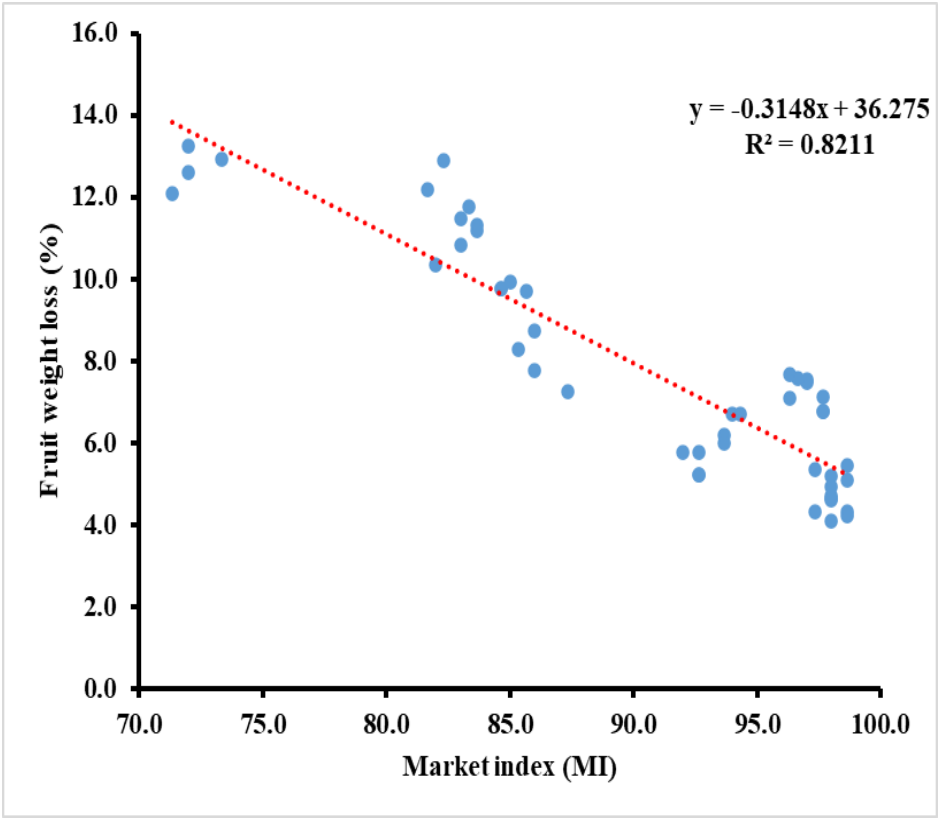

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Conclusion

- Chitosan (0.25%), and silicon (150 ppm) both can improve the blackberry shelf-life by maintaining fruit physicochemical properties.
- Preharvest spray treatments were found suitable to extend the shelf-life by minimizing supplementary operations after harvesting the fruit.
- It is critical to mention that the integration of chitosan (0.25%) + Silicon (150 ppm) as preharvest spray treatments could be beneficial for blackberry production

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Acknowledgment

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- Fruit Physiology Lab members at NFREC Quincy
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- Grower Bryan Baxley for providing fruit.

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THANK YOU..!!

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