

THE EFFECT OF PACKAGING AND STACKING ON THE QUALITY AND MARKETABILITY OF MANDARIN (*Citrus reticulata* Blanco var Szinkom)

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Introduction



Mandarin (*Citrus reticulata* Blanco var Szinkom) of the Family Rutacea

High demand during long holiday season (Christmas and New Year) due to its shape

Normal harvest season is from November to January

In recent years, harvest is either earlier or later by 1 to 3 months



Top five mandarin producing regions and provinces by volume (in metric tons) and percent of total production, Philippines, 2015 (Source: PSA, 2016)

Rank	Region	Volume mt	% of Total Production	Province	Volume mt	% of Total Production
	PHILIPPINES	14,064				
1	Cagayan Valley	6,446	46	Nueva Vizcaya	4,711	33
2	CALABARZON	3,661	26	Laguna	2,521	18
3	Davao Region	1,061	8	Quezon	964	7
4	CAR	872	6	Cagayan	800	6
5	Bicol Region	843	6	Davao City	680	5





7-tonner truck



3-tonner jeepney



Issues in *Szinkom* mandarin

Issues

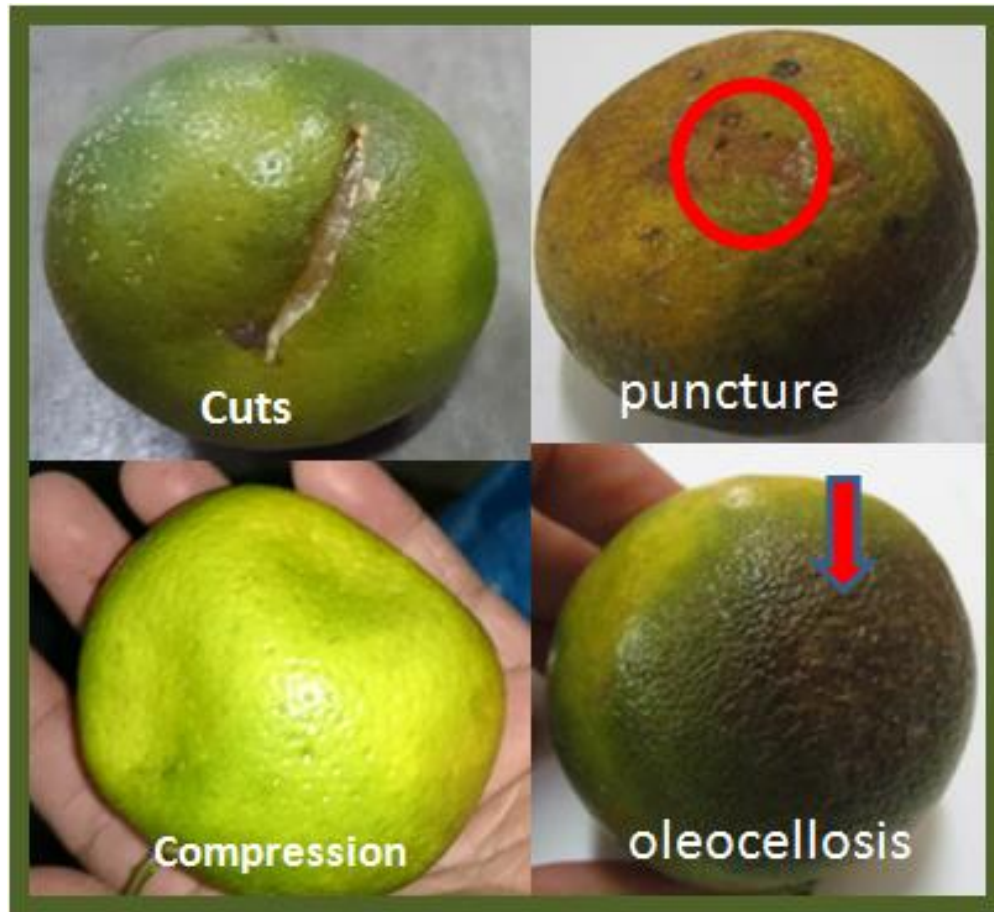
- Lack of infrastructure (packingshed, storage, roads)
- Lack of adequate transport
- Lack of appropriate packaging materials
- Rough handling



Outcomes

- High mechanical damage (compression, abrasion, puncture, cuts)
- High postharvest losses (5-37%)**





Mechanical damage observed in *Szinkom* mandarin. **Oleocellosis** (breakage of oil glands) is a result of a combination of compression and abrasion.

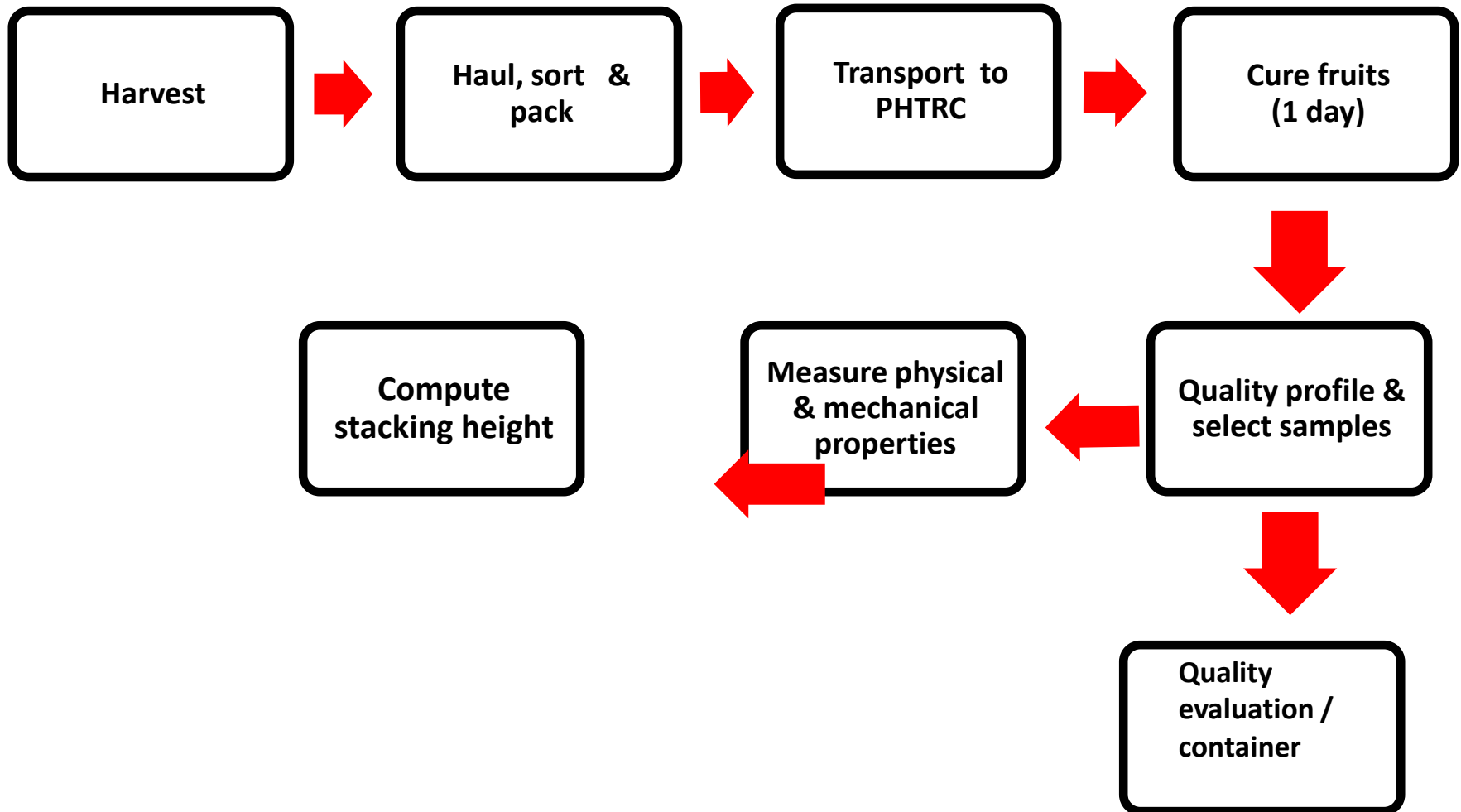
Objectives

- Determine and compare the quality of *Szinkom* mandarins packed using different containers, and
- Determine the physical and mechanical properties of the fruit in relation to packaging and stacking



Methodology

- Fruits were harvested from San Antonio, Quezon
- Early season (September) and late season (January)





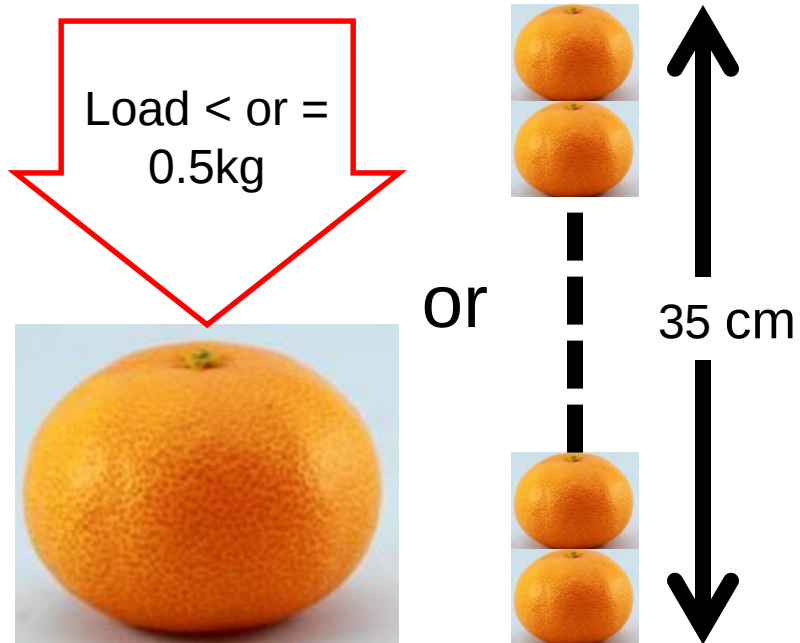
Harvesting



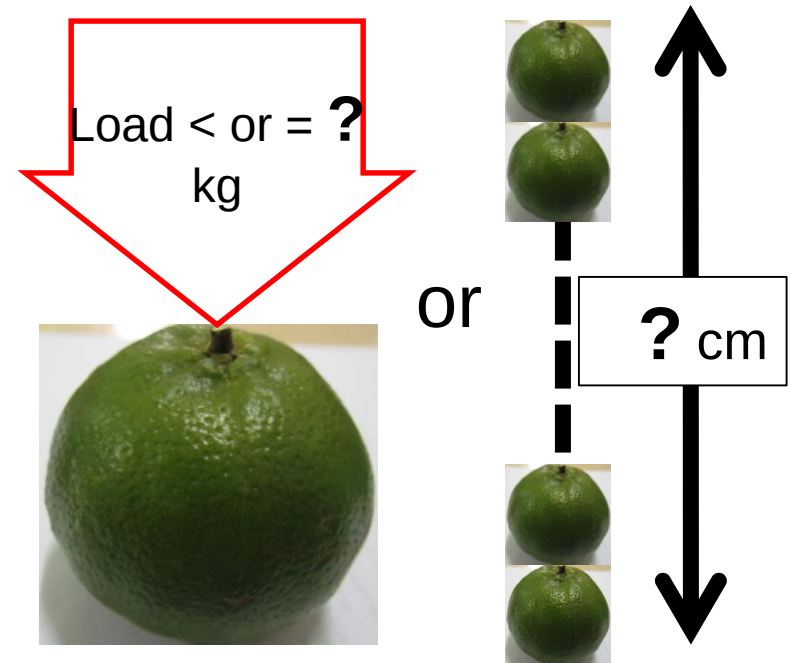
Field sorting

Stacking height

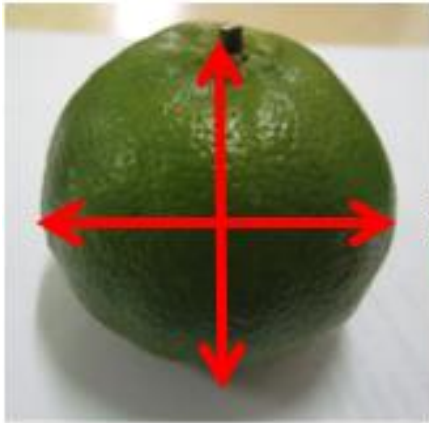
Japanese 'Satsuma'



Philippine 'Szinkom'



Yamashita and Kitano, 1981



Polar diameter

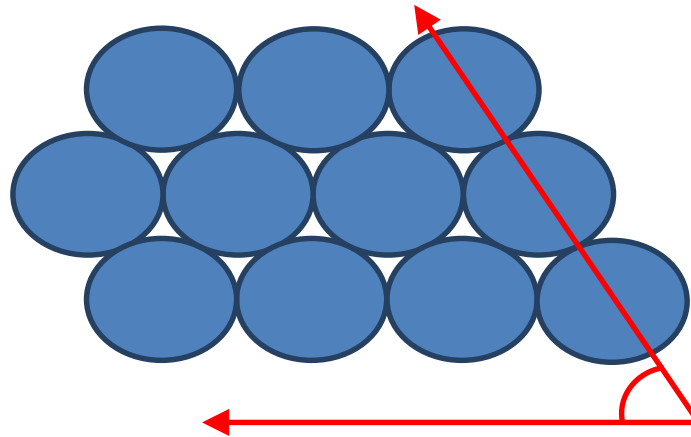
Equatorial
diameter



Aikoh digital force gauge
Compression test
(force and deformation)

Physical and Mechanical Tests

- Stress-strain graph using reading in force gauge and downward distance travelled by probe
- Point of inflection of the stress-strain curve (N/cm^2) – where structural failure starts
- No. of layers = $[\text{pt. of inflection} \times 1000] \div [\text{Wgt}_{\text{individual}} \times 9.81 \text{ m/s}^2]$
- Stacking height, cm = no. of layers $\times$ diameter $\times \sin \emptyset$



Results and discussion

Flexible packaging materials



Red net sacks



Plastic sacks

Rigid containers



Used cartons



Plastic crates

Dimension (cm) and volume (kg) of different packaging containers for mandarin.

Packaging	Dimension (cm)	Volume (kg)
Carton box	50 x 36 x 20 (L x W x H)	15 -18
Plastic crate	49 x 33.5 x 30.8 (L x W x H)	20
Plastic sack	15-18 (H)	20-25
Red net sack	22-24 (H)	20



Mechanical damage (%) in mandarins packed in various containers at the early (September) and late (January) seasons.

Time of harvest	Packaging	(%)Mean mechanical damage per pack	Highest & lowest % mechanical damage observed
Early (September)	Carton box	7	2.44 - 12.58
	Plastic crate	5	1.34 - 7.93
	Plastic sack	9	1.29 - 13.67
	Red net bag	9	5.14 - 13.78
Late (January)	Carton box	20	1.15 - 35.00
	Plastic crate	20	3.75 - 37.94
	Plastic sack	37	12.24 - 53.37
	Red net bag	29	8.44 - 47.42



Physical dimensions of *Szinkom* mandarins according to size in relation to packaging and stacking.

Size	Weight, gm	Polar diameter, cm	Equatorial diameter, cm	Minimum force to deform, kg _f	Minimum stacking layers	Maximum stacking height, cm
Large	96.96	5.55	6.25	0.92	9.7	49.95
Small	66.04	4.27	4.87	0.66	9.8	38.43

- Standard/common plastic crates used for fresh produce = 30 cm inside depth
 - Horizontal dividers every 1-foot or 30-cm piled mandarins during bulk loading



Conclusions

- Mandarins harvested during late season had higher incidence of mechanical damage due to more ripe fruits
- Fruits placed in rigid packaging materials (carton and crate) had lower incidence of mechanical damage than flexible packs (plastic sack and red net bag).
- Though the differences were not significant, translation in terms of more marketable volume and reduced losses will be very important to the growers and traders.



Conclusions

- *Szinkom* stacking should not exceed 38 cm
The standard plastic crate (50L) can be used for storing and handling - its depth does not exceed 38 cm.
- For bulk handling and transport, it is recommended to use horizontal dividers for every foot (30 cm) depth.



References cited

- Agravante JU & OK Bautista, 2007. Packaging. IN: Postharvest Technology for Southeast Asian Perishable Crops. OK Bautista & and EB Esguerra (eds). UPLB, College Laguna and DA-BAR. Quezon City. 153-169
- Aremu D. O., Ogenlowo Q. O., Azuz A. A., Babajide N. A. and Ogulande C. A. (2015). Effectiveness and availability of packaging materials for fruits and vegetables: A case study of Ido local government, Ibadan Oyo



Have a fruitful and
enjoy the rest of the
day !

