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Dalal Werner (Aerial)

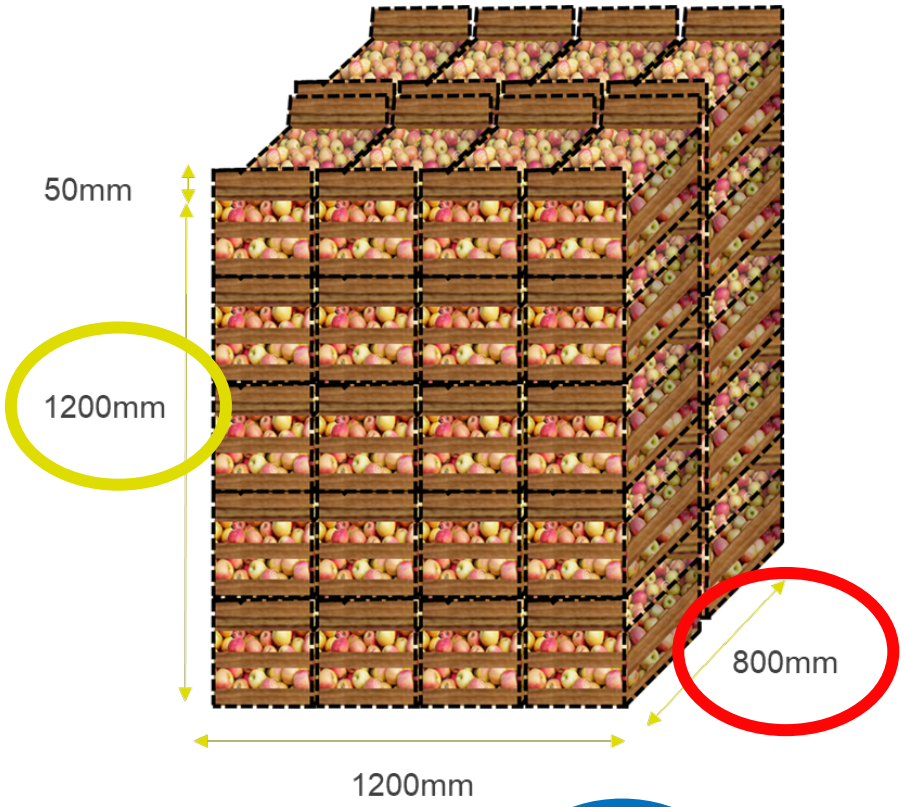
X-ray dose mappings on fresh fruit pallets

Apples & Mangoes

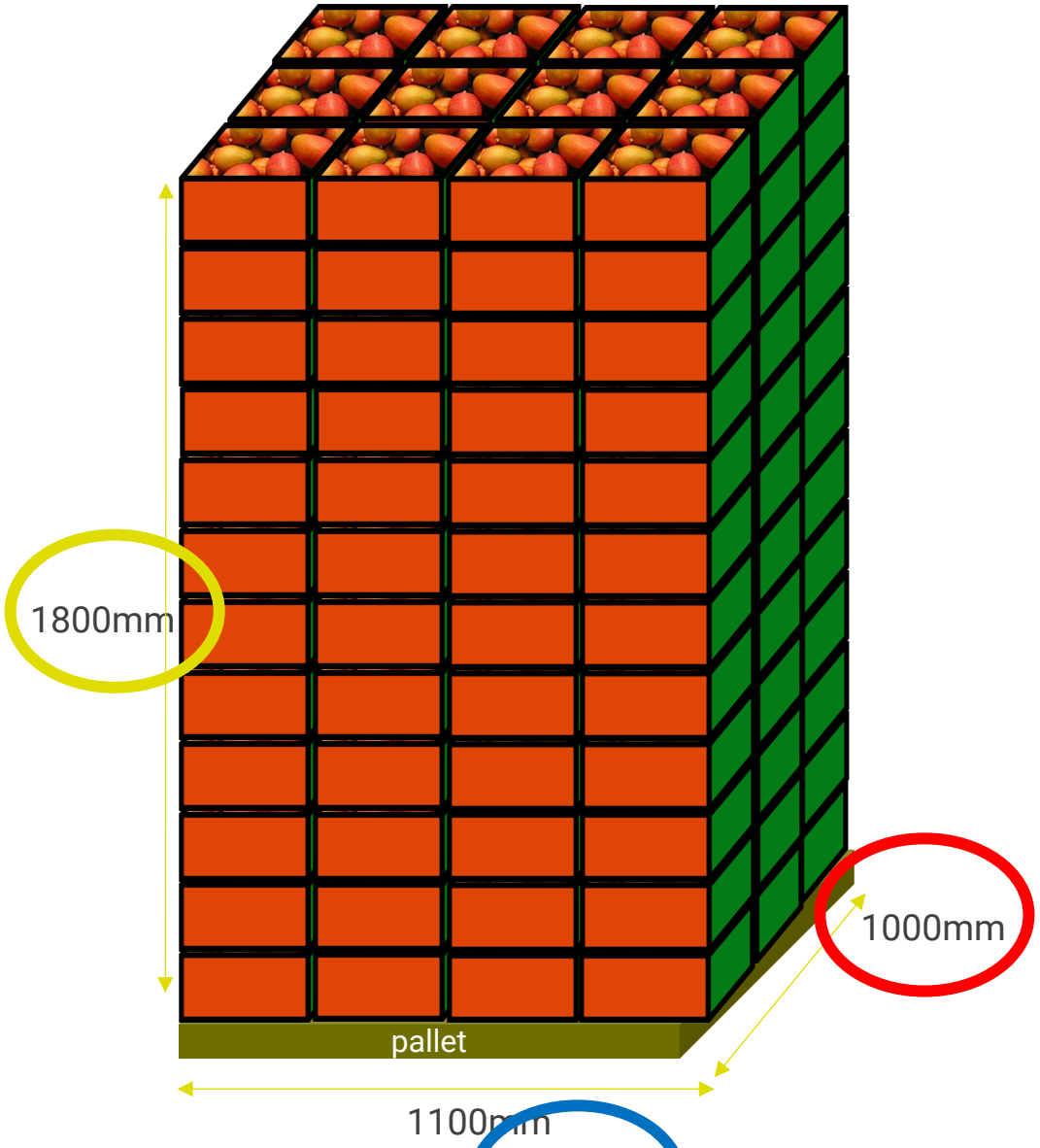
Apples (Braeburn variety)
February 2020
Local french fruit, easily available

Mangoes (Palmer variety)
October 2020
Important use case for Brasil
(Abrafrutas)

Product configurations



Avg. density: 0.38 g/cm³
Total mass: 440 kg

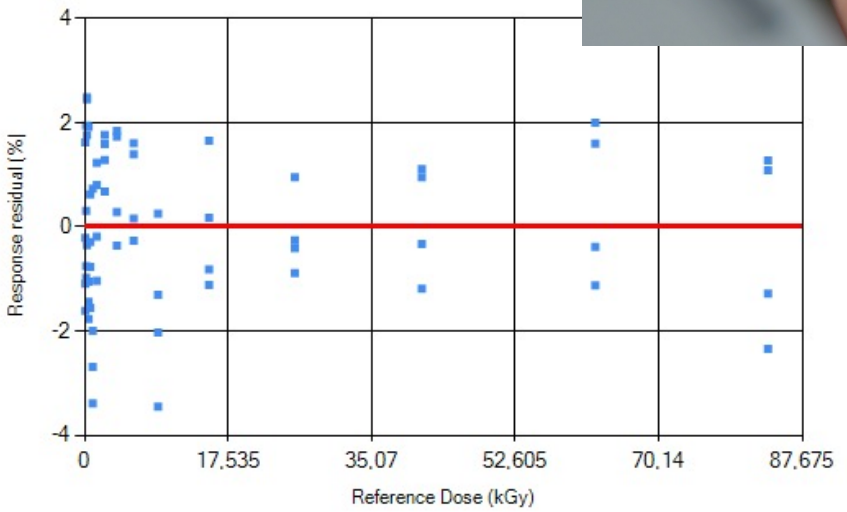


Avg. density: 0.47 g/cm³
Total mass: 920 kg

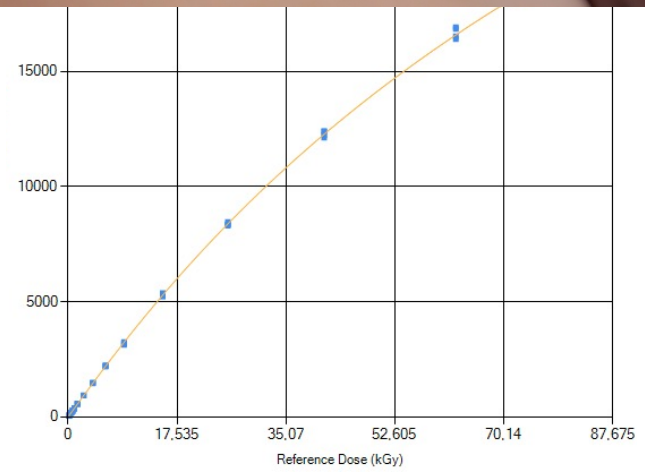
Dosimetry systems

Alanine/EPR:

- Alanine (amino acid) 4mm diameter - 36.4mg
- Under blister for easy handling
- MS5000 EPR spectrometer
- AerEDE dosimetry software
- Single point, absolute, high accuracy (~2%)



Residual plot for Blister Calibration



Blister Batch 05/17 Calibration

Dosimetry systems

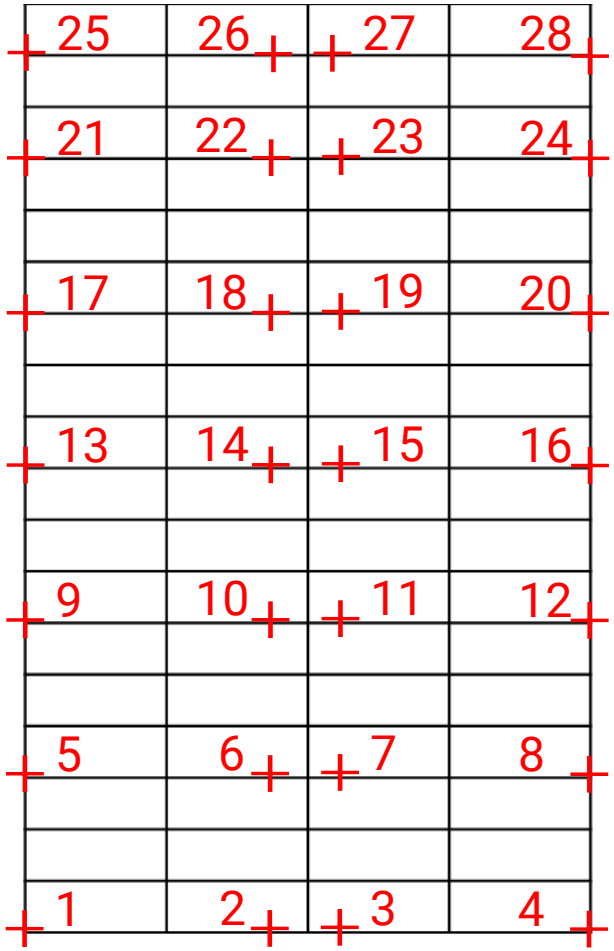
CTA (cellulose triacetate) films, read by UV absorbance.

Allows to measure 1D dose profiles and to identify the positions of minima and maxima.

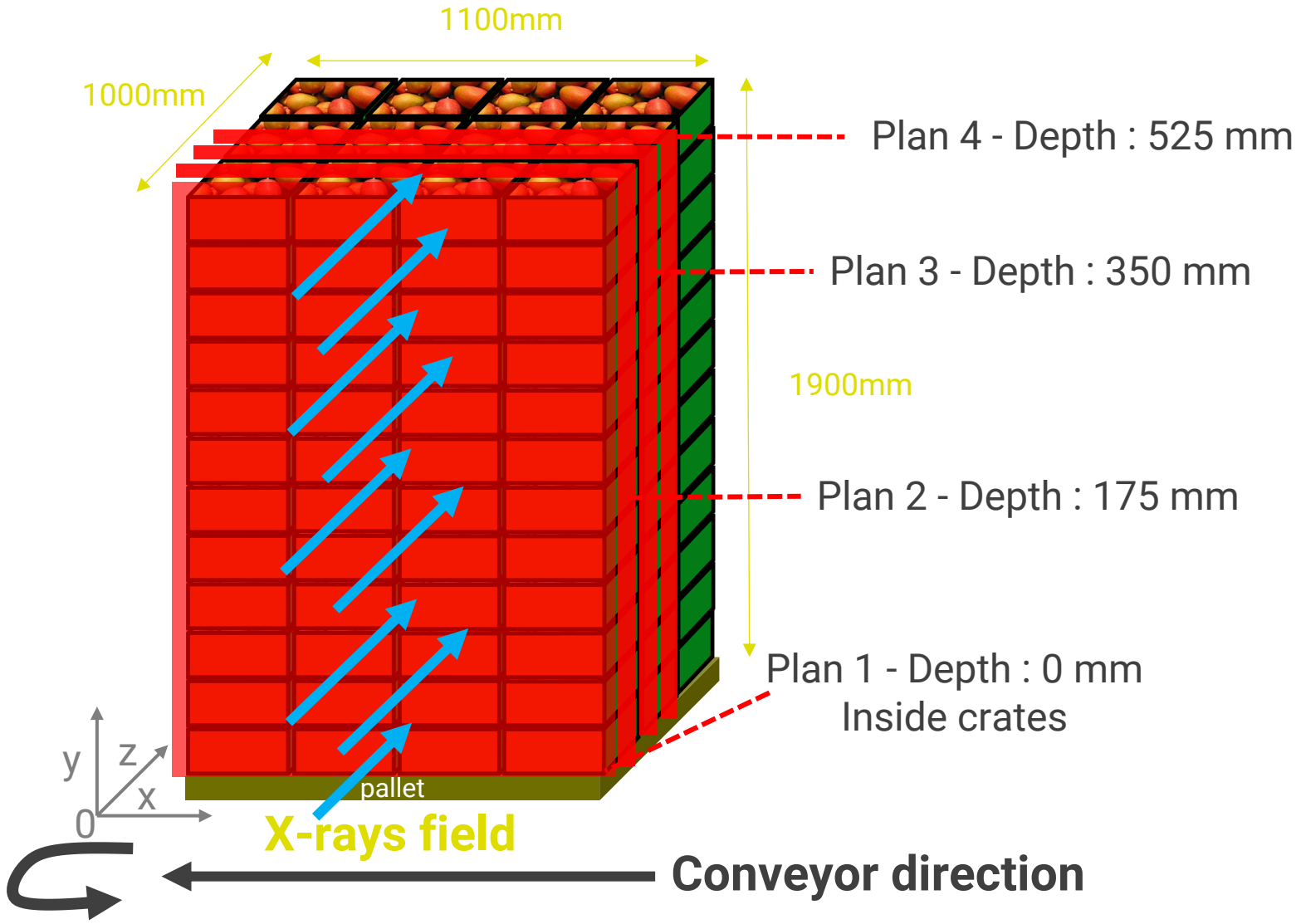
Reader: Aerial Dos'ASAP

Planification (mangoes example)

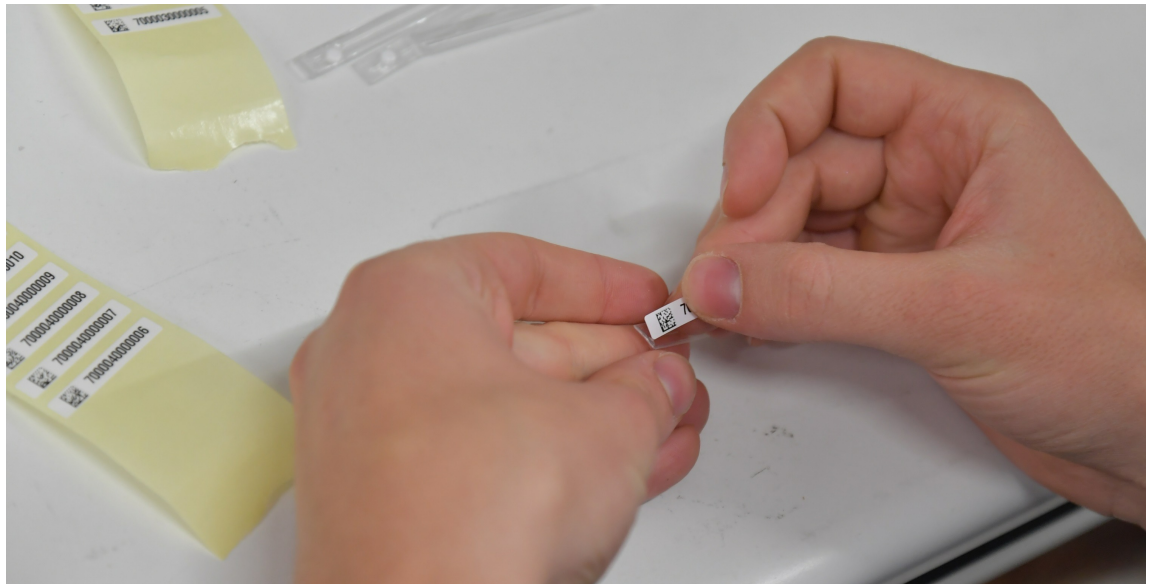
Dosimeter positions



Front view



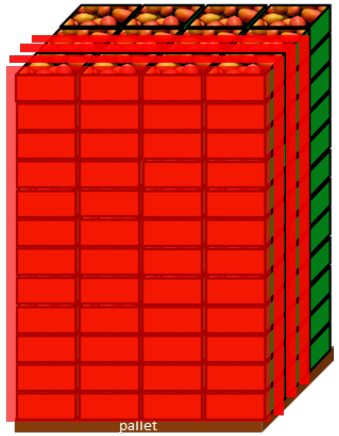
Mapping



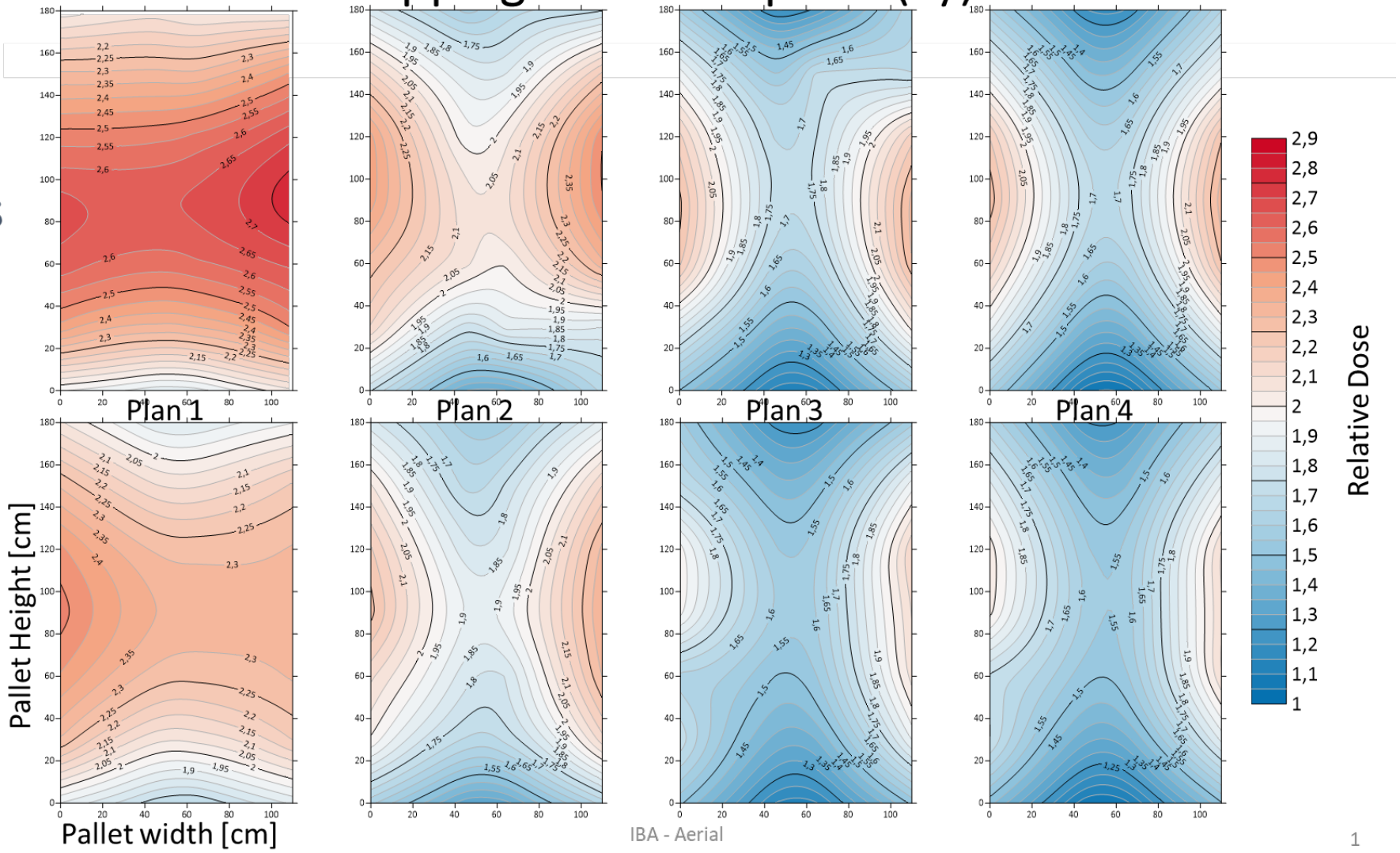
Results: surface mapping (mangoes)

3D dose mappings - Vertical plans (xy)

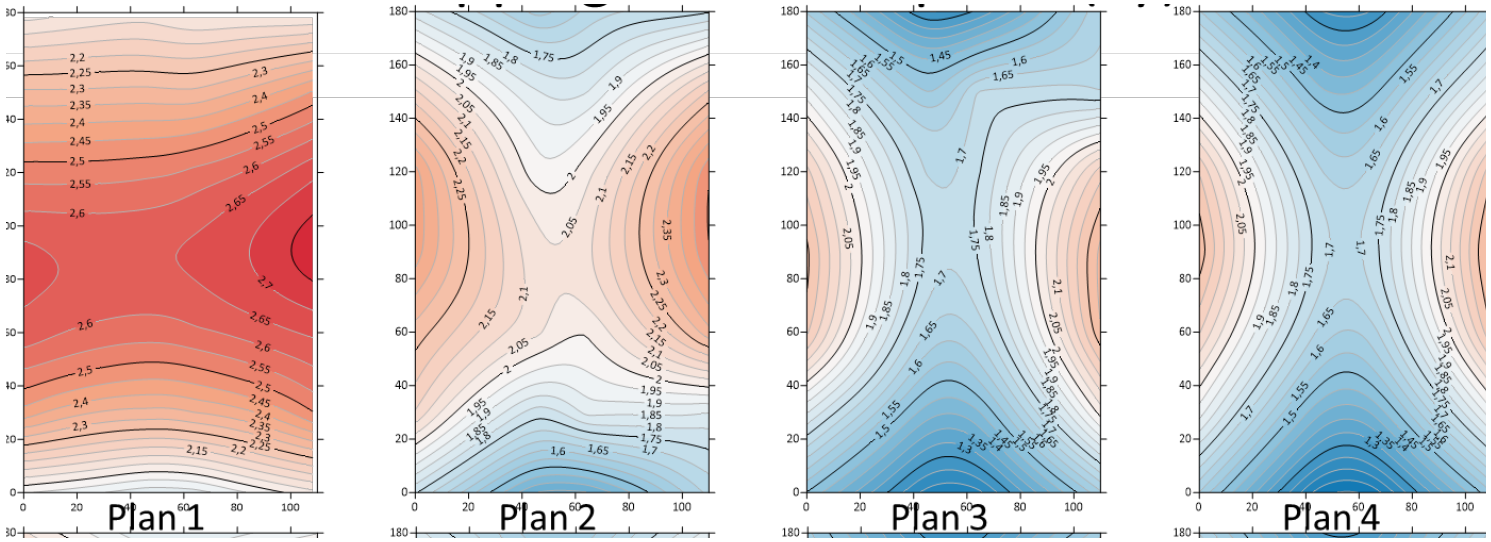
5MV – X-rays

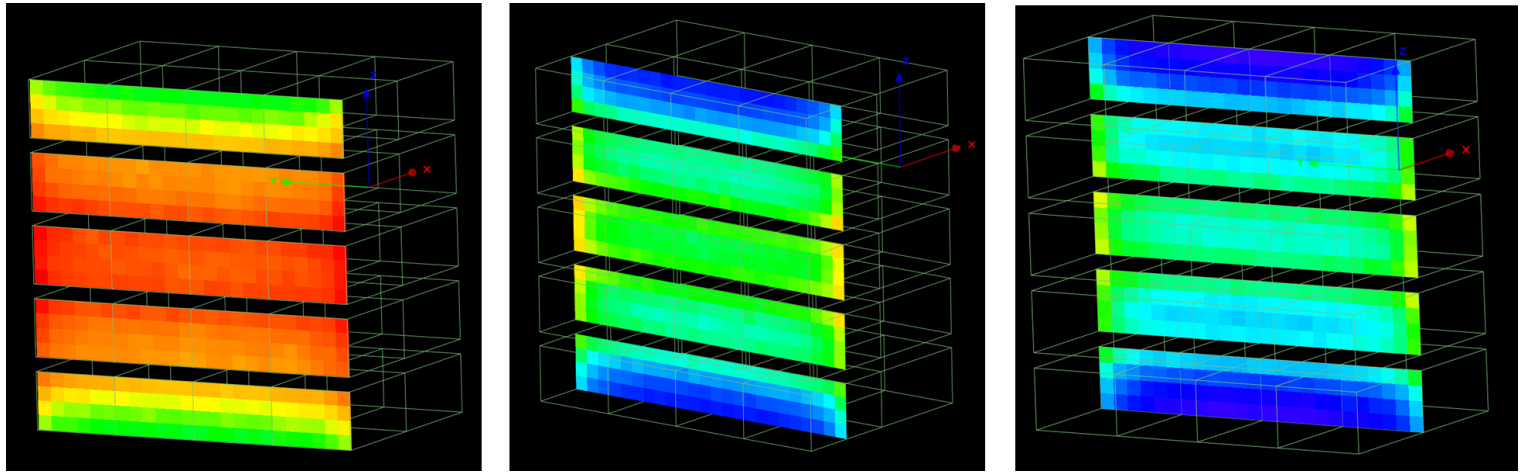


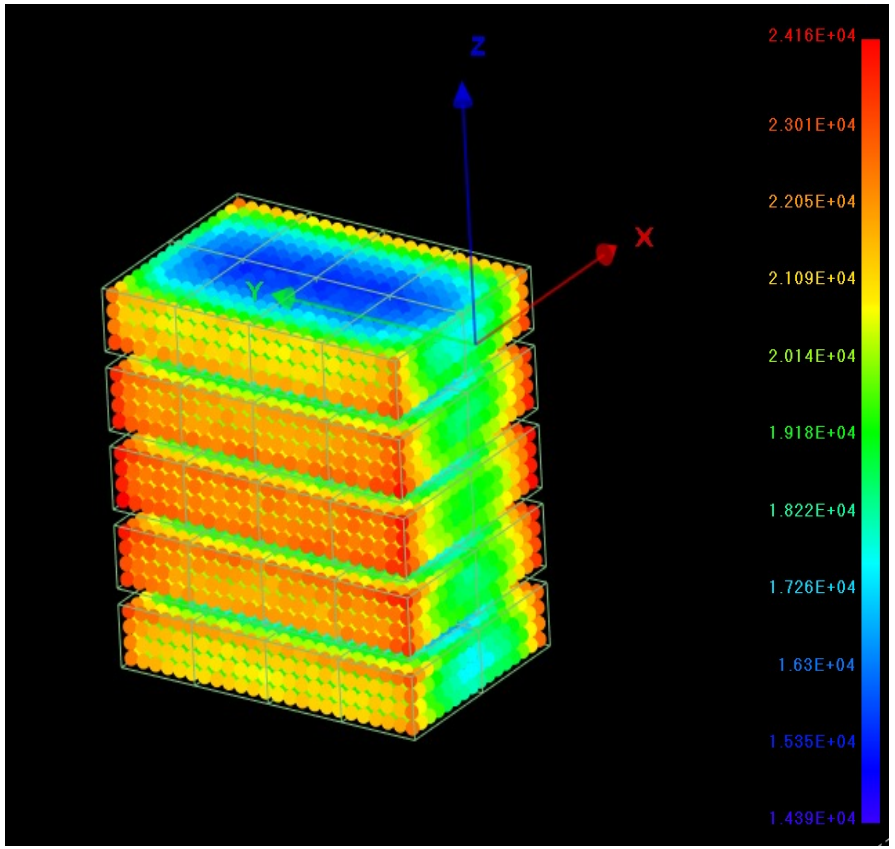
7MV – X-rays



Results analysis

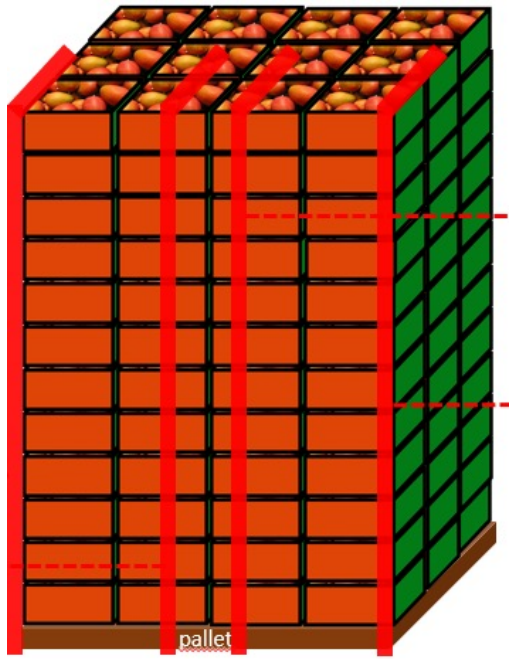






Global Figures

	Height [cm]	Depth [cm]	Avg. Density [g/cm³]	Mass [kg]	DUR (max/min)	Throughput [t*kGy/100kW/h]
Apples 5 MeV	120	80	0.38	440	1.69	2.27
Apples 7 MeV	120	80	0.38	440	1.62	3.75
Mangoes 5 MeV	180	100	0.47	920	2.87	8.31
Mangoes 7 MeV	180	100	0.47	920	2.56	9.37



DUR breakdown for mangoes 7 MeV

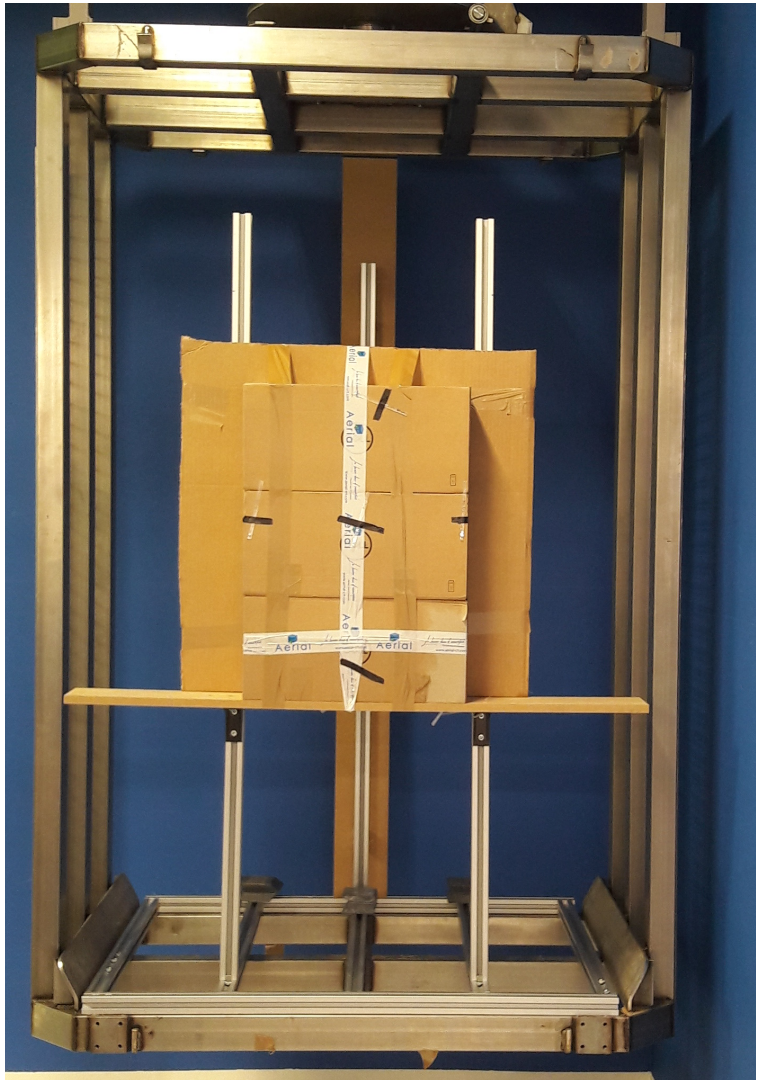
- Vertically on median plane, surface: 1.42
- Vertically on median plane, in-depth: 1.31
- In depth: 1.58
- Lateral: 1.13

- In central volume (excluding lateral plans): 2.37

- Total: 2.56

Irradiations for physico-chemical analysis

Irradiations for physico-chemical analysis



➔ Guaranteed +/- 10% dose precision and uniformity across all mangoes, and inside their whole volume

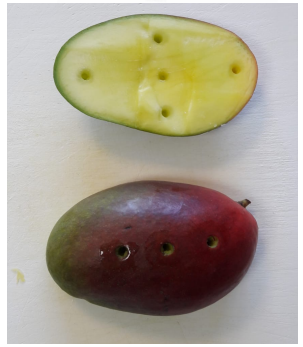
TRIAL CONDITIONS

Irradiation conditions :

- Source: X-rays 5 MeV, Feerix Aerial
- Doses: 0 (control) – 200 – 400 – 800 Gy

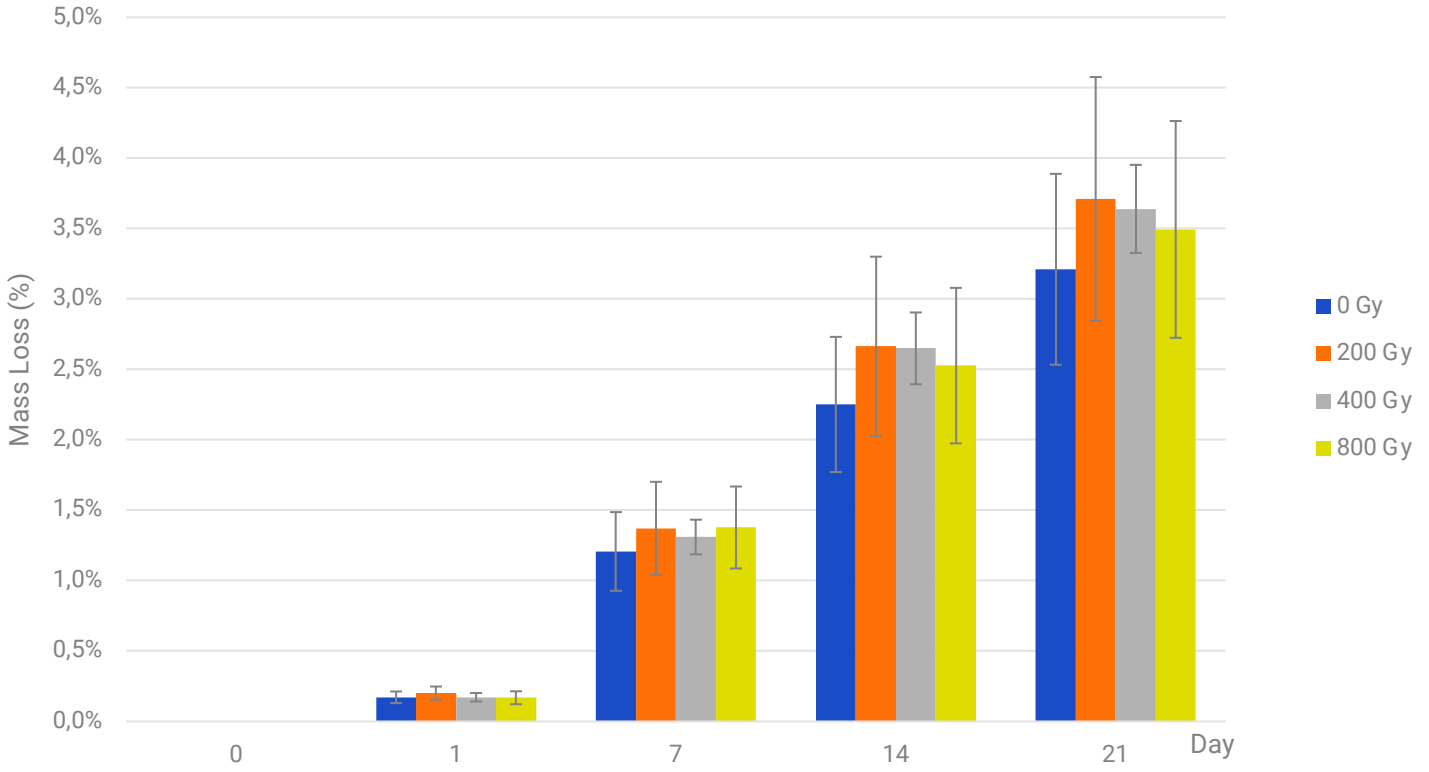
Parameters monitored

- Mass loss
- Texture of peel and pulp (hand dynamometer PCE-FM 200)
- pH & Titrable acidity
- Brix index (hand refractometer)
- Pulp shade (chromameter Konica Minolta CR-400)



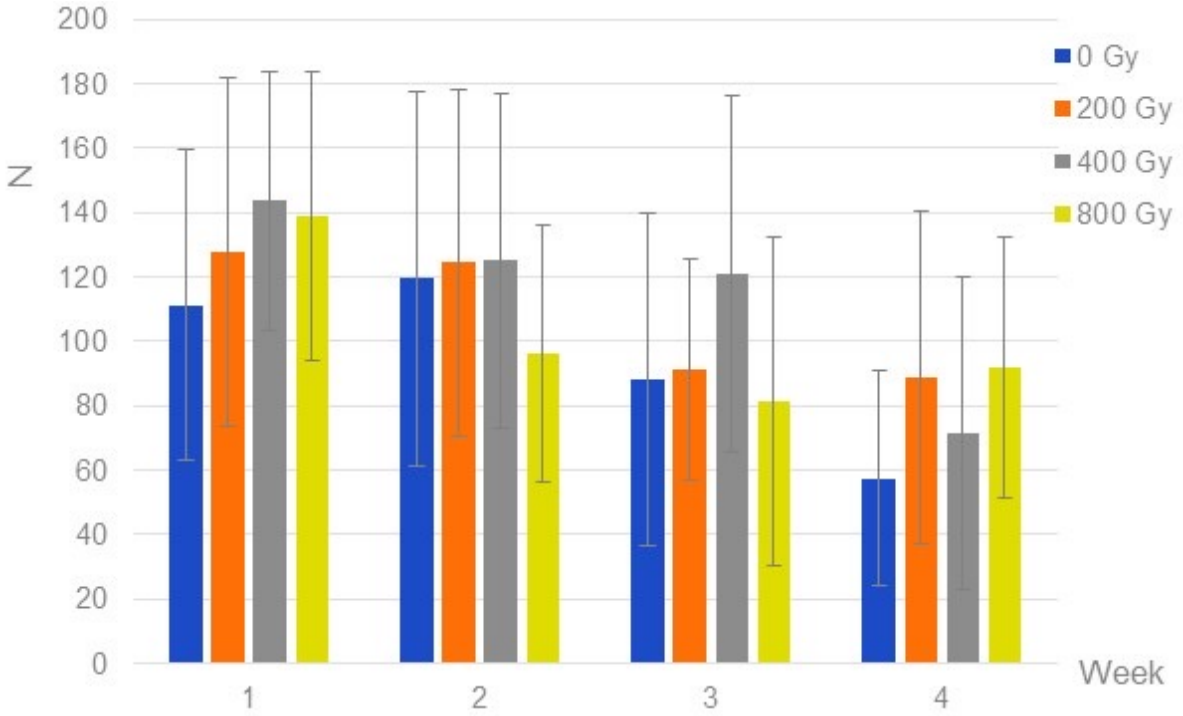
- Sampling: 10 fruits /picking date
- Picking date: D1, D7, D14, D21
- Storage T°C: +8°C to 10°C

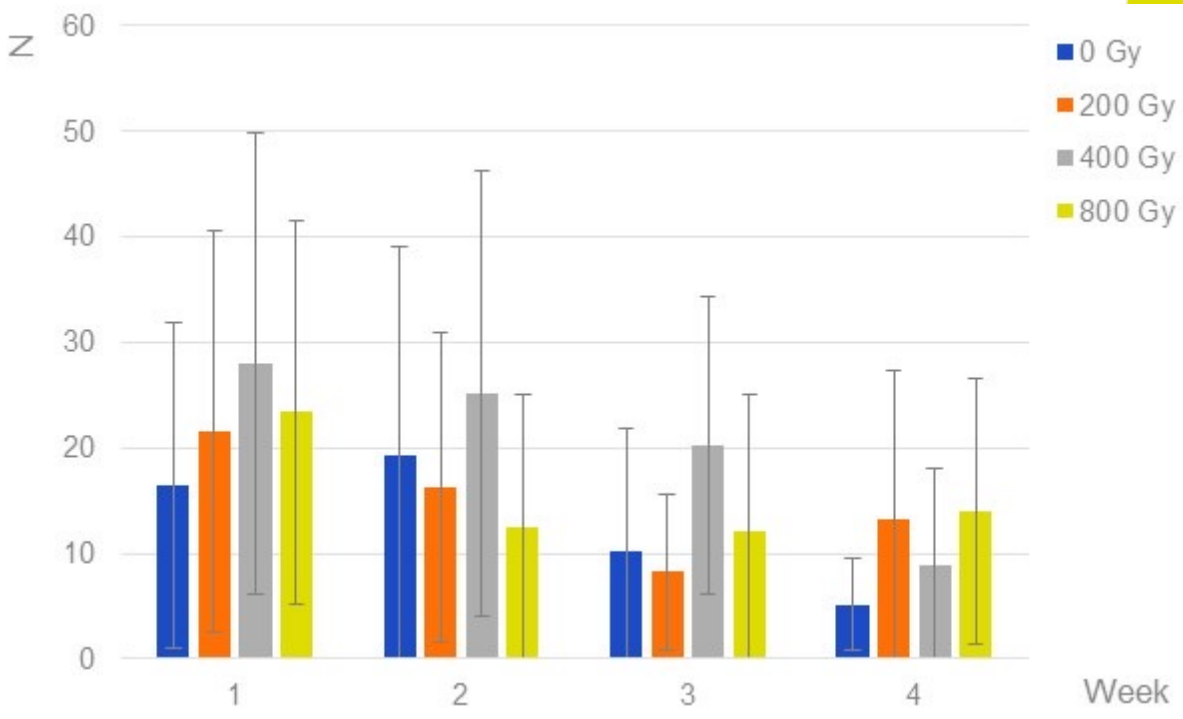
Mass loss (%) as a function of the applied dose and storage duration

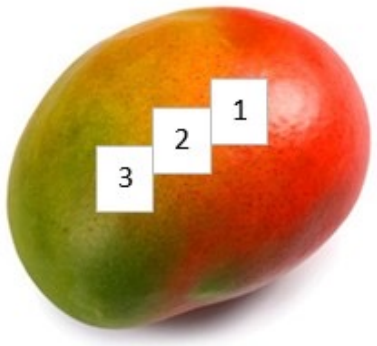


Results expressed as mean ± SD
N= 10

Texture (in Newton) of peel and pulp as a function of the applied dose and storage duration

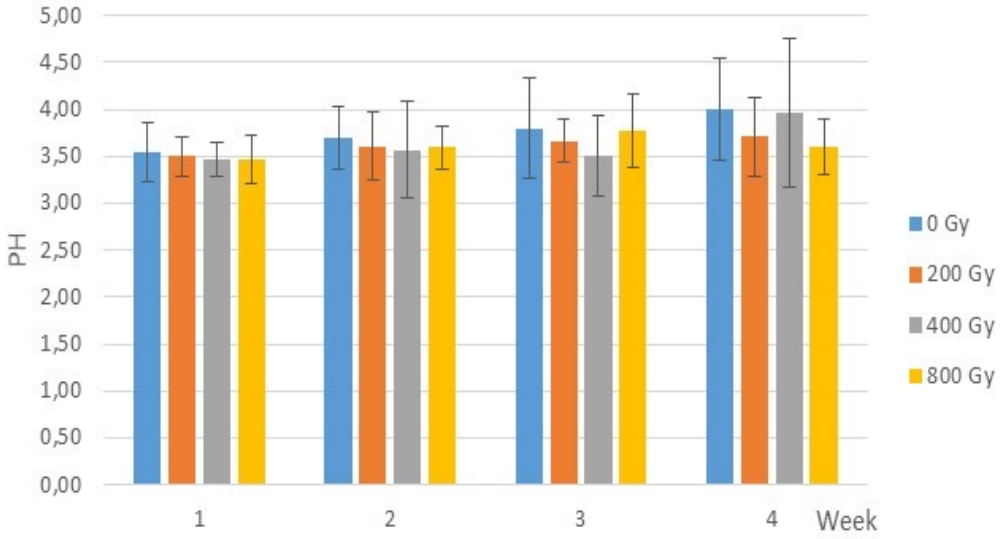


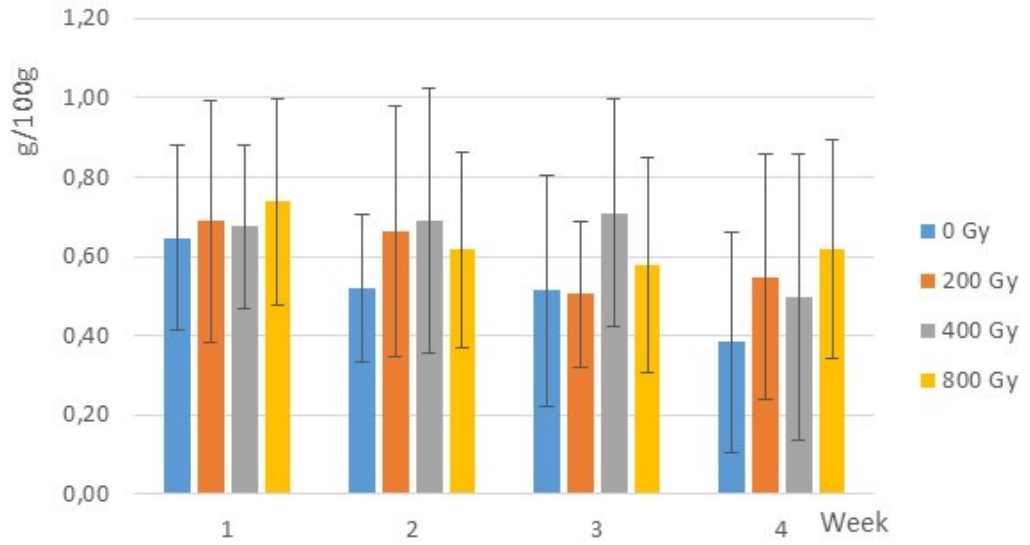


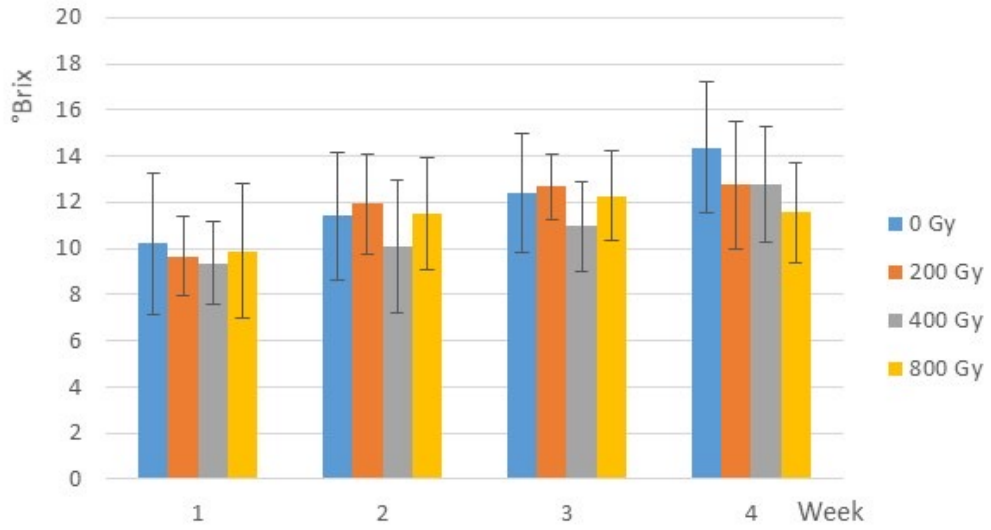


Results expressed as mean ± SD
N= 10

pH ; acidity (g of citric acid /100g of mangoes juice %) ;Total soluble solids content (°brix) as a function of the applied dose and storage duration

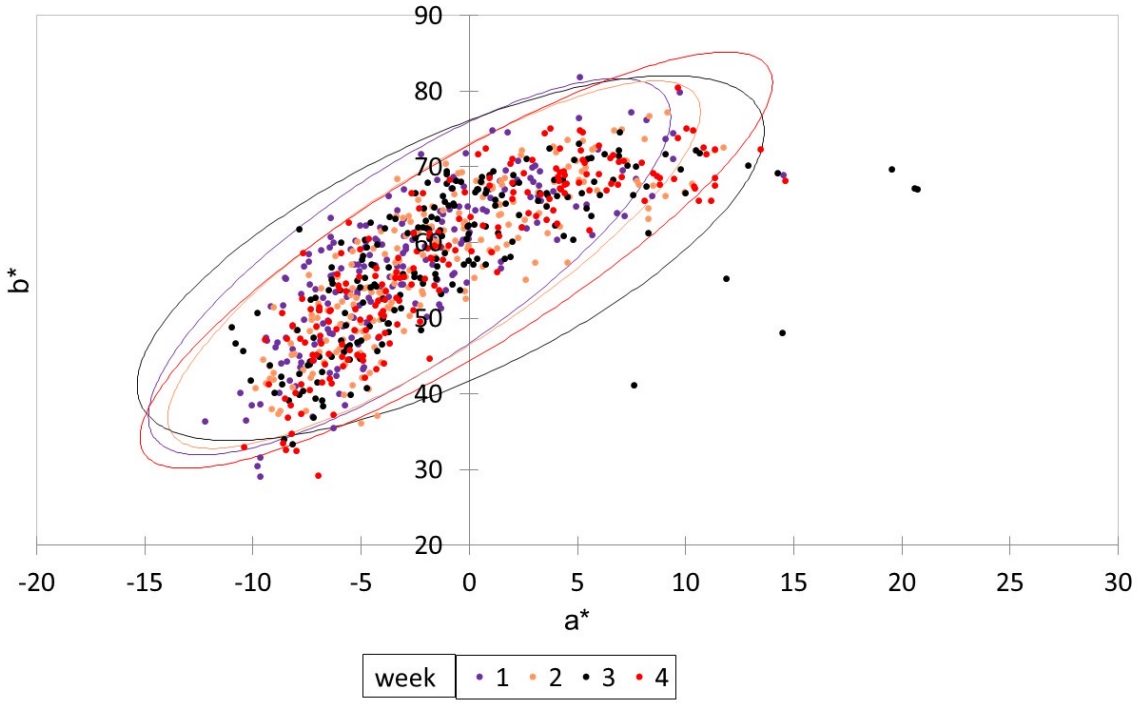


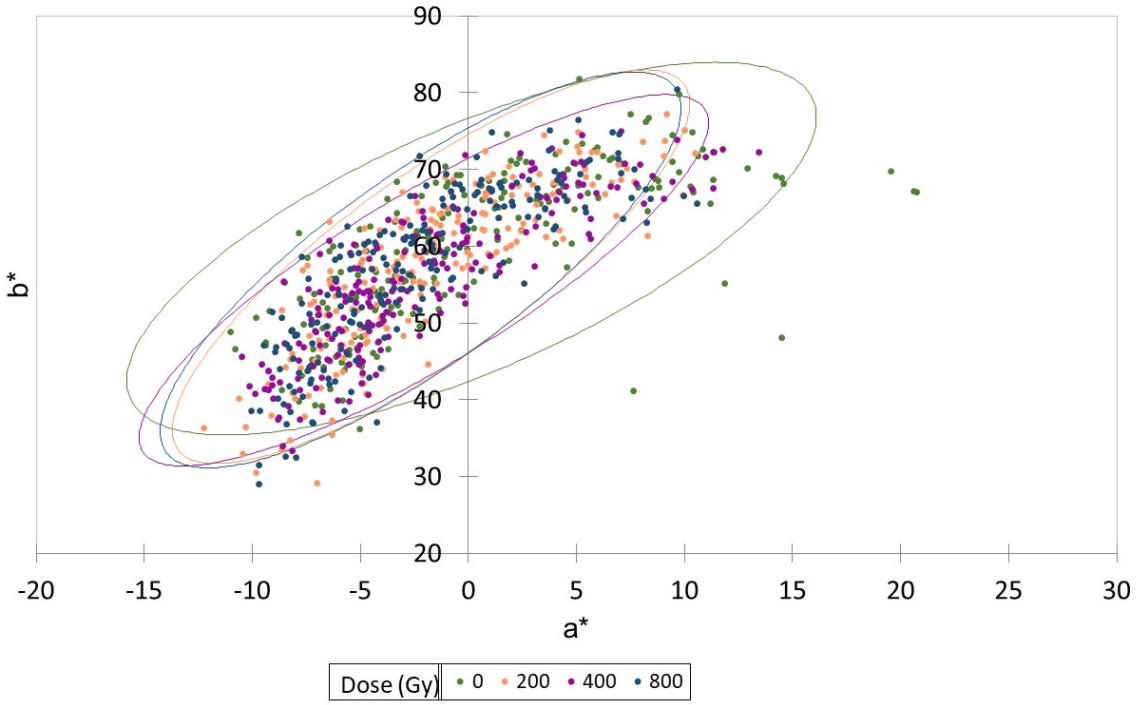


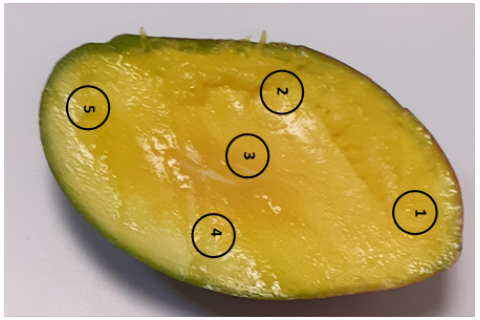


Results expressed as mean ± SD
N= 10

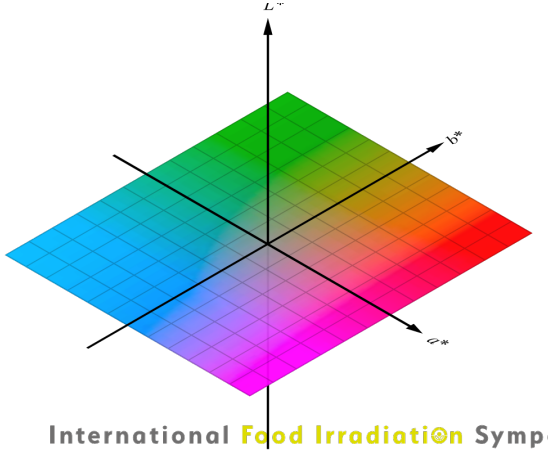
Color measurements (a* vs b*) of mangoes as a function of storage duration and of the applied dose







L*= degree of lightness
a* = degree of redness or greenness
b*= degree of yellowness or blueness



Impact of phytosanitary irradiation dose on Physical–chemical quality attributes of mangoes

Non irradiated mangoes, D_0

- Physical–chemical properties of mangoes have the same behavior no matter the absorbed dose of the fruits
- The values for total soluble solids, acidity, pH, texture of peel and pulp as well as color are independent of radiation dose or storage duration (up to 3 weeks)

↳ The differences observed as a function of the applied dose and/or the storage duration are not significant, taking into account the inter- and intra-fruit variability

- The mass loss increases in function of time for all doses

Thanks.

www.ifis2021.om

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