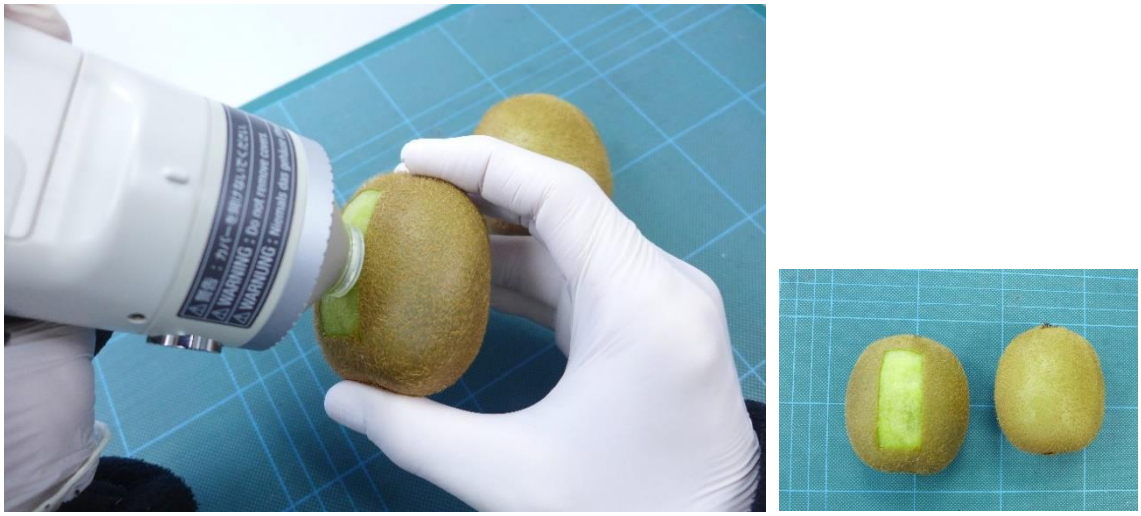
## Chroma Meter CR-400 for Kiwifruit Maturity Monitoring

Ensuring that all kiwifruits are harvested at the correct maturity is a key step in ensuring consumers receive quality fruits. In New Zealand, prior to harvest, all orchards have to be tested to ensure that the kiwifruit meets the strict maturity requirements established by the exporter. The kiwifruit exporter will appoint an independent laboratory to collect and process kiwifruit orchard maturity clearance samples for their export maturity clearance programme. If the sample meets the specified standard, a clearance will be issued for that maturity area of the grower line to be accepted for export. Some of the tests carried out on clearance samples include Brix, Dry Matter, Seed Color, Weight, Flesh Color, Core Disorder and Firmness. The kiwifruit sample will be subjected to these tests depending on the variety and time of the season. These tests will ascertain when growers are able to harvest their crops and also at what rate they will get paid for their fruit.

## Kiwifruit Color Assessment Method

A 2-mm-thick layer of skin and cortical tissue was removed from the kiwifruit to expose a flat and even surface in the outer pericarp, to avoid measuring the flesh immediately beneath the skin where color is variable because of uneven exposure to direct light. Color of the exposed flesh was then measured immediately using a Chroma Meter CR-400 fitted with a glass light projection tube CR-A33f under CIE illuminant D65 lighting conditions. Calibration of the chromameter was conducted before each use with a standard white plate. Color measurement was carried out on two sides of each fruit, at 90° to the equator, and the results averaged. Color was expressed in Hue angle (h) obtained from the CIE L*C*h colour space.



CR-400 employed for the determination of the color of the Kiwifruit (with skin removed) employing the scale CIELAB

For example, in the case of the Actinidia chinensis 'Hort 16-A' (yellow-fleshed kiwifruit), flesh color changes from green to yellow, which coincides with the end of maturation and beginning of ripening. Using the hue angle (h) obtained from CR-400, a standard can be set for harvesting Actinidia chinensis. In New Zealand, a hue angle of ≤103° for Actinidia chinensis cultivar is required for harvest. For more information on kiwifruit maturity colour development, please refer to this journal* on "Modelling of colour development in the fruit of Actinidia chinensis 'Hort16A'"

Why Chroma Meter CR-400?

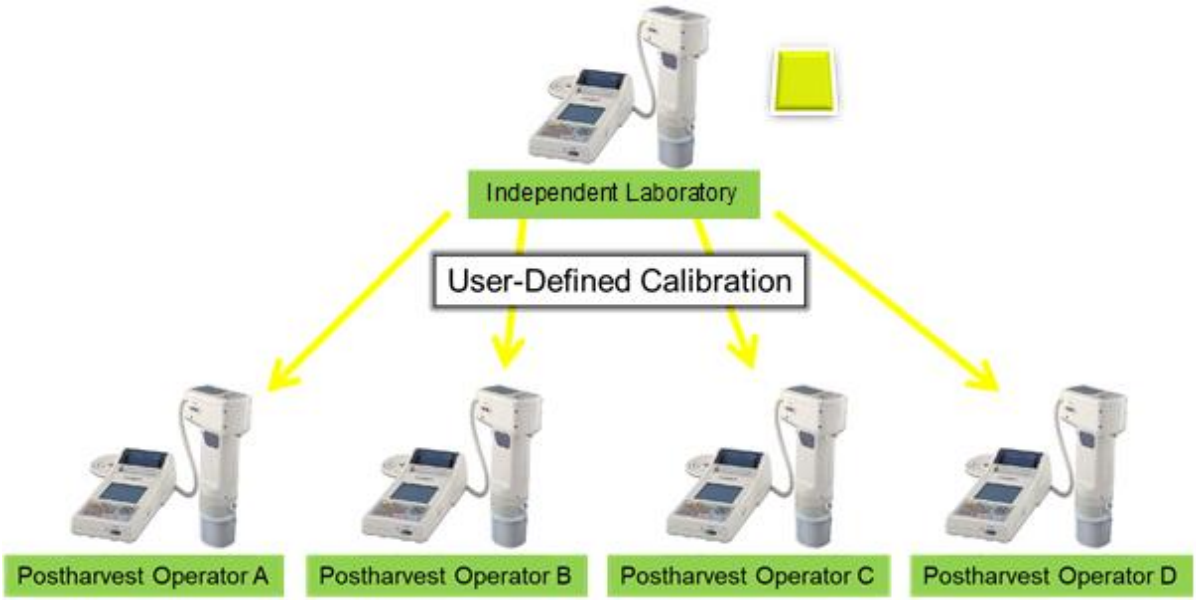
Ease-of-Usage and Rugged Design –

CR-400 was preferred largely due to its ease of usage and through the years, the CR series has proven to be a reliable instrument with minimum maintenance. Being a filtered colorimeter, its rugged design enables rough field handling, not possible with a spectrophotometer.

User-defined Calibration Feature –

A unique key feature in Konica Minolta Chroma Meter utilised by this Kiwifruit industry is the User-defined Calibration (UDC). UDC technology uses a matrix or single user-calibration function to improve reproducibility in a network of chroma meters when calibrated against a designated master unit. In an integrated color management program or supply chain management, UDC improves the workflow within the network of instruments leading to improved production yields by reduction in measurement uncertainty caused by inter-instrument agreement (IIA).

Chroma Meter CR-400 has an IIA within ΔE*ab 0.6 and with UDC technology, CR-400s can be calibrated to an inter-instrument agreement of within ΔE*ab 0.07 based on a single colour UDC.



In New Zealand, when the kiwifruit industry players either receive a new CR-400 or a corrective unit back from recalibration/repair, they need to send the unit to the independent laboratory appointed by the kiwifruit exporter first and the laboratory will perform the user-defined calibration on the unit using specific color tiles before they commence the usage of the instrument. This common practise is to ensure close inter-instrument agreement of CR-400 used in the kiwifruit industry.

CR-400MH for Affordability –
The availability of CR-400 Measuring Head (i.e., CR-400MH) made it more affordable as CR-400MH can be connected to PC for direct test report printout. Portability is also enhanced as measuring head can be used independently of the Data Processor.

## Exploring The Horticulture Market

Resellers to explore the horticulture market in their respective country for similar needs in fruit and vegetable maturity monitoring and research. For fruits such as bananas, mangoes, raspberries, olives, among many others, there are colour charts associated with fruit maturity. In general, the visual estimation of color is a very simple and inexpensive method, but at the same time is inaccurate and subjective, as it depends on the experience of a human expert. It is hardly representative and non-quantifiable for analysis. There is a potential market if we could replace such subjective visual evaluation with a more objective color quantification methodology with the help of a color instrumentation. The establishment of an objective maturity index plays an important role in the trade of fresh fruits and vegetables.

## References

P. E. H. Minchin , N. De Silva , W. P. Snelgar , A. C. Richardson & T. G. Thorp (2003) Modelling of colour development in the fruit of Actinidiachinensis 'Hort16A', New Zealand. Journal of Crop and Horticultural Science, 31:1, 41-53, DOI: 10.1080/01140671.2003.9514234