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—Scientific Note—

Nutrient Management to Enhance Citrus Fruit Color Break and Quality at Maturity

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In Florida's subtropical climate, color break usually occurs naturally during the Fall when day length decreases and temperatures drop. During the color break process, the decline in peel chlorophyll content occurs over a several month period while carotenoid content increases, and is affected by environmental conditions, nutrient availability and phytohormones such as ethylene. Optimized fertilization may be one of the most cost-effective and practical methods for enhancing color break in Florida citrus, especially when warmer temperatures during the Fall inhibit the process. We investigated the relationships between peel color and leaf nutrients of 'Honey' Murcott (*Citrus reticulata*) measured on 8. Dec. 2020 in a screen house located in Lake Alfred, FL. Leaf and peel tissue nutrient concentrations were determined in samples (5 fruit, 25 leaves per tree) from 20 trees, and average peel color was determined for fruit samples by digital image processing according to the CIE L*a*b* color measurement system. Regression methods were used to determine the relationships between peel color in the a* (green-red) or b* (blue-yellow) axes, and leaf or peel nutrient concentrations. Loss of green color and increase of red peel color was negatively correlated with leaf nitrogen (N), phosphorus (P), sulphur, and iron concentrations, and positively correlated with leaf magnesium concentrations (Fig. 1). Peel nutrient results mirrored the leaf data, but with weaker correlations. Total soluble solids (Brix) concentrations in the juice were correlated with leaf nutrients in similar fashion to the peel a* color, but a negative correlation with leaf P was the most significant (Fig. 2).

Pearson's correlation coefficient (r) for peel **a* (green-> red color)**

Fruit variables	a*	Leaf nutrients	a*	Peel nutrients	a*
Diameter	-0.367	N % ***	-0.723	N % **	-0.665
L*	0.333	P % ***	-0.762	P %	-0.417
b*, yellow ***	0.805	K % **	-0.630	K %	-0.343
Brix % ***	0.816	Mg % *	0.490	Mg %	0.342
Juice %	-0.059	Ca %	0.353	Ca % *	0.530
Acid %	0.308	S % ***	-0.687	S % *	-0.536
Ratio *	0.538	B mg/kg	-0.253	B mg/kg *	-0.472
SS /box *	0.459	Zn mg/kg	0.124	Zn mg/kg	-0.021
		Mn mg/kg	-0.368	Mn mg/kg	-0.050
		Fe mg/kg **	-0.607	Fe mg/kg *	-0.460
		Cu mg/kg	0.107	Cu mg/kg	-0.142

*, **, *** indicate statistical significance at 5%, 1% and 0.1%

Fig. 1. Correlation coefficient (r) for peel a* color with fruit quality, leaf and peel nutrients in *Citrus reticulata*.

Pearson's correlation coefficient (r) for **Brix%**

Fruit variables	Brix %	Leaf nutrients	Brix %	Peel nutrients	Brix %
Diameter **	-0.562	N % **	-0.577	N % *	-0.445
L*	-0.075	P % ***	-0.789	P %	-0.392
a*, red ***	0.816	K % **	-0.61	K %	-0.261
b*, yellow *	0.469	Mg %	0.349	Mg % *	0.475
Juice %	0.286	Ca %	0.146	Ca %	0.398
Acid % *	0.488	S % **	-0.658	S %	-0.286
		B mg/kg	-0.333	B mg/kg *	-0.458
		Zn mg/kg	0.035	Zn mg/kg	-0.132
		Mn mg/kg	-0.263	Mn mg/kg	0.21
		Fe mg/kg *	-0.553	Fe mg/kg *	-0.446
		Cu mg/kg	-0.061	Cu mg/kg	-0.14

*, **, *** indicate statistical significance at 5%, 1% and 0.1%

Fig. 2. Correlation coefficient (r) for juice Brix with other fruit quality variables, leaf and peel nutrients in *Citrus reticulata*.

The detrimental effects of high leaf N during the fruit maturation phase are illustrated in Fig. 3, where leaf N concentrations in the low to deficient ranges are conducive to the best color break. To enhance early, complete color break and high juice quality, we recommend that annual P fertilization should be completed at post-bloom, and N fertilization should be completed mid- to end-summer, depending on whether the citrus variety is early- or late-maturing.

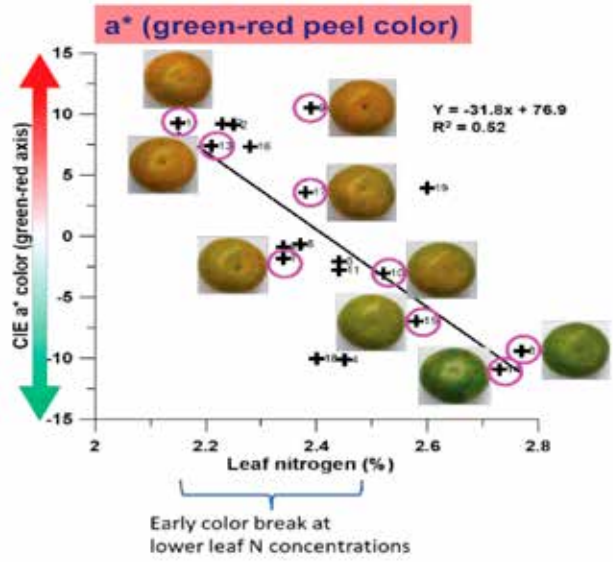

Fig. 3. Scatter plot and linear regression of peel a* color with leaf N concentrations in *Citrus reticulata*.

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