

Dwarf **Tomato** and **Pepper** Cultivars for Space Crops

ICES Paper 2019-164

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Methods and Materials

Environmental and Horticultural Conditions

- All plants grown in 10-cm square pots
- 7:3 Fafard #2B : turface (arcillite) potting soil
- Fertilized with time release 18-6-8 type 180 (Florikan Inc.)
- Automated drip irrigation to excess three times daily, using complete nutrient solution after 60 days following plants
- Triphosphor fluorescent lamps with PPF of $\sim 315 \mu\text{mol m}^{-2} \text{s}^{-1}$
- 16 h light / 8 h dark photoperiod
- Constant 22°C temperature
- Constant 60% relative humidity
- CO₂ elevated to 1500 ppm



Methods and Materials

Cultivars initially selected based on size and yield traits from commercial vendors:

Tomato (*Solanum lycopersicum* L.) cultivars:

- 1) Red Robin,
- 2) Scarlet Sweet 'N' Neat,
- 3) Tiny Tim,
- 4) Mohamed,
- 5) Patio Princess Hybrid, and
- 6) Tumbler

Pepper (*Capsicum annuum* L.) cultivars:

- 1) Red Skin,
- 2) Fruit Basket,
- 3) Cajun Belle,
- 4) Chablis,
- 5) Sweet Pickle, and
- 6) Pompeii



Methods and Materials

- Tomato fruit for six cultivars harvested after they turned fully red, beginning ca. 74, 78, and 89 days after planting.
- Second test of the best performing tomato cvs., Red Robin, Mohamed, and Sweet 'N' Neat, using same conditions was carried out to provide fruit for organoleptic testing.
- Pepper fruit were harvest at 109 days, when most showed color.
- Second test of best performing pepper cvs. Fruit Basket, Pompeii and Redskin, using same conditions was carried out to provide fruit for organoleptic testing.



Methods and Materials

Evaluation criteria:

- Plant growth / vigor
- Fruit yield
- Plant height (short being desirable)
- Organoleptic acceptability
- Nutrient composition



Dwarf Tomatoes in Growth Chamber



Tomato cultivars with ripening fruit (above) ↑
and individual plant of cv. Red Robin tomato (right)



Dwarf Peppers in Growth Chamber



Pepper cultivars with fruit (above) ↑
and individual plant of cv. Pompeii pepper (right)



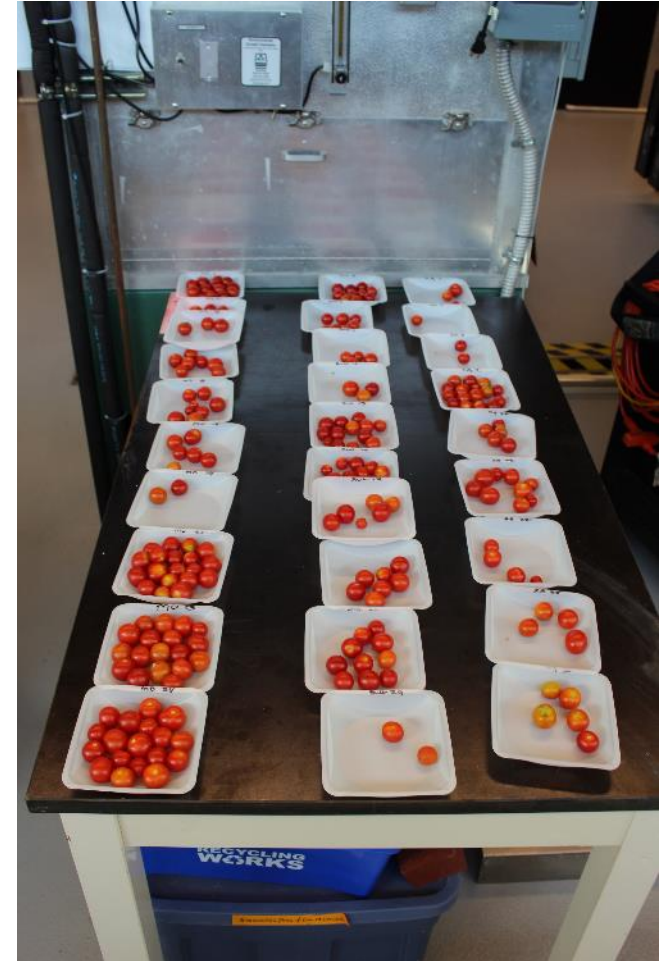
Harvesting of Fruit



Harvesting tomato fruit (left) and fruit from individual pepper (right). Tomatoes were harvested as they ripened. Pepper fruits all harvested at the end of the test.



Tomatoes at Final Harvest



Tomato fruit following harvest (above) and preparing for shipment for organoleptic testing (right).



Peppers at Final Harvest



Pepper fruit following harvest and preparing for shipment for organoleptic testing.



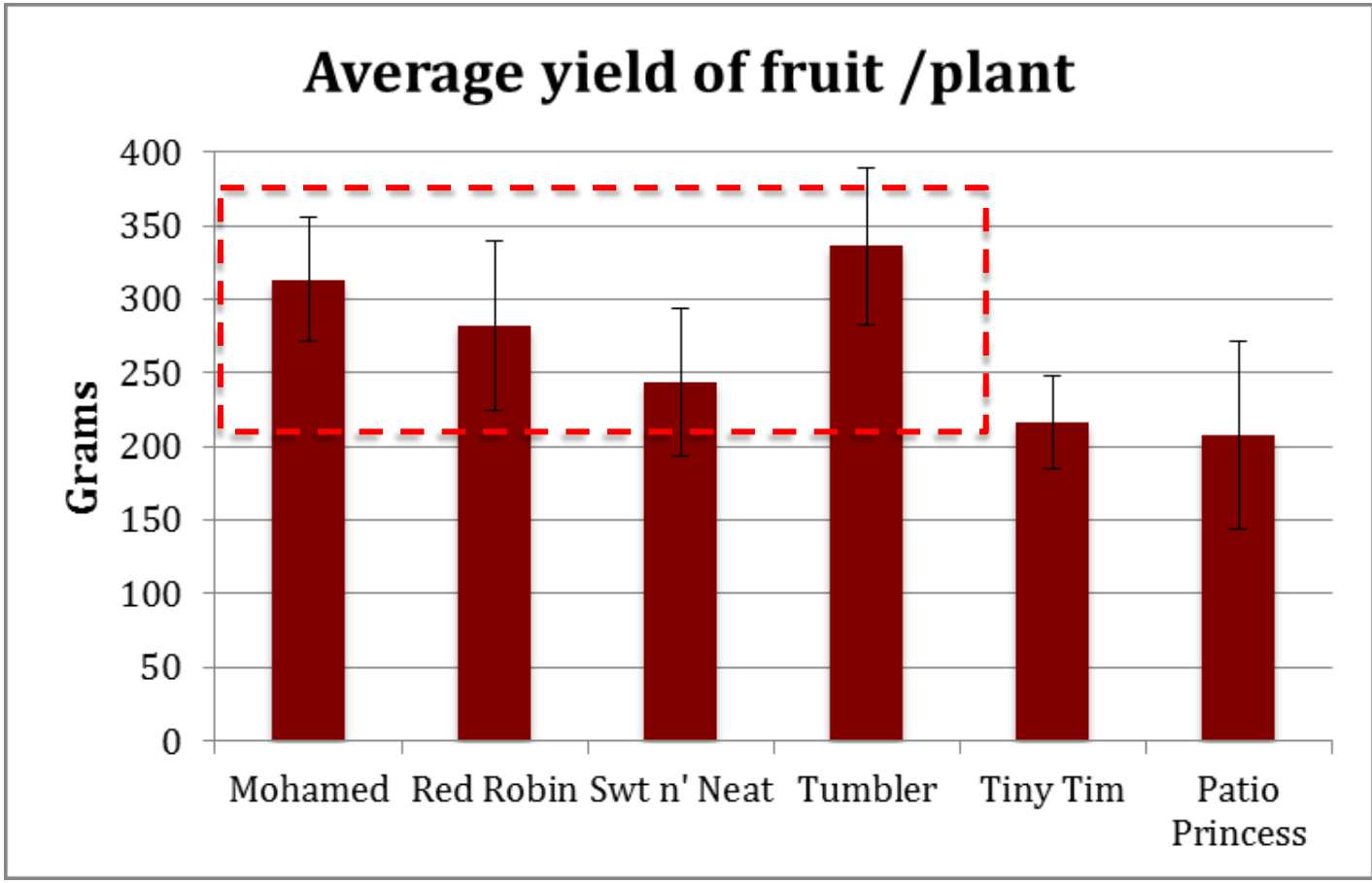
Pepper and Tomato Fruit for Shipping



Pepper and tomato fruit for shipment for organoleptic testing. All fruits were shipped over night in cold containers.



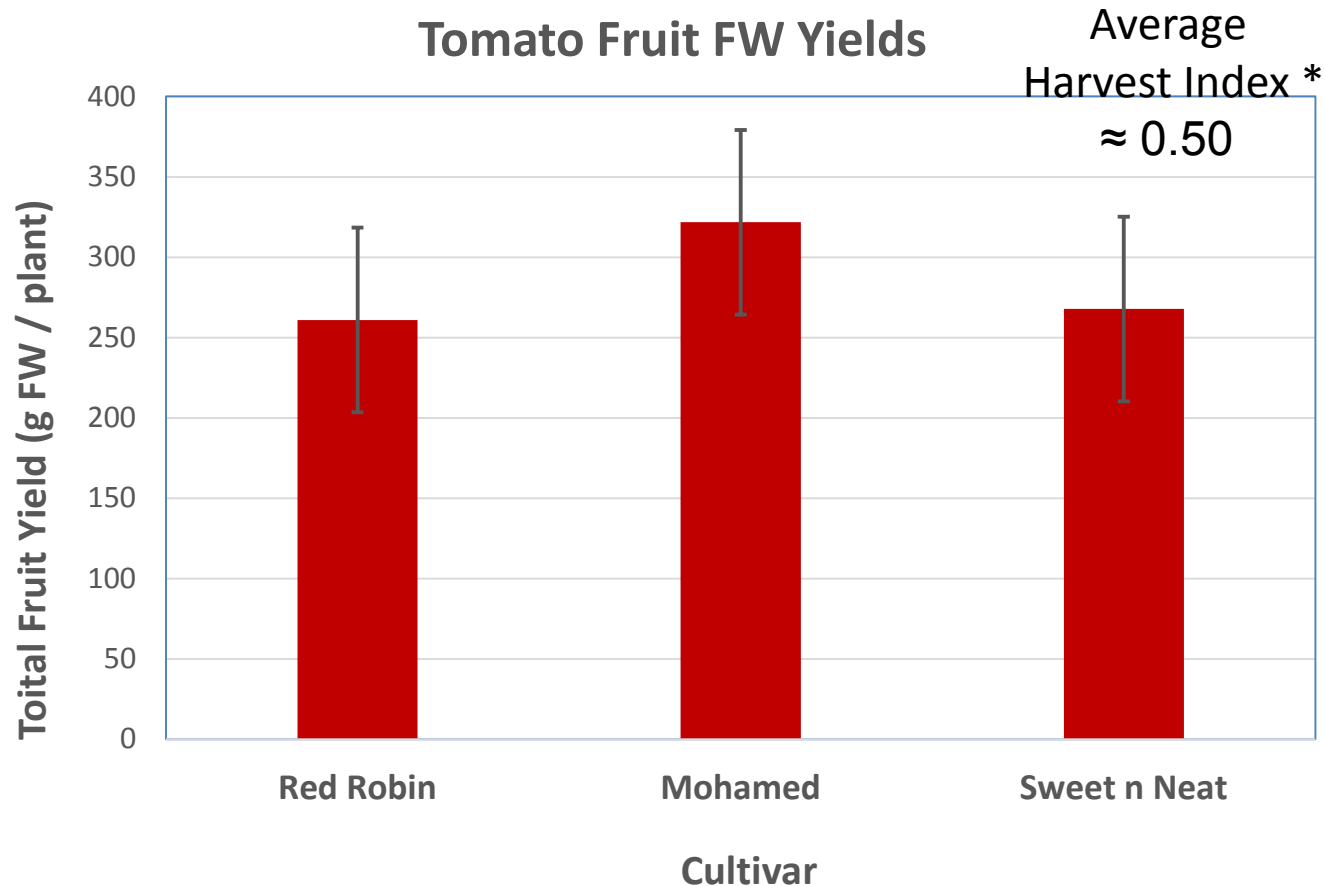
Fruit Yield—Tomatoes, 1st Trial



Average fruit yield for different tomato cultivars (g FW/ plant)



Fruit Yield—Tomatoes, 2nd Trial



Average fruit yield for down-selected tomato cultivars (g FW/ plant)



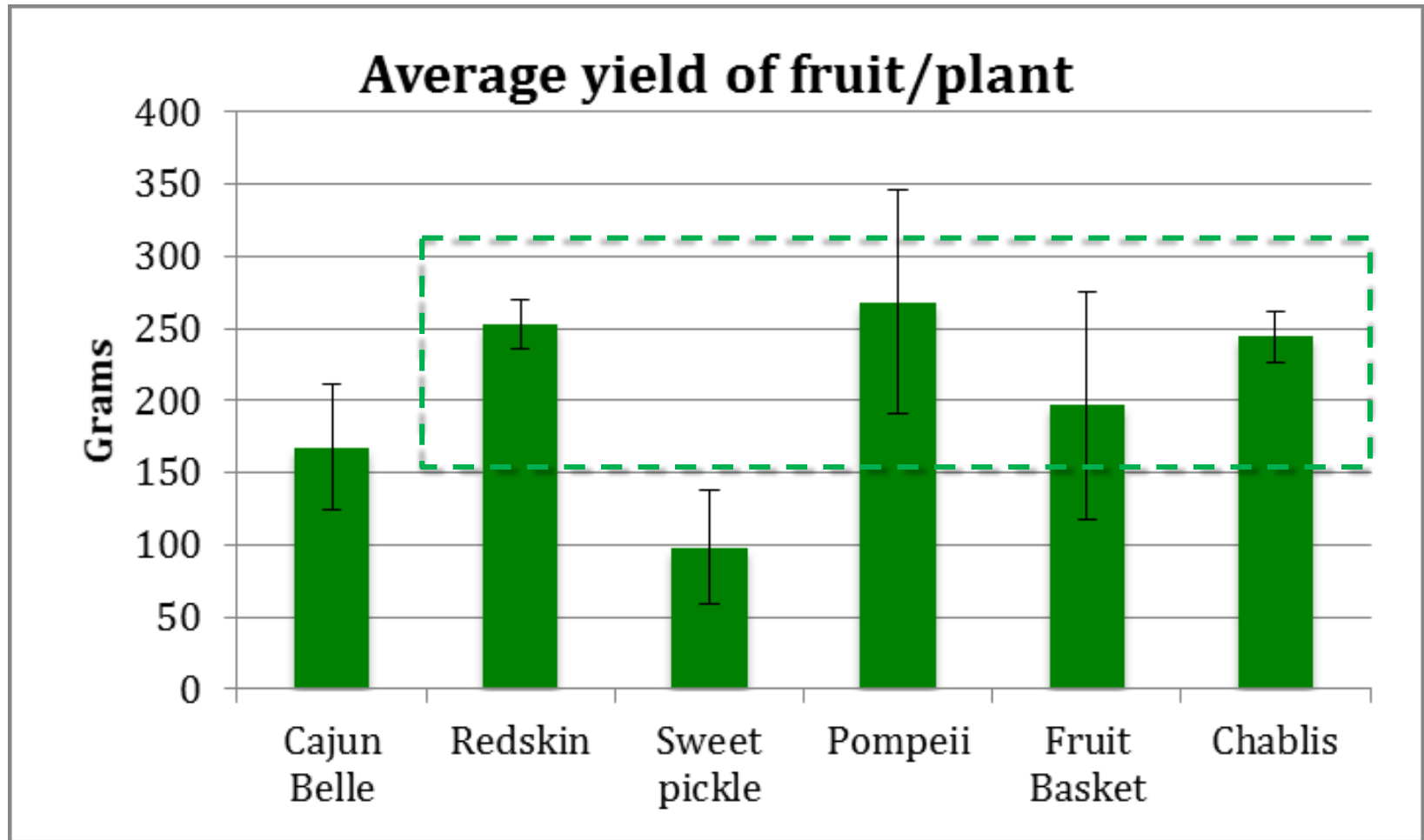
Taste Test—Tomatoes

Sensory analysis results using 9-point hedonic scale for tomato fruit.
Values are means \pm standard deviations (n = 34).

Attribute	Tomato Cultivar		
	Red Robin	Mohamed	Sweet 'N' Neat
Overall Acceptability	7.12 \pm 1.75	7.62 \pm 1.18	6.88 \pm 1.82
Appearance	8.15 \pm 0.82	8.47 \pm 0.56	8.03 \pm 1.00
Color Intensity	8.00 \pm 0.18	8.29 \pm 0.72	8.06 \pm 1.07
Aroma	6.44 \pm 1.78	6.24 \pm 1.58	6.18 \pm 1.64
Flavor	7.06 \pm 1.79	7.50 \pm 1.44	6.65 \pm 2.14
Texture	6.35 \pm 2.44	7.91 \pm 1.14	6.79 \pm 2.16



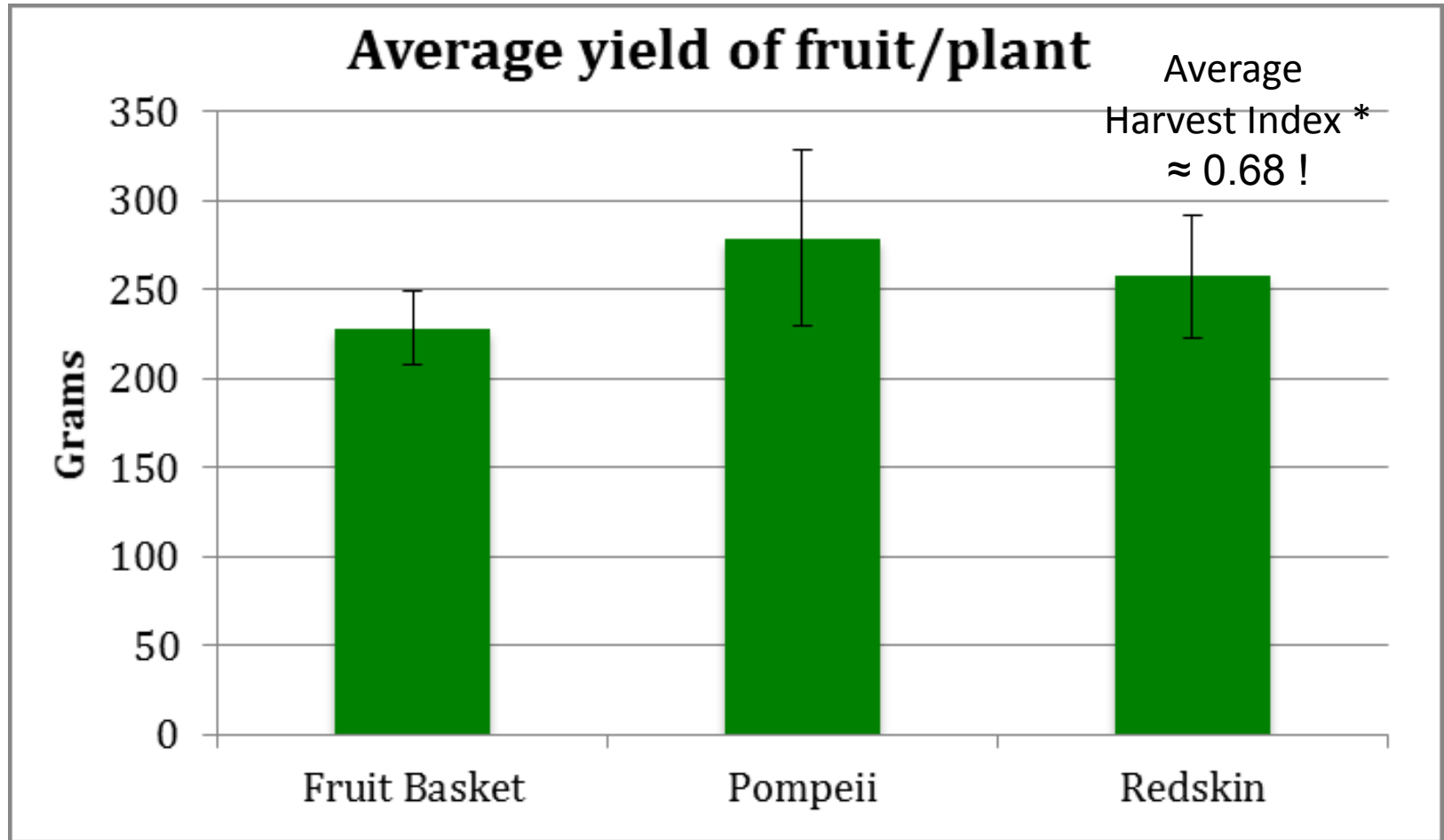
Fruit Yield—Peppers, 1st Trial



Average fruit yield for different pepper cultivars (g FW/ plant)



Fruit Yield—Peppers, 2nd Trial



Average fruit yield for down-selected pepper cultivars (g FW/ plant)



Taste Test—Peppers

Sensory analysis results pepper fruit using 9-point hedonic scale.
Values are means (\pm one standard deviation, n=22).

Attribute	Pepper Cultivar		
	Pompeii	Red Skin	Fruit Basket
Acceptability	7.91 \pm 0.68	6.77 \pm 1.54	6.23 \pm 1.82
Appearance	8.14 \pm 1.08	7.09 \pm 1.72	8.18 \pm 0.96
Color Intensity	8.23 \pm 1.11	7.64 \pm 1.92	8.27 \pm 1.03
Aroma	7.59 \pm 1.22	6.82 \pm 1.44	6.82 \pm 1.59
Flavor	7.73 \pm 0.88	6.77 \pm 1.57	5.73 \pm 2.00
Texture	8.27 \pm 0.63	7.95 \pm 1.00	7.82 \pm 1.05



Phytonutrients—Tomato

Phytonutrients in tomato fruits. Different letters indicate significant differences within columns ($p < 0.05$) (Tukey's multiple comparison test).

Tomato cv.	Phenolic	ORAC	Lycopene	Antho- cyanin	Lutein	Zeaxan- thin	Vit. K
	$\mu\text{g/g}$	$\mu\text{mol TE/g}$	mg/g	mg/g	mg/g	mg/g	mg/100g
Red Robin	7.72 ^a	71.32 ^a	34.99	1.58	1.85	0.03	19.75 ^a
Mohamed	7.17 ^a	74.70 ^a	36.98	2.00	1.77	0.03	18.85 ^{ab}
Sweet'n'Neat	7.83 ^a	72.18 ^a	42.02	1.61	1.46	0.04	14.45 ^b



Phytonutrients—Pepper

Phytonutrients in mature pepper fruits. Different letters indicate significant differences within columns ($p < 0.05$) (Tukey's multiple comparison test).

Pepper cv.	Phenolics $\mu\text{g/g}$	ORAC $\mu\text{mol TE/g}$	Lutein mg/g	Zeaxanthin mg/g	Vit. K mg/100g
Pompeii	14.99	107.41 ^b	3.52 ^b	0.09 ^b	103.0
Fruit Basket	15.28	142.71 ^{cb}	10.17 ^{cb}	0.04 ^a	106.0
Red Skin	16.26	117.87 ^{cb}	8.44 ^{cb}	0.10 ^b	110.0
Cajun Belle	19.30	163.16 ^a	6.03 ^a	0.10 ^b	105.0
Chablis	16.61	147.23 ^{ac}	2.55 ^{ac}	0.05 ^a	95.0



Conclusions

- Tomato cvs. Red Robin, Mohamed, and Sweet 'N' Neat produced high fruit yields (g FW / plant) on short plants
 - Tumbler also had high yields but plants were considered too tall
- Pepper cvs. Fruit Basket, Pompeii, and Red Skin produced high fruit yields (g FW / plant) on short plants
 - Chablis also had high yields but plants were considered too tall
- Organoleptic comparisons showed that all the down-selected pepper and tomato cultivars were acceptable to the panelists, with no single cultivar standing out.
- Analysis of phytonutrients showed that tomatoes were a good source of lycopene, and that peppers were slightly higher in ORAC, lutein, and Vit K than tomato.
 - Further testing is need to compare green versus colored pepper fruit



Acknowledgements



We wish to thank Larry Koss for his assistance with environmental chamber management and Genesis Rivera-Marquez for help with plant harvests. This project was funded through the NASA's Human Research Program and NASA's Center Innovation Fund Program.

