# Introducing the Plant Tissue Sap Analysis and Practical Implications for Quality Evaluation of Honeycrisp

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Lake Ontario Fruit Company

Cornell Cooperative Extension
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Lake Ontario
FRUIT

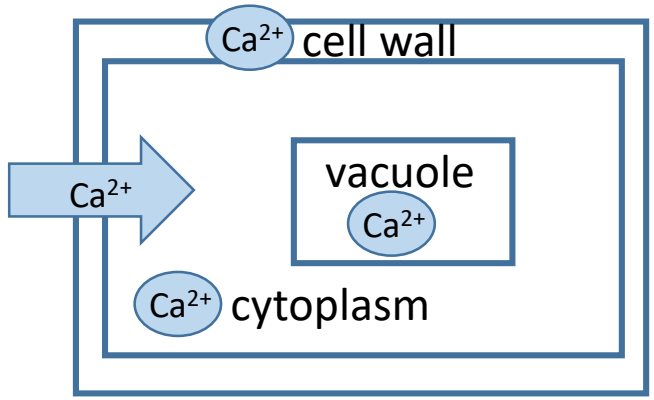
‘Honeycrisp’ tree

Peel

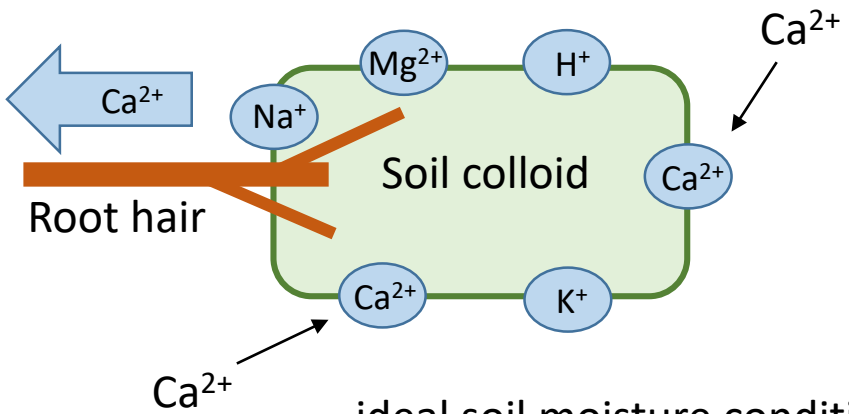
$Ca^{2+}$ transport driven by transpiration rate

Rootstock genotype

## Calcium distribution in the fruit cell




## Soil-root interaction




**An imbalance of calcium with potassium in the peel predisposes ‘Honeycrisp’ to bitter pit**

**In our study, ‘Honeycrisp’ fruit had only half the calcium, but nearly 50% more potassium in the peel than ‘Gala’**

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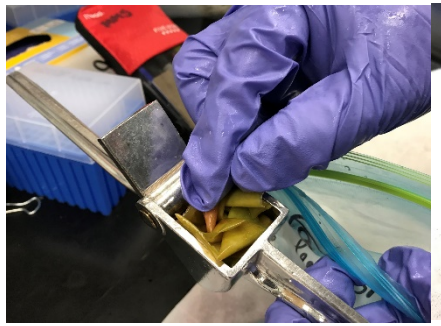
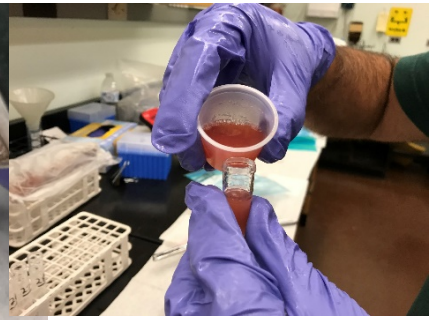
# Fruit Peel Method

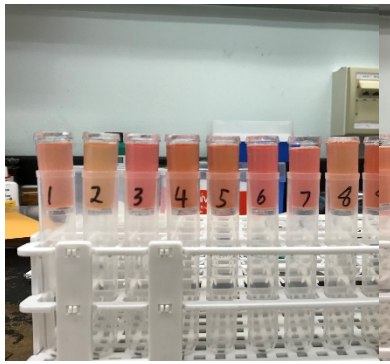
Peels dried and ready to be ground

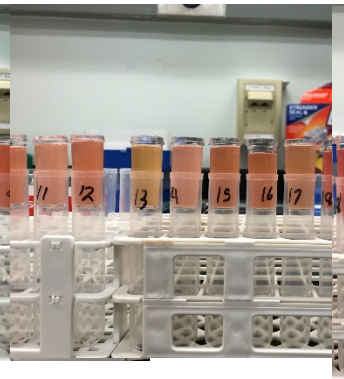
# Peel SAP Method

Frozen peels, then thawed, and ready to be squeezed







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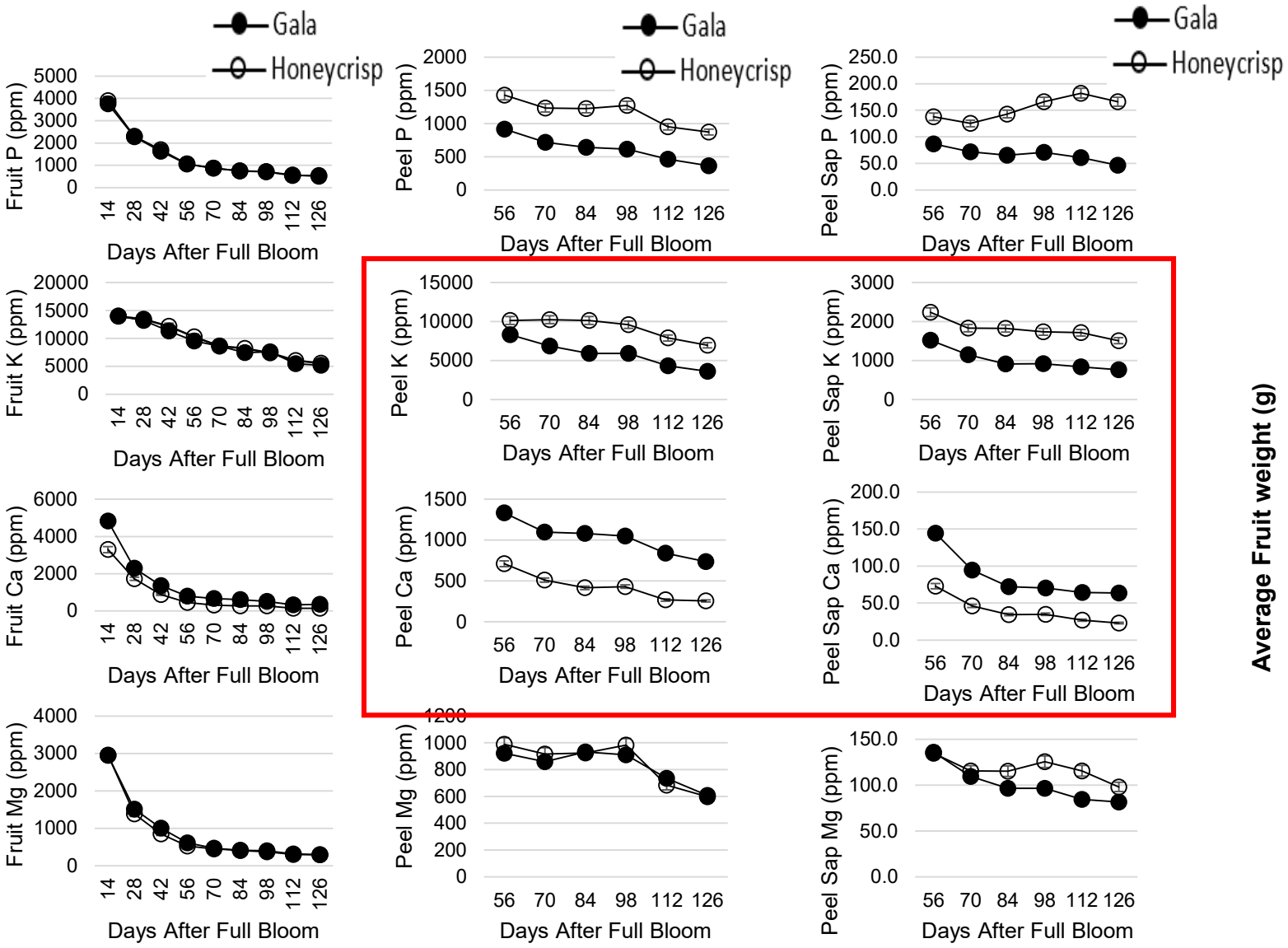
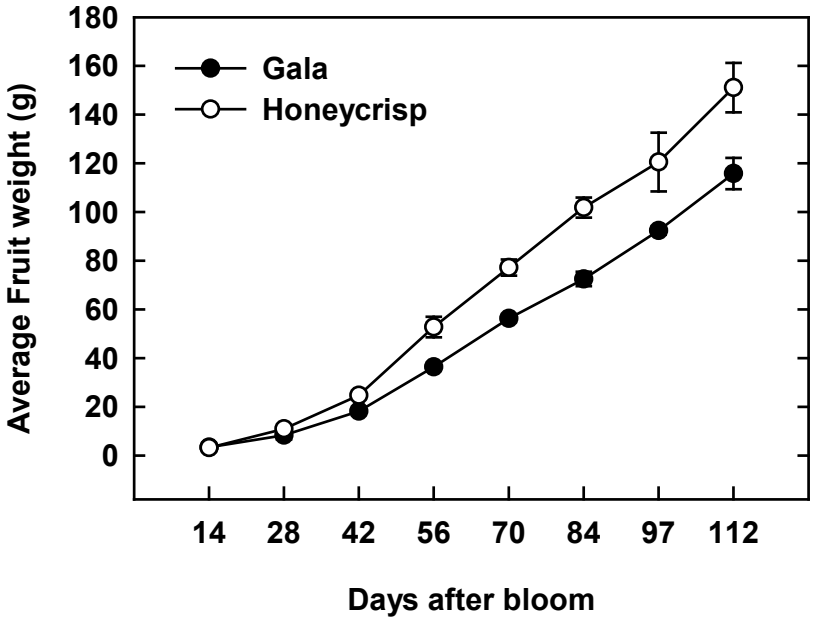
# Developmental changes of fruit nutrients in Honeycrisp & Gala at VanDeWalle Fruit Farm




## Developmental patterns of fruit growth in Honeycrisp & Gala during the 2017 growing season, NY

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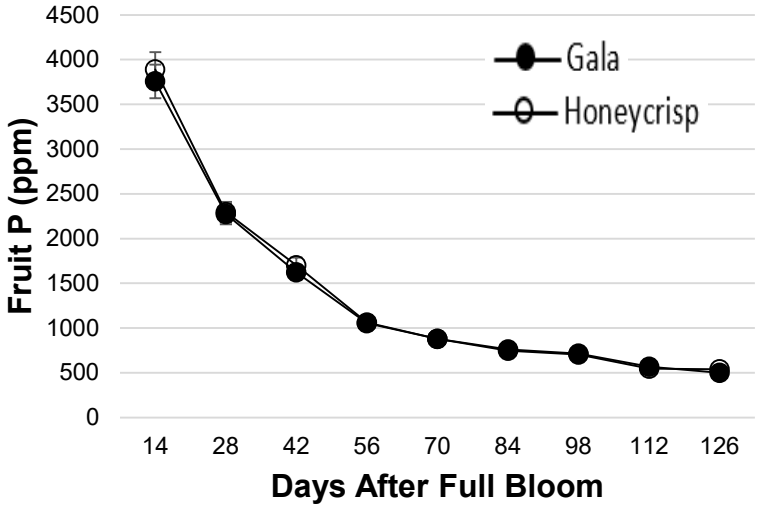
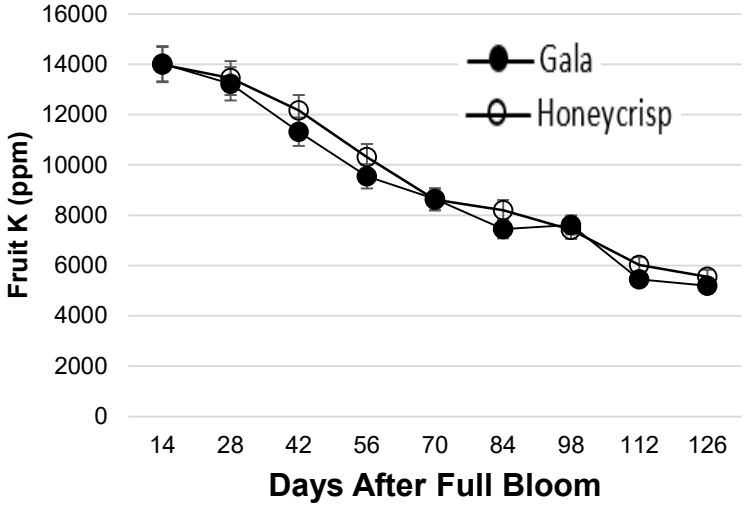
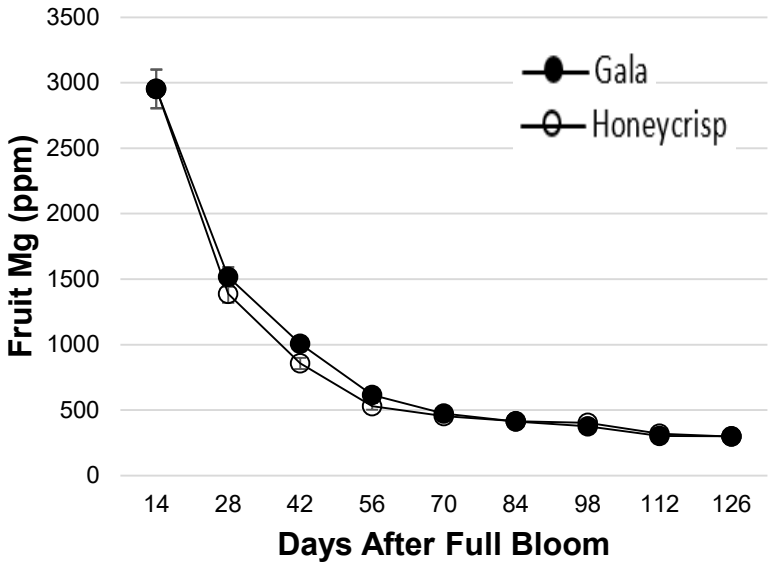
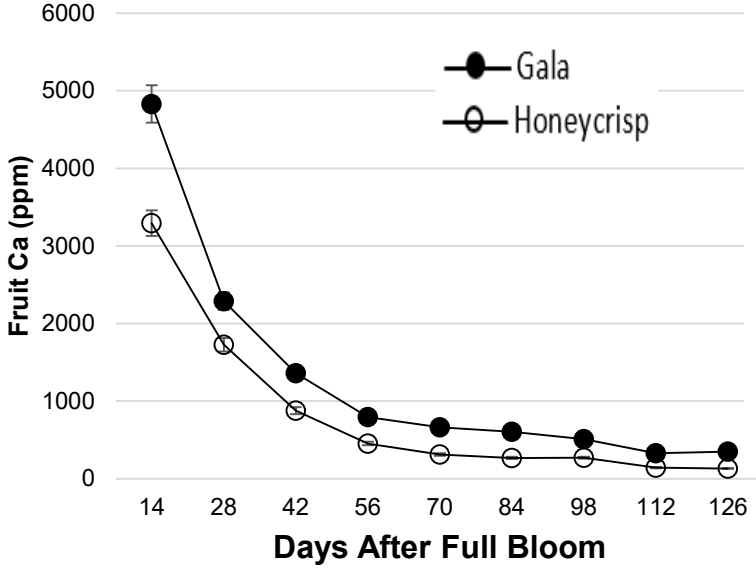
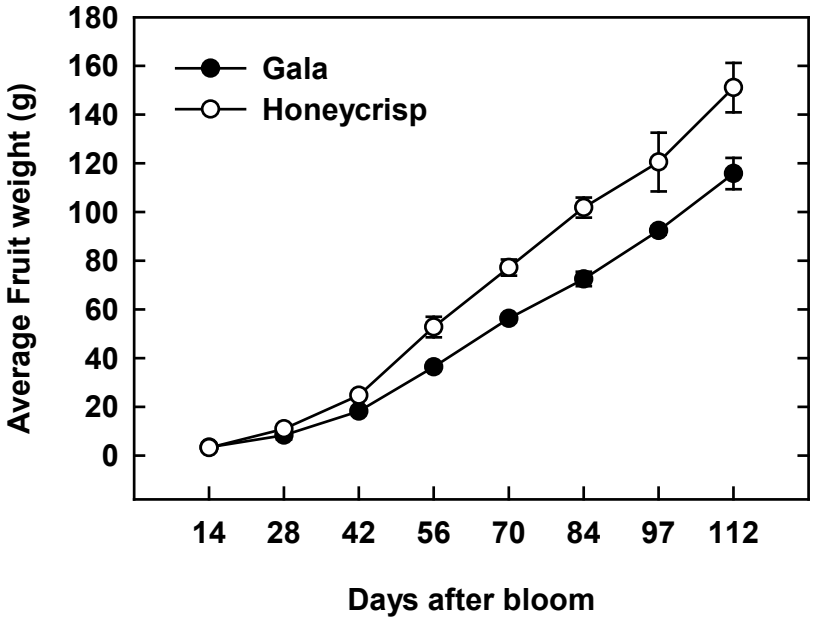



## Developmental patterns of fruit growth in Honeycrisp & Gala during the 2017 growing season, NY




## Bulk Fruit

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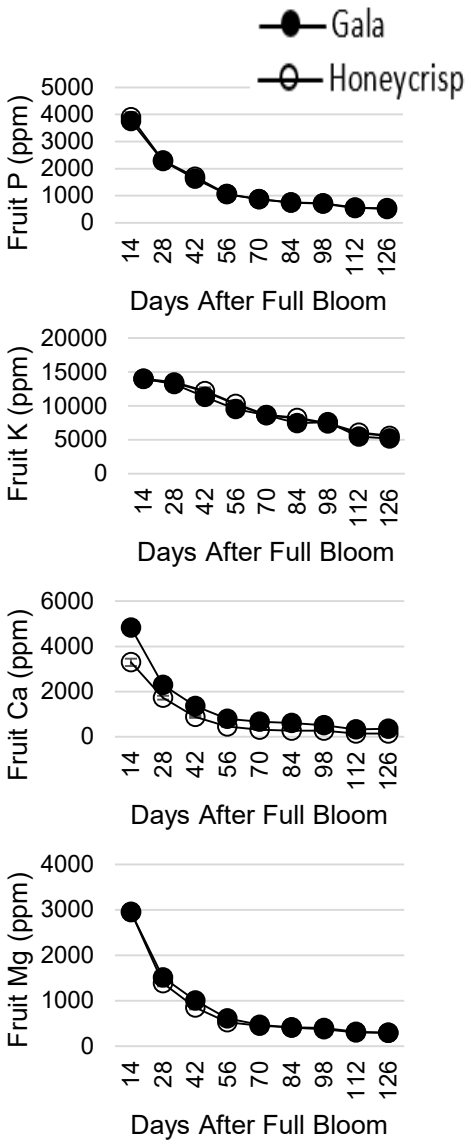
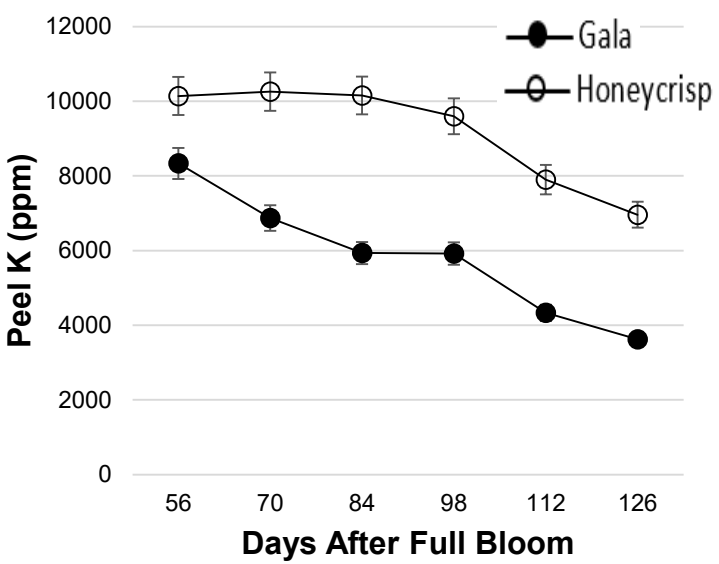
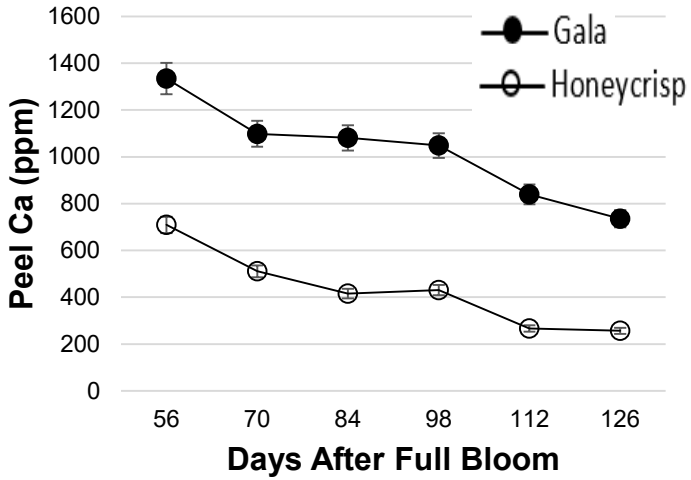
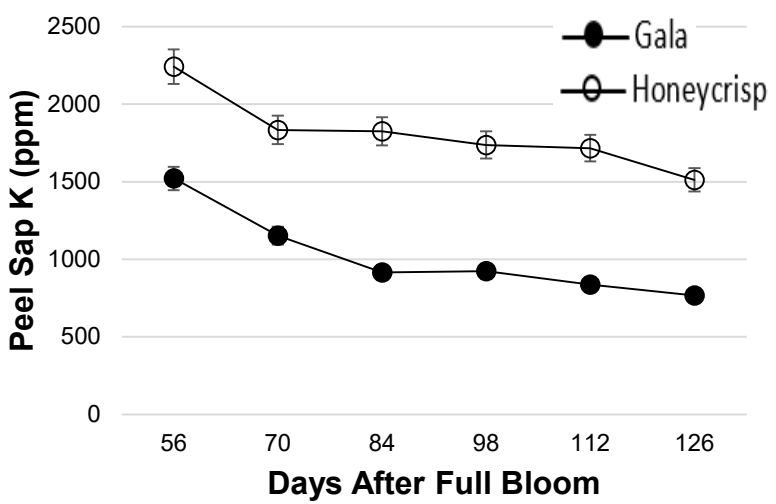
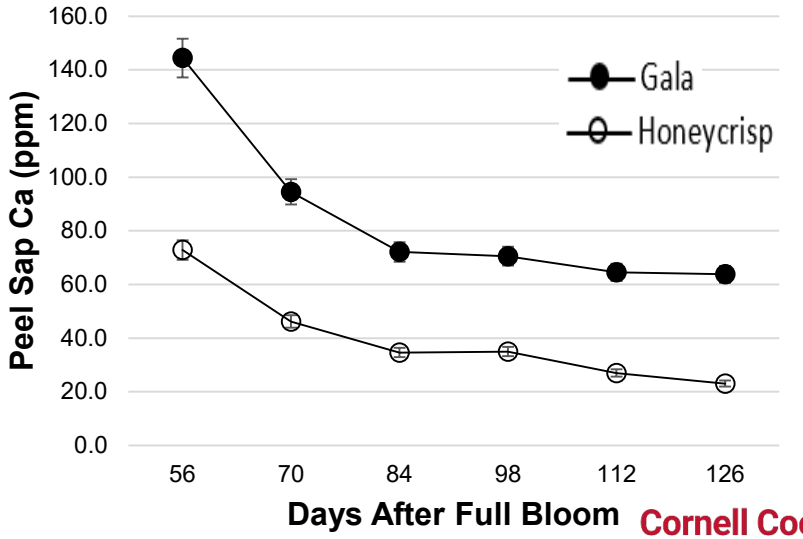
# Developmental changes of fruit nutrients in Honeycrisp & Gala at VanDeWalle Fruit Farm

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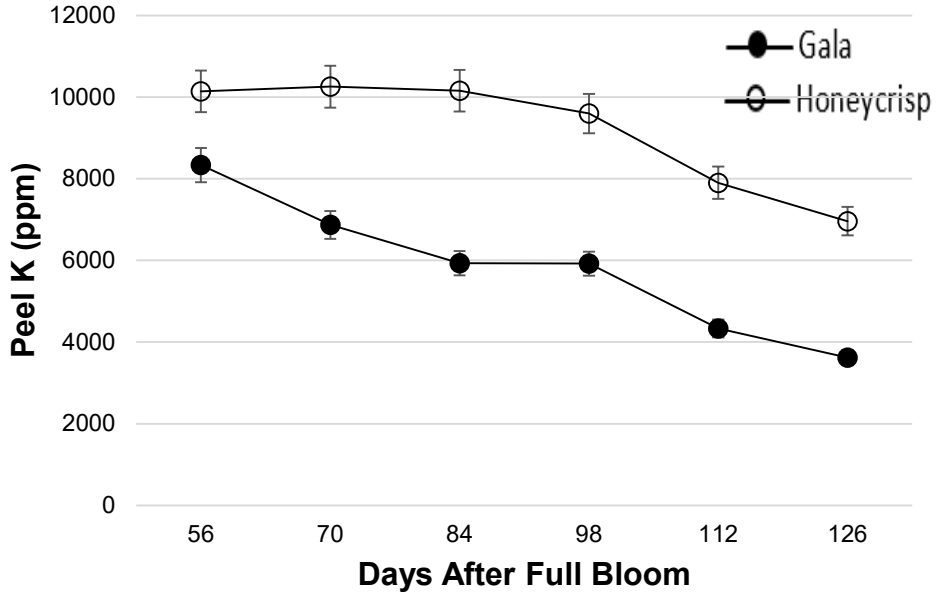
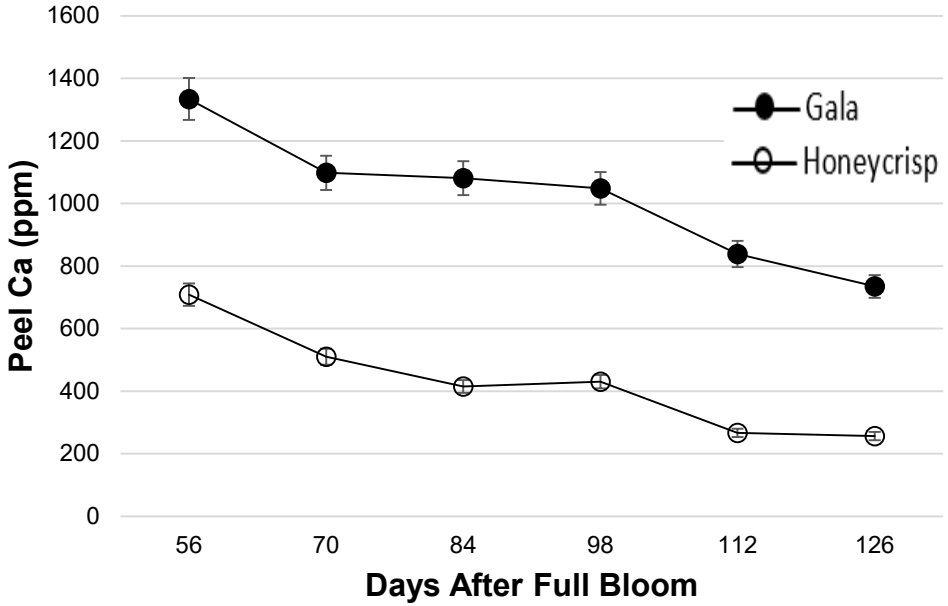
**Bulk Fruit** | **Fruit Peel** | **Peel Sap**

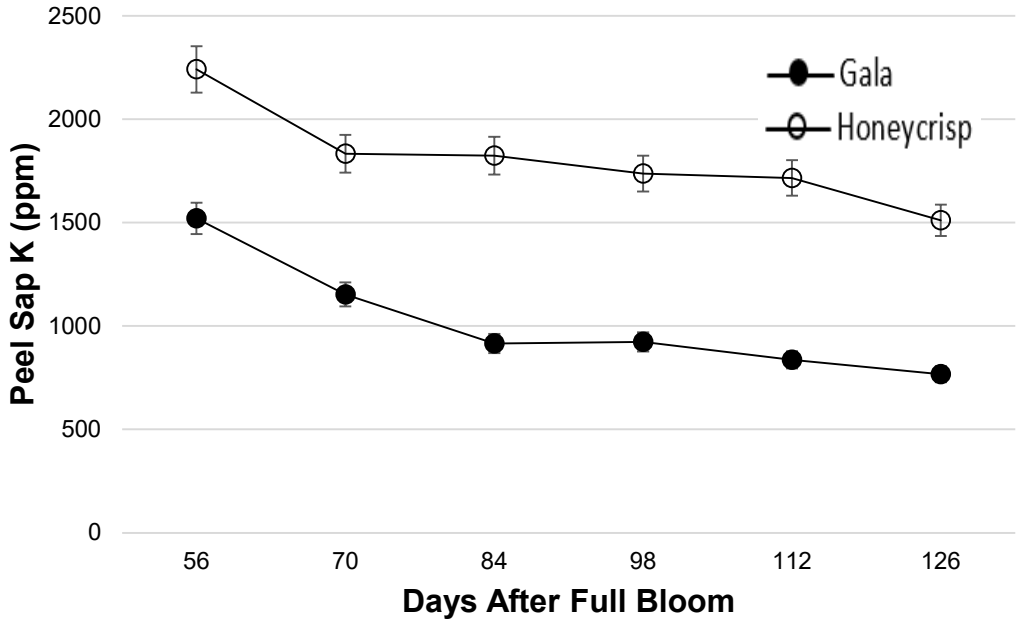
# Fruit Peel

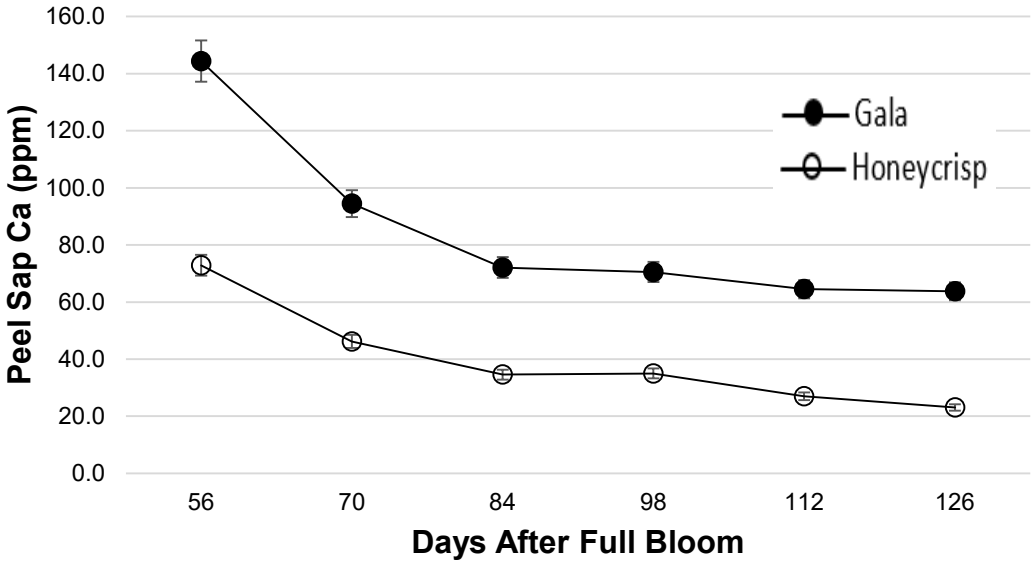



| | | FRUIT PEEL | | | | | |
|---|---|---|---|---|---|---|---|
| | | Fruit Peel K (ppm) | | Fruit Peel Ca (ppm) | | Fruit Peel K/Ca ratio | |
| Date | DAFF | Gala | HC | Gala | HC | Gala | HC |
| July 7 | 56 | 8335 | 10143 | 1334 | 709 | 6.23 | 14.30 |
| July 21 | 70 | 6870 | 10258 | 1098 | 511 | 6.25 | 20.07 |
| Aug. 4 | 84 | 5934 | 10156 | 1081 | 415 | 5.49 | 24.47 |
| Aug. 18 | 98 | 5921 | 9597 | 1048 | 431 | 5.65 | 22.26 |
| Sept. 1 | 112 | 4332 | 7903 | 839 | 267 | 5.16 | 29.60 |
| Sept.15 | 126 | 3622 | 6962 | 735 | 257 | 4.93 | 27.08 |

# Peel SAP




| | | PEEL SAP | | | | | |
|---|---|---|---|---|---|---|---|
| | | Peel SAP K (ppm) | | Peel SAP Ca (ppm) | | Peel SAP K/Ca ratio | |
| Date | DAFF | Gala | HC | Gala | HC | Gala | HC |
| July 7 | 56 | 1521 | 2242 | 144.4 | 72.8 | 10.53 | 30.79 |
| July 21 | 70 | 1153 | 1833 | 94.5 | 46.2 | 12.20 | 39.67 |
| Aug. 4 | 84 | 916 | 1825 | 72.1 | 34.6 | 12.70 | 52.74 |
| Aug. 18 | 98 | 923 | 1737 | 70.5 | 35 | 13.09 | 49.62 |
| Sept. 1 | 112 | 837 | 1716 | 64.5 | 27 | 12.97 | 63.55 |
| Sept.15 | 126 | 767 | 1512 | 63.8 | 23.1 | 12.02 | 65.45 |

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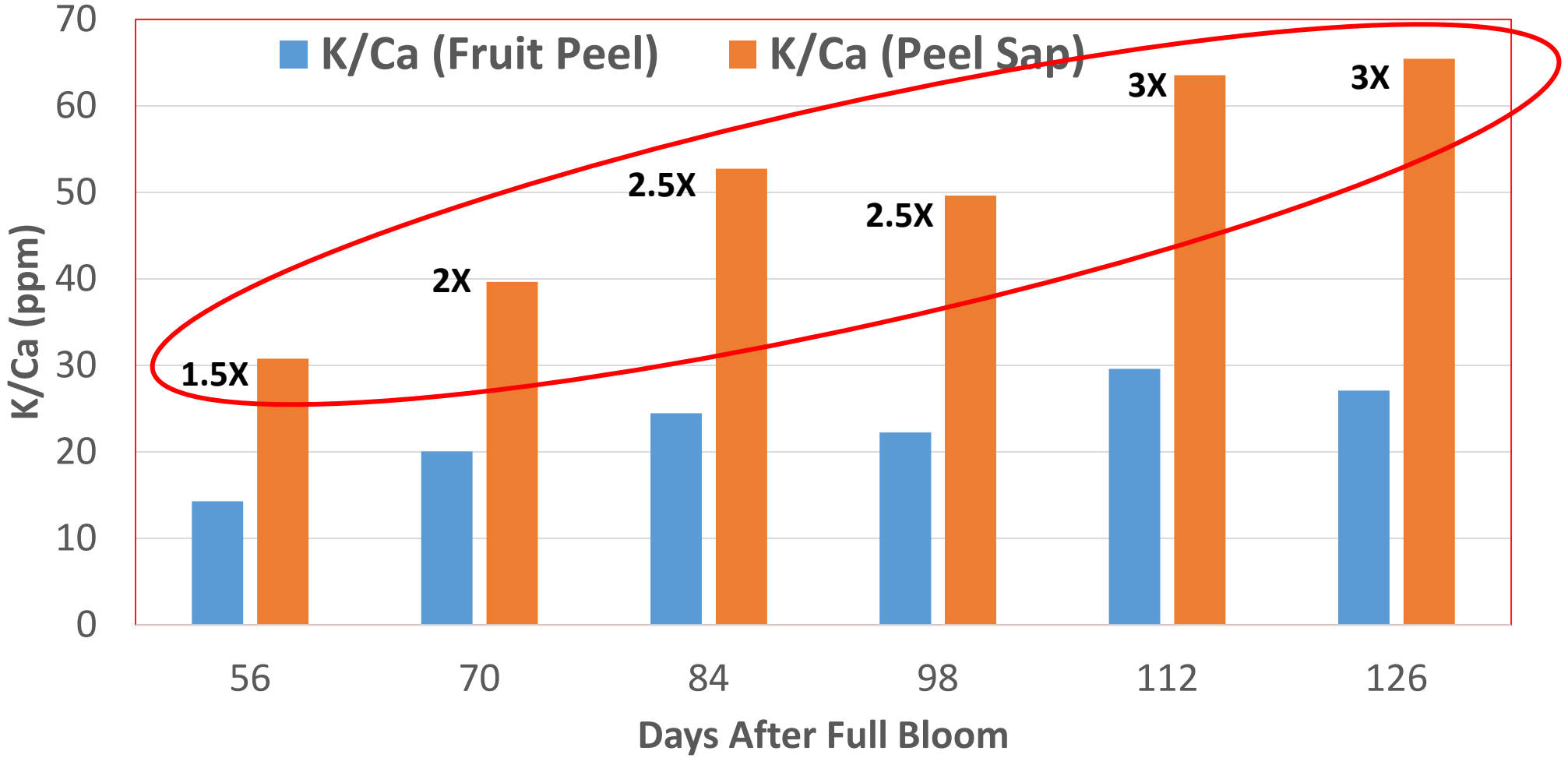
# K/Ca ratios of Fruit Peel versus Peel SAP in Honeycrisp

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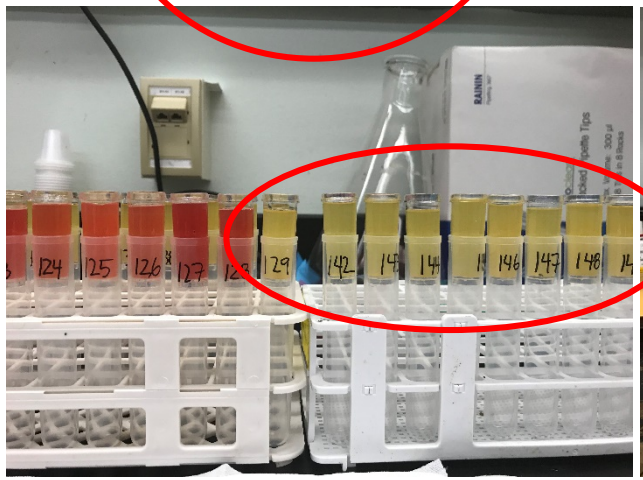
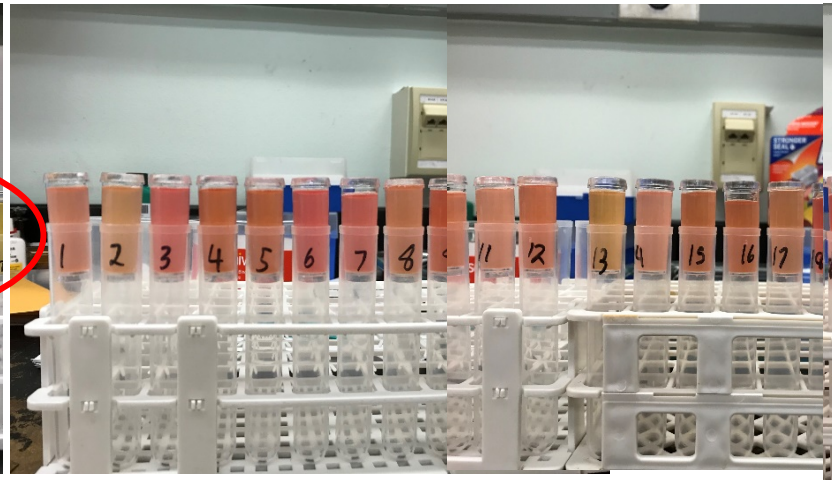
# Fruit collection sampling for K/Ca peel SAP ratios

**Golf ball fruit size**
**50-55 gr/fruit**

| July | | Sept. | Harvest | Storage |
|---|---|---|---|---|
| July 6, 2017<br>July 16, 2018<br>July 10, 2019 | | Sept. 5, 2017<br>Sept. 6, 2018<br>Sept. 16-18, 2019 | | |



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# Practical Implications for Quality Evaluation of Honeycrisp

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# Grafting to Honeycrisp?

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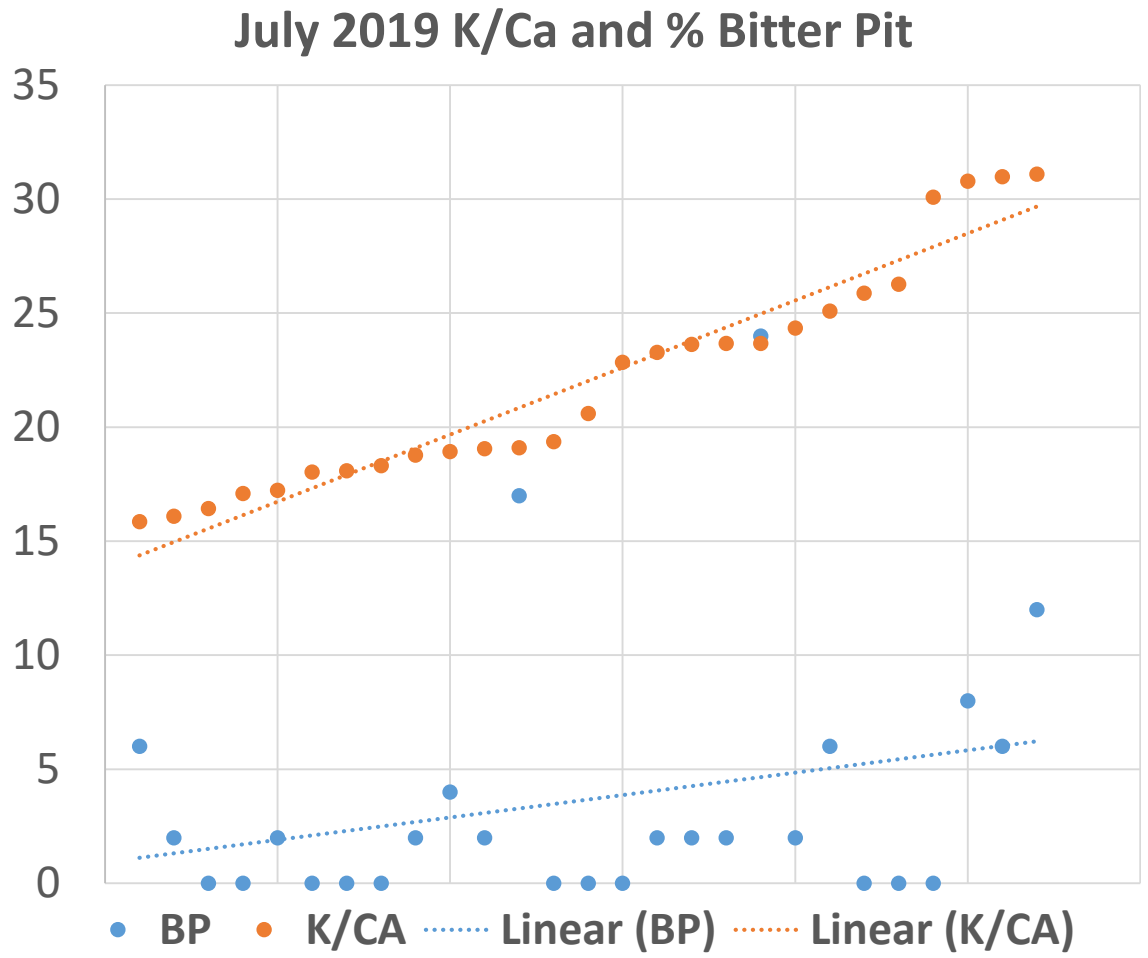
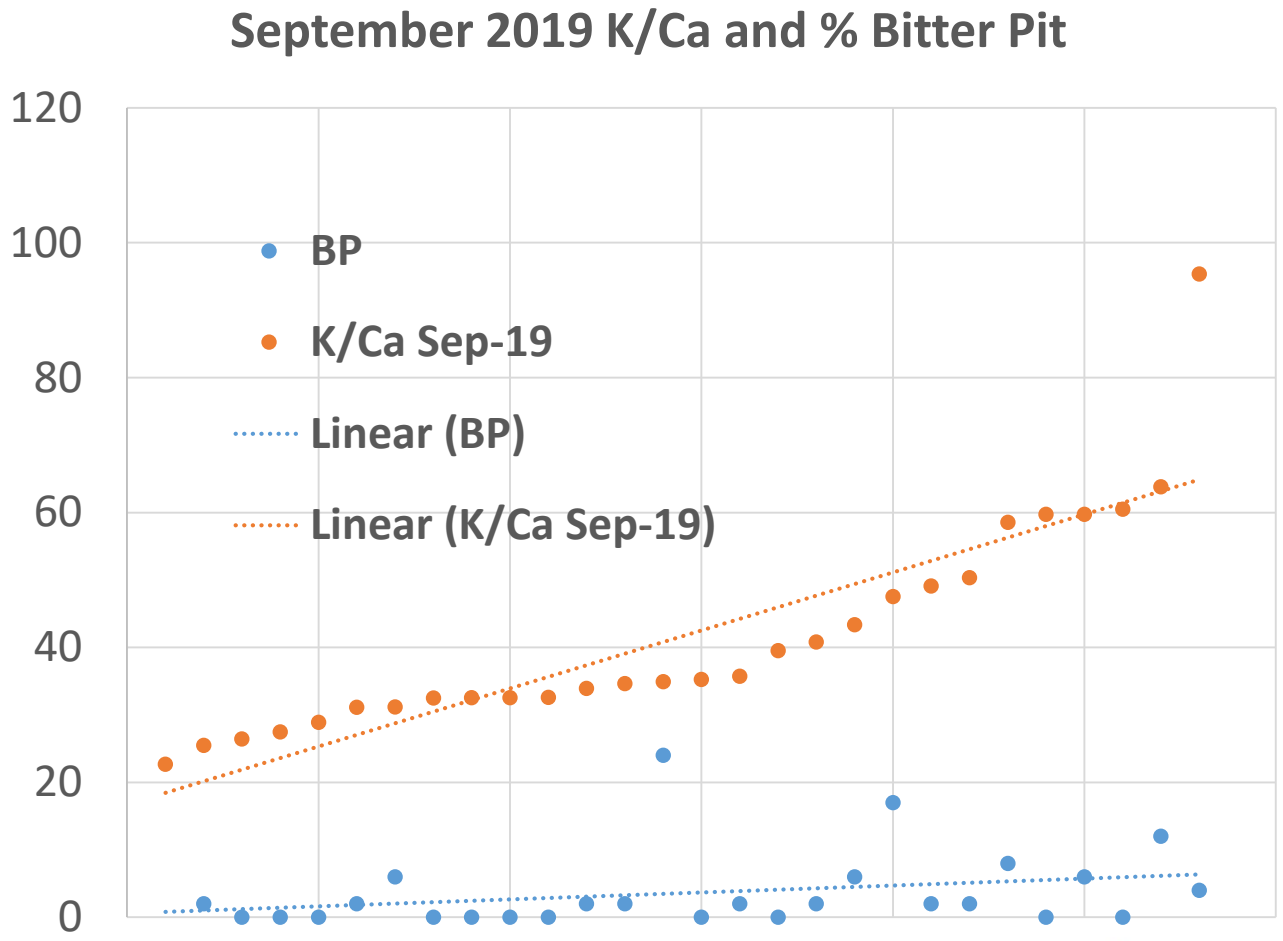
| Block | RootStock | Grafted | Year | Density | K/Ca Jul-19 | Block | K/Ca Jul-18 | Block | K/Ca Jul-17 |
|---|---|---|---|---|---|---|---|---|---|
| 4 | M26 | GRAFTED | 2007 | 10X18 | 15.86 | SC7 | 17.99 | LS10 | 17.34 |
| 241 | B9 | | 2006 | 2x11 | 16.09 | 239 | 19.6 | 229 | 19.92 |
| Y163 | B9 | | 2006 | 2X11 | 16.43 | 241 | 19.87 | 24 | 21.15 |
| 33 | M9/111 | GRAFTED | 2004 | 10X18 | 17.09 | LS10 | 19.87 | 101 | 21.64 |
| 6 | M9 | | 2007 | 3.5X14 | 17.24 | Z15 | 20.52 | 6 | 22.62 |
| 58 | M9 NIC29 | | 2000 | 4X13 | 18.03 | 22 | 20.64 | Z9 | 23.4 |
| 59 | M9 | | 1999 | 6X13 | 18.09 | 33 | 20.73 | 34 | 25.16 |
| 101 | M9 NIC29 | | 2005 | 4X14 | 18.32 | 6 | 22.04 | SC7 | 25.9 |
| 34 | B9 | | 2015 | 2x11 | 18.59 | 5 | 22.27 | Y163 | 26.39 |
| 5 | M9 | | 2004 | 3.5X14 | 18.77 | 24 | 22.3 | 22 | 26.9 |
| Z15 | M9 EMLA | | 2008 | 5X13 | 18.93 | SC8 | 22.58 | SC8 | 27.22 |
| Z9 | M9 | | 2009 | 5X12 | 19.05 | 58 | 22.59 | 239 | 27.24 |
| SC7 | M26 | | 2000 | 6X16 | 19.1 | 229 | 22.69 | 33 | 27.66 |
| 105 | M9 NIC29 | | 2005 | 4X14 | 19.36 | 101 | 23.32 | 105 | 27.86 |
| 24 | M9 NIC29 | | 2003 | 4X13 | 20.6 | Z9 | 23.62 | Y157 | 29.78 |
| 22 | B9 | | 2013 | 3X12 | 22.84 | Y163 | 24.95 | 58 | 31.46 |
| 51 | M9/111 | GRAFTED | 2007 | 12X20 | 23.28 | 59 | 25.12 | 59 | 31.46 |
| 230 | M9 | GRAFTED | 2005 | 8X14 | 23.63 | 105 | 25.36 | Z15 | 33.97 |
| 54 | M9/106 | GRAFTED | 2007 | 10X20 | 23.67 | R335 | 26.69 | 54 | 33.98 |
| SC8 | M26 | | 2000 | 6x14 | 23.68 | 23 | 26.85 | 241 | 34.31 |
| 23 | B9 | | 2014 | 2.5X11 | 24.35 | 34 | 26.95 | 4 | 34.31 |
| LS10 | M26 | | 2010 | 3X13 | 25.1 | 54 | 27.39 | 5 | 35.41 |
| 239 | M9 | | 2002 | 2X11 | 25.88 | 51 | 28.09 | 230 | 35.77 |
| Y157 | M9 | GRAFTED | 1998 | 5X14 | 26.27 | 4 | 29.35 | 23 | 36.07 |
| 229 | B9 | | 2005 | 2X11 | 30.09 | 230 | 29.5 | Y161 | 36.5 |
| Y161 | M26 | GRAFTED | 2005 | 10X16 | 30.79 | Y157 | 29.79 | R335 | 37.06 |
| R335 | M7 | GRAFTED | 2010 | 10x16 | 30.98 | NICE | 30.98 | NICE | 39.02 |
| NICE | M26 | GRAFTED | 1998 | 6X16 | 31.1 | Y161 | 34.95 | 51 | 40.6 |

# 2019 Field Samples K/Ca ratio and %BP

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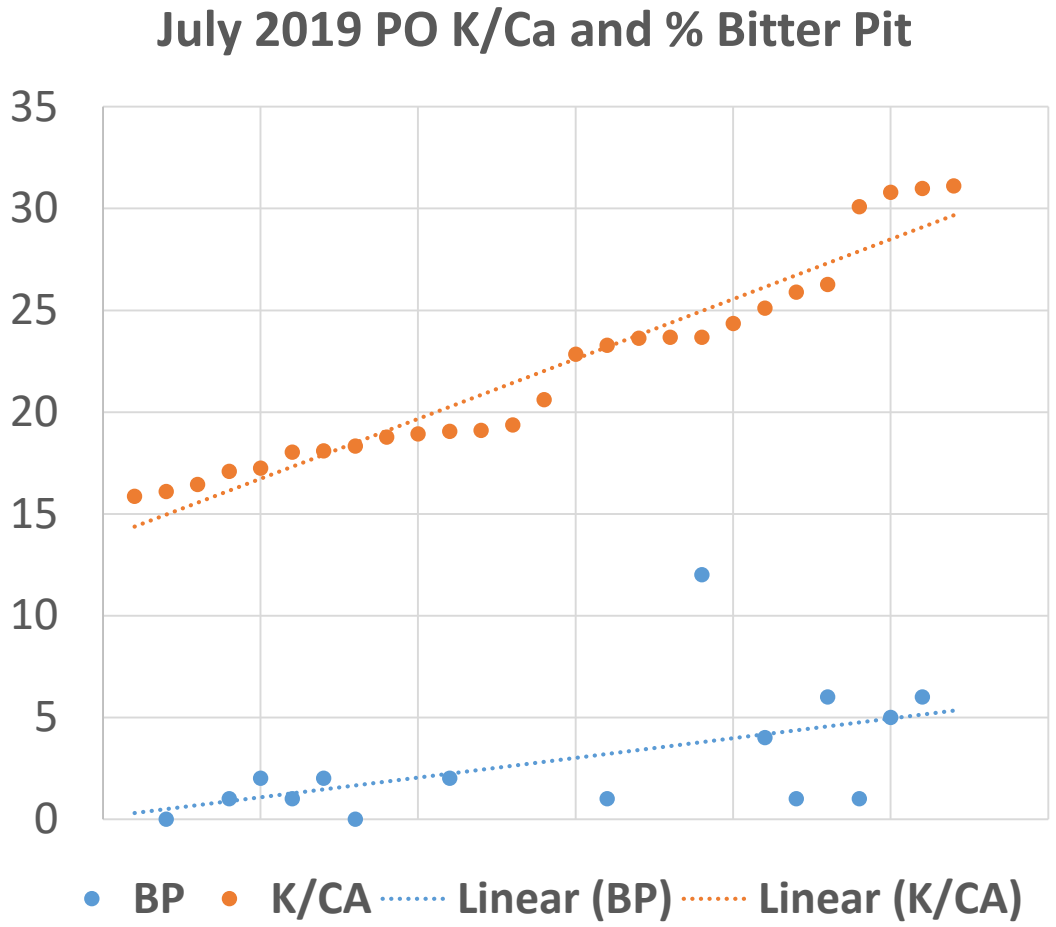
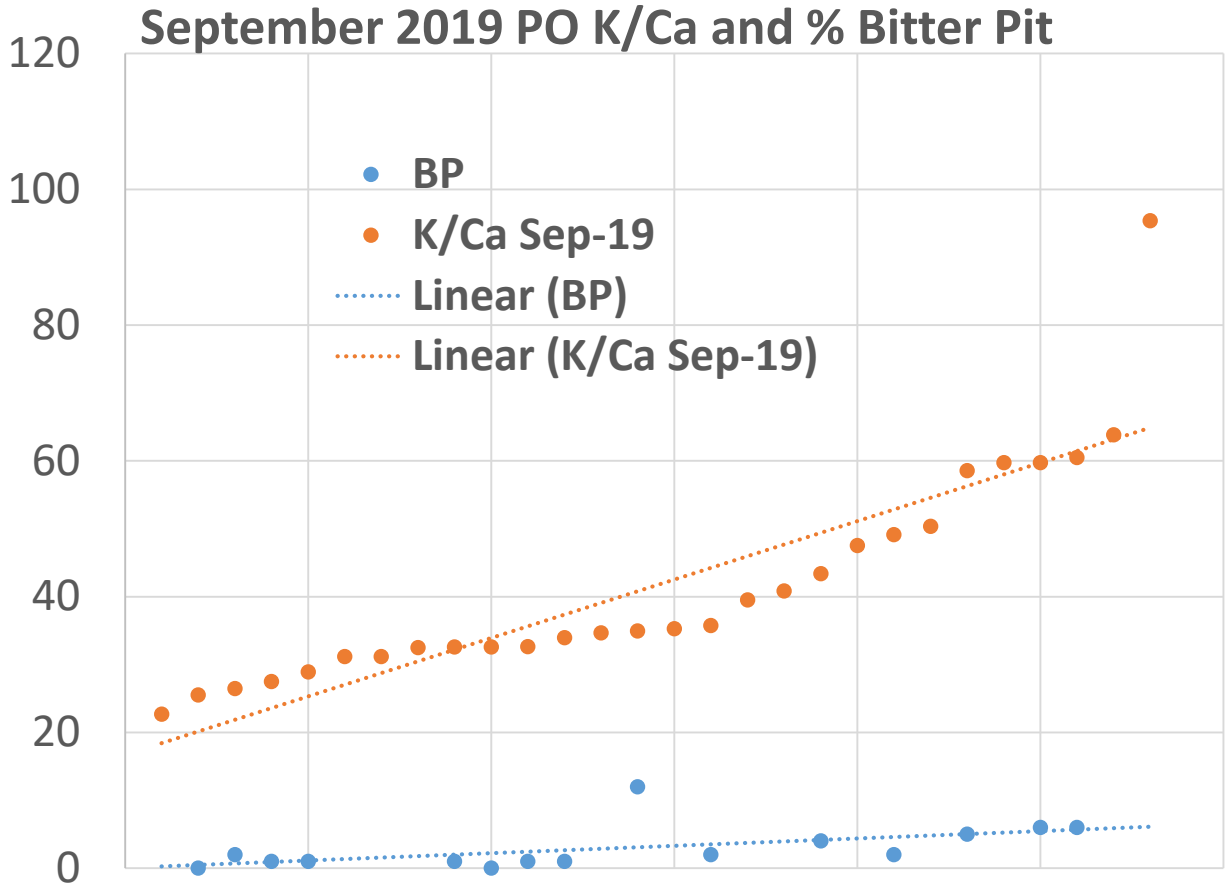
# 2019 Pack Out Data K/Ca Ratio and %BP

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# Take home message

- **Peel SAP K/Ca ratios** above **23-25 in July** appears to be associated with higher risk of bitter pit incidence
- **Peel SAP K/Ca ratios** above **35-45 in early Sept.** appears to be associated with higher risk of bitter pit incidence
- **Peel sap K/Ca ratio** in early July and early September might provide a **sensitive indication** of bitter pit risk at harvest and after storage

# Acknowledgments

**Lake Ontario Fruit Growers** - Lamont, Orchard Dale, Nesbitt, Zingler, Sandy Knoll Fruit Farms (28 Honeycrisp blocks for peel SAP studies conducted in 2017, 2018, and 2019)

**Vandewalle Fruit Farm** (developmental and nutrition studies of Gala and Honeycrisp in 2015, 2016, and 2017)

**USDA NIFA SCRI Apple Rootstock Project** (#2016-51181-25406) and **NY Apple Research & Development Program**

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