

Nutrient Requirements of 'Gala'/M.26 Apple Trees



Lailiang Cheng and Terence Robinson
Department of Horticulture
Cornell University

- **When and how much nitrogen and other nutrients are required by 'Gala' trees on dwarfing rootstocks to produce high yield and good size fruit?**

Experimental Procedures

- **Six-year-old 'Gala'/M.26 were grown in sand culture at 3.5 by 11 feet spacing (1125 trees/acre).**
- **Each tree received 30 g N in Hoagland's solution during the entire growing season.**
- **Cropload was adjusted to 8.2 fruit/cm² TCA at 10 mm king fruit (~104 fruit/tree).**
- **Four trees were destructively sampled for analysis at each key developmental stages.**



Leaf & Fruit Nutrient Status

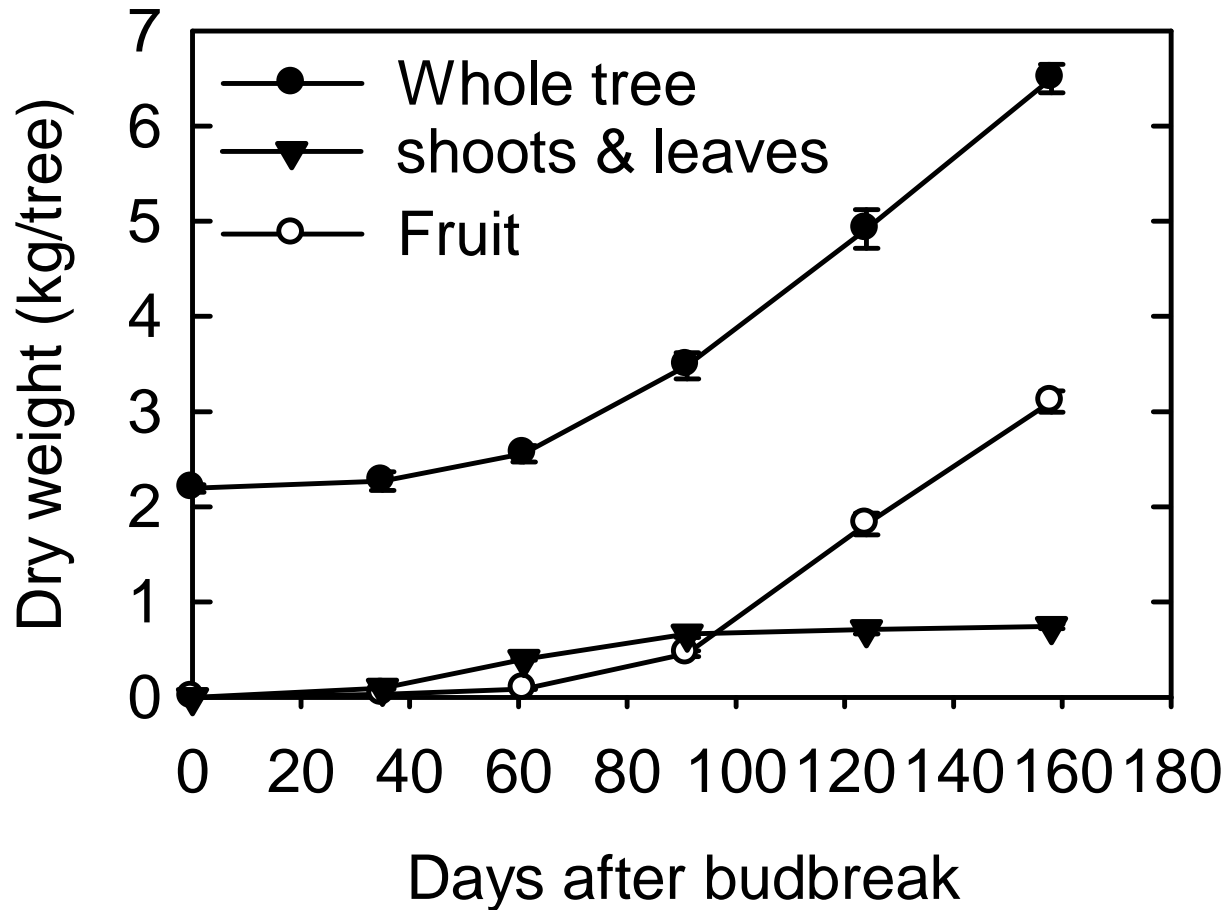
Macronutrients (%)

<i>Tissue</i>	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
Leaf	2.00	0.18	1.61	1.10	0.39
Fruit	0.25	0.06	0.80	0.05	0.04

Micronutrients (ppm)

<i>Tissue</i>	<i>B</i>	<i>Zn</i>	<i>Cu</i>	<i>Mn</i>	<i>Fe</i>
Leaf	27.3	27.3	8.3	143.8	83.5
Fruit	21.8	3.5	3.8	7.8	25.3

Dry Matter Accumulation of 6-yr-old Gala/M.26



Cropload: 8.2 frt/cm²TCA

Fruit#/tree: 104

Yield: 18.8Kg/tree

Leaf area/fruit: 550 cm²/frt

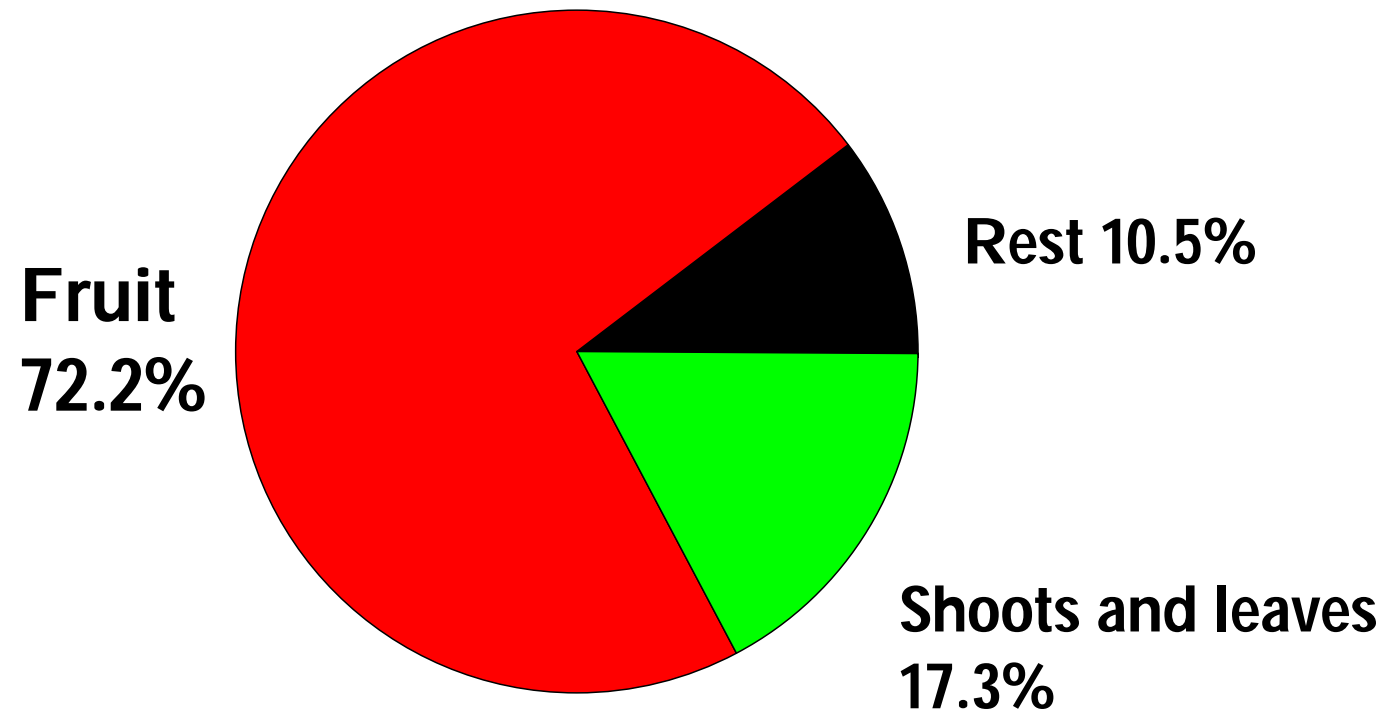
Fruit size: 181 g/fruit

Fruit firmness: 16.8 lbs

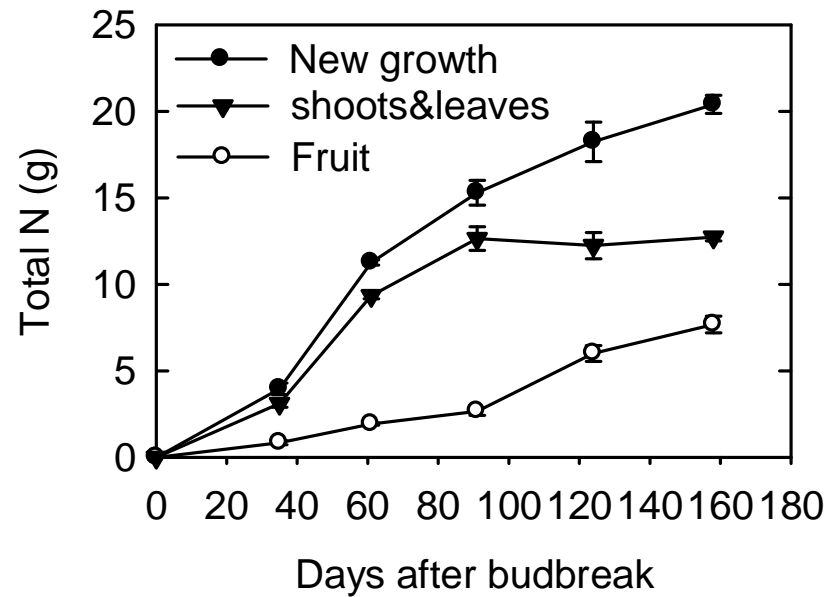
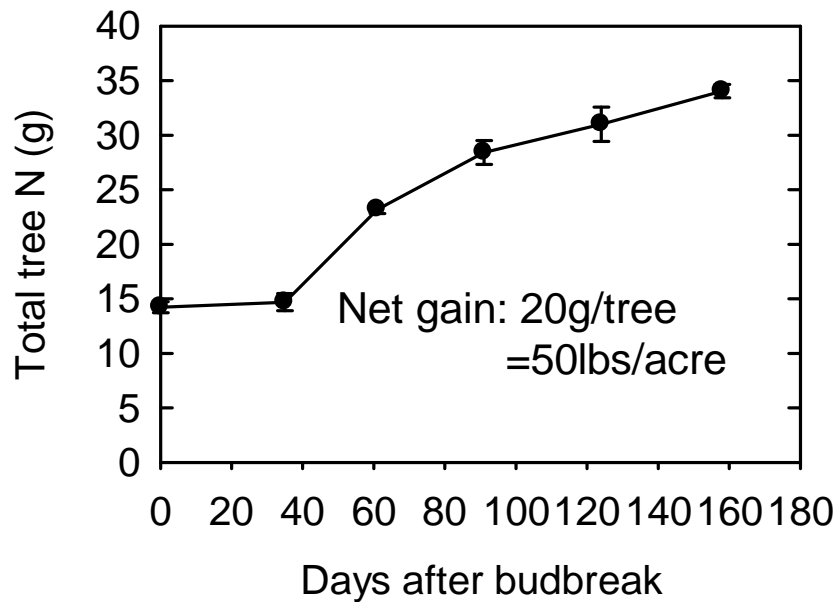
Soluble solids: 14.5%

Net Dry Matter Gain & Its Partitioning

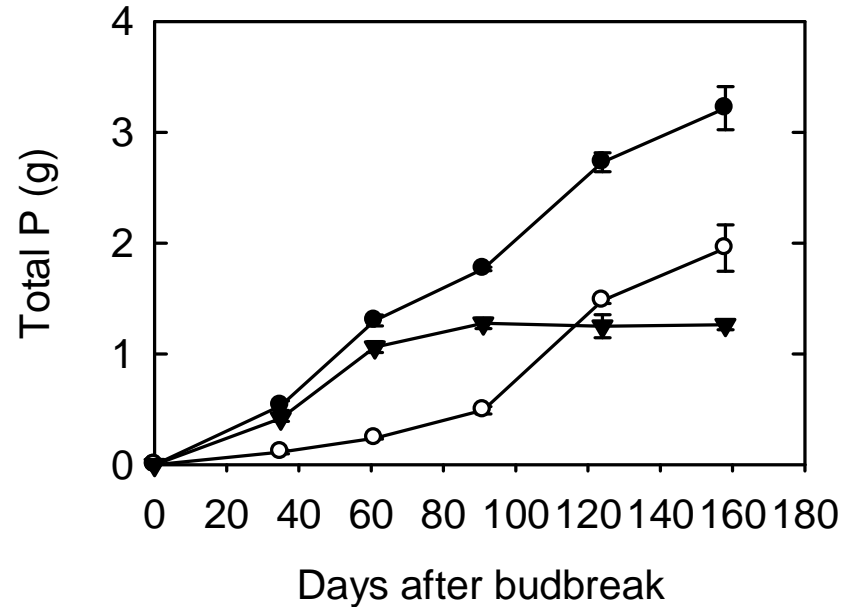
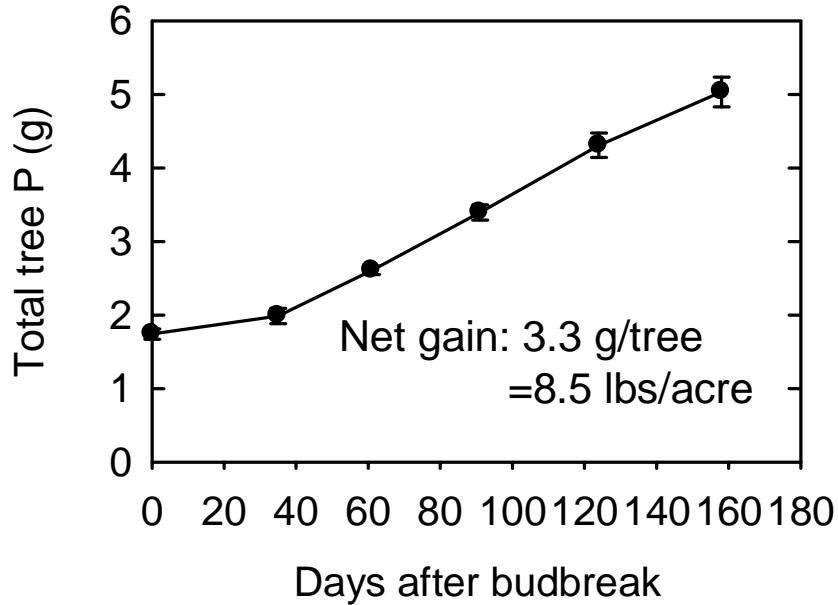
(Net DW gain: 4.3 kg)



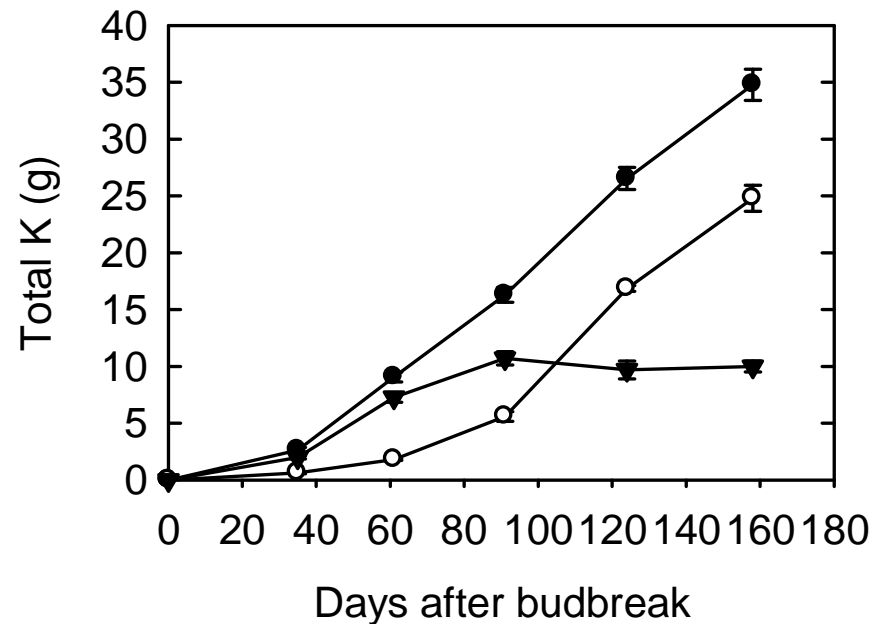
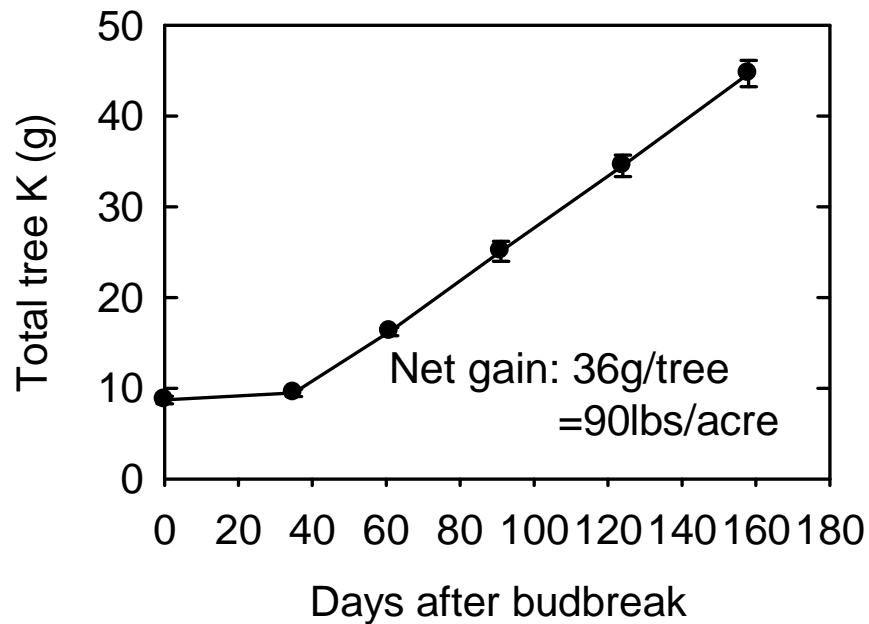
Total N in the Whole Tree & the New Growth (fruit + shoots and leaves)



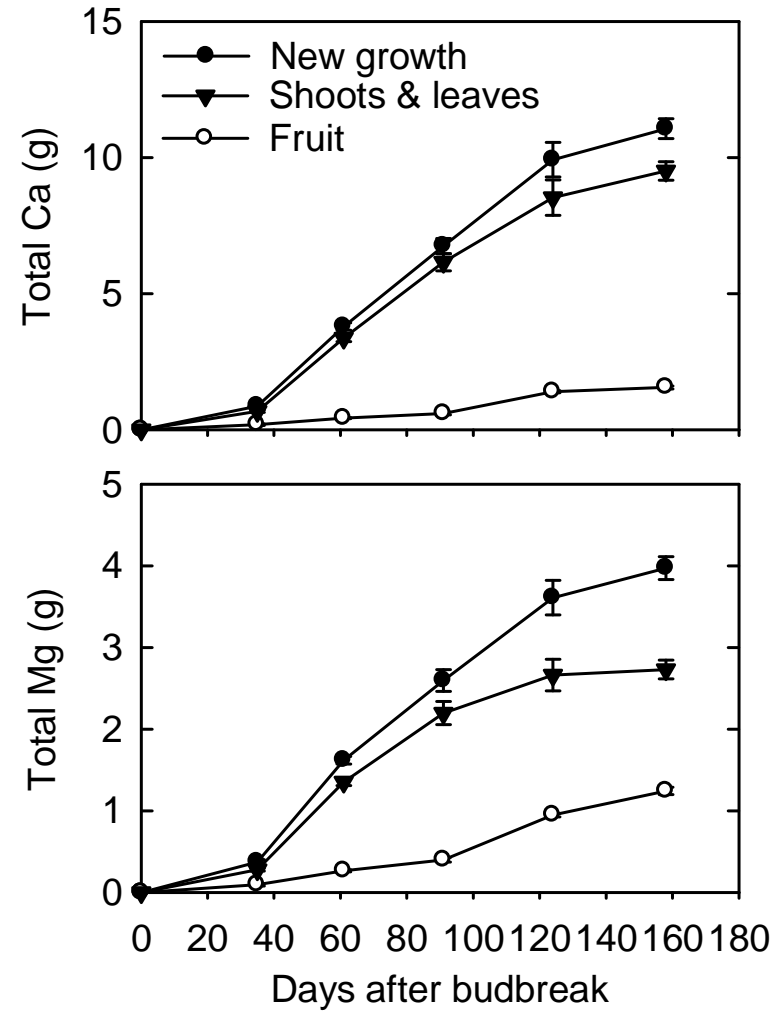
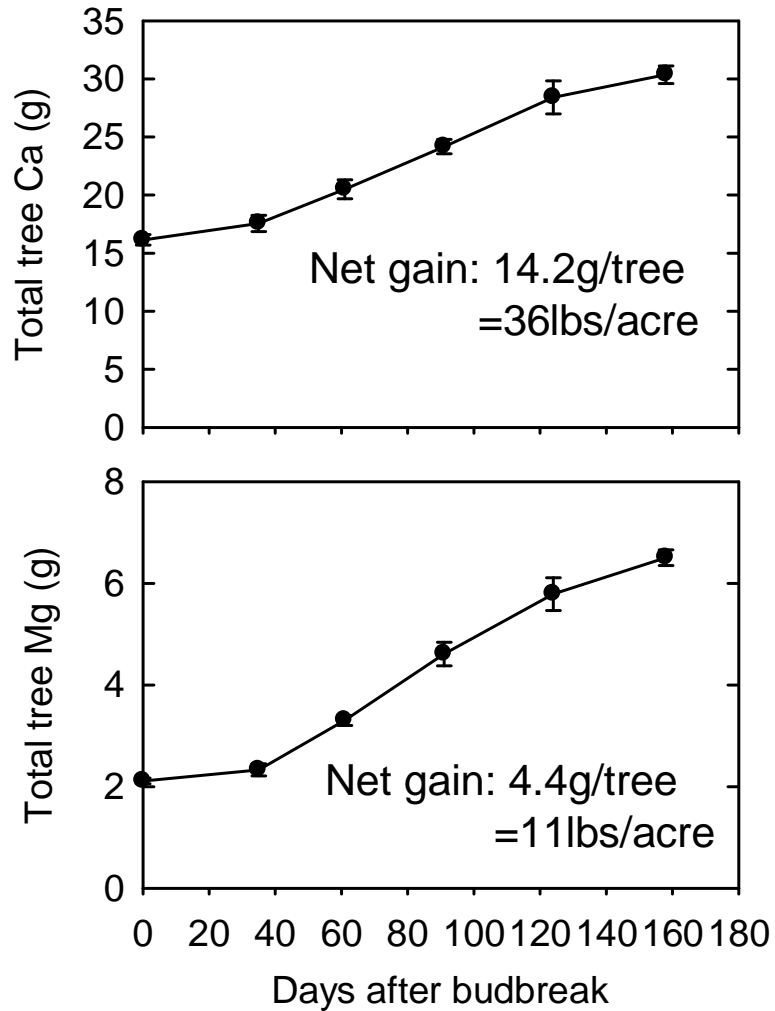
Total P in the Whole Tree & the New Growth (fruit + shoots and leaves)



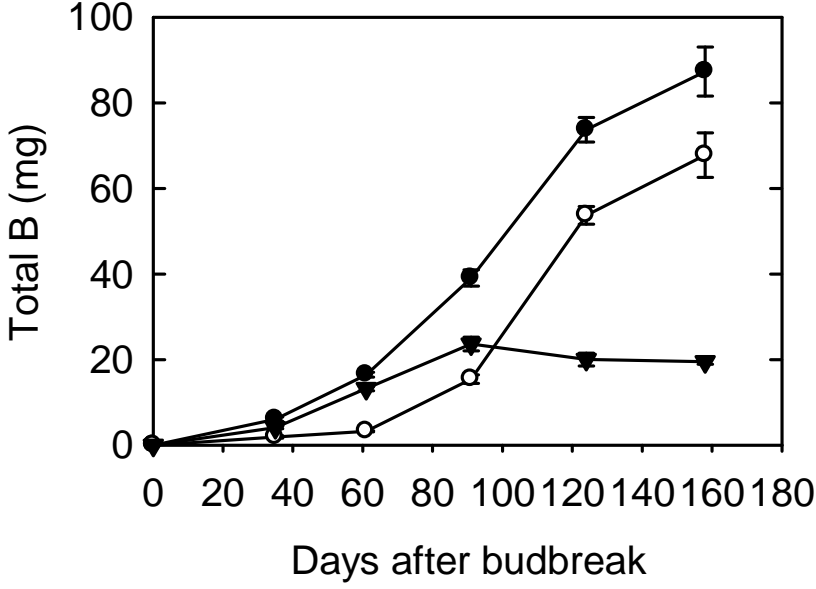
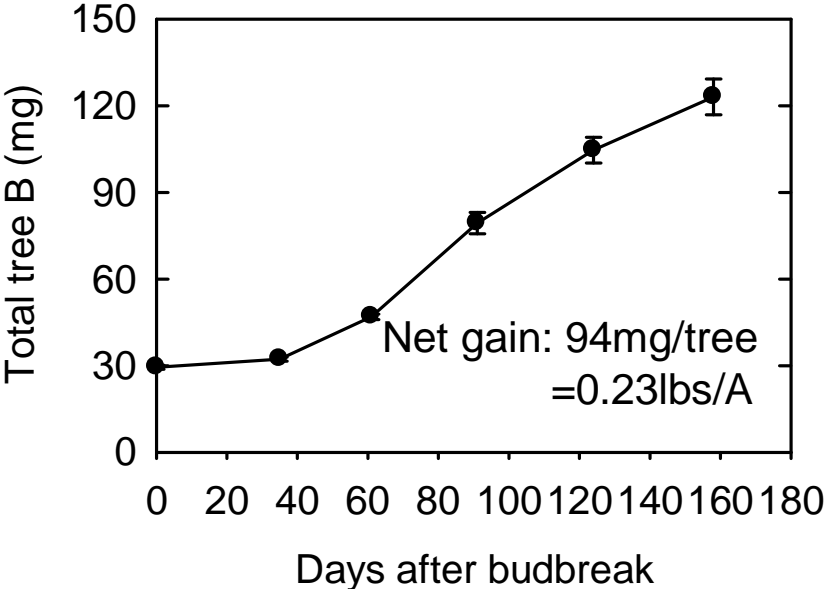
Total K in the Whole Tree & the New Growth (fruit + shoots and leaves)



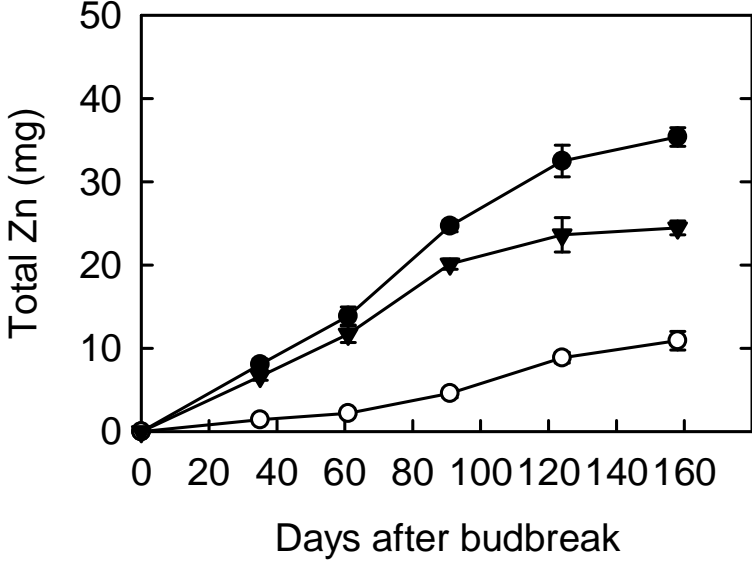
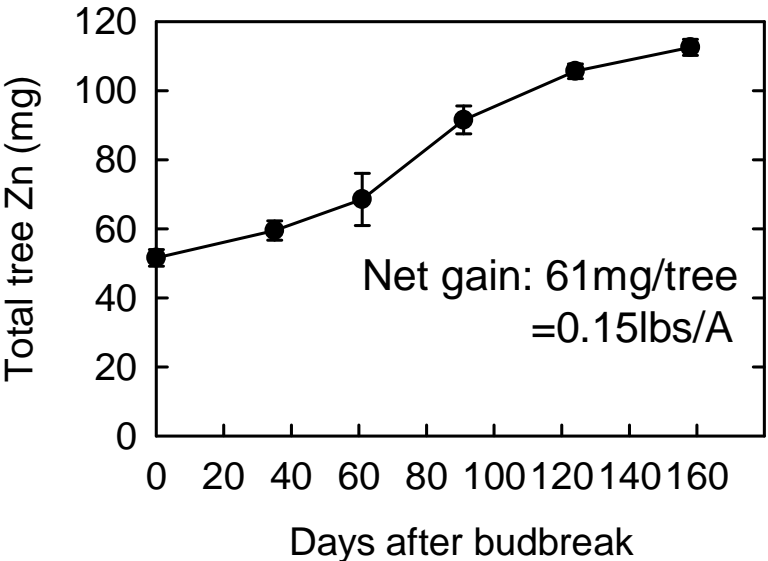
Total Ca & Mg in the Whole Tree & the New Growth (fruit + shoots and leaves)



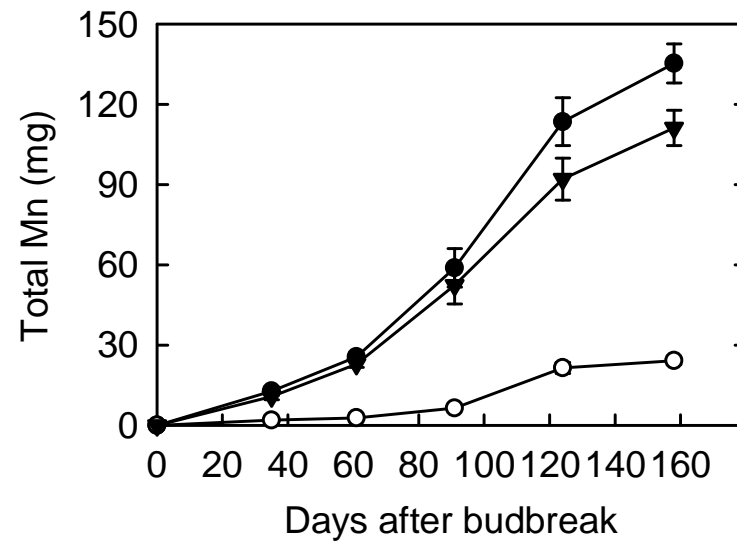
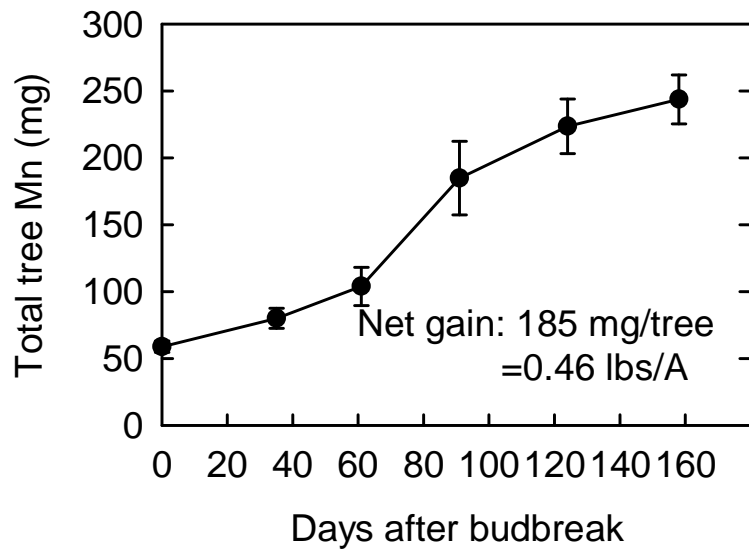
Total B in the Whole tree & the New Growth (fruit + shoots and leaves)



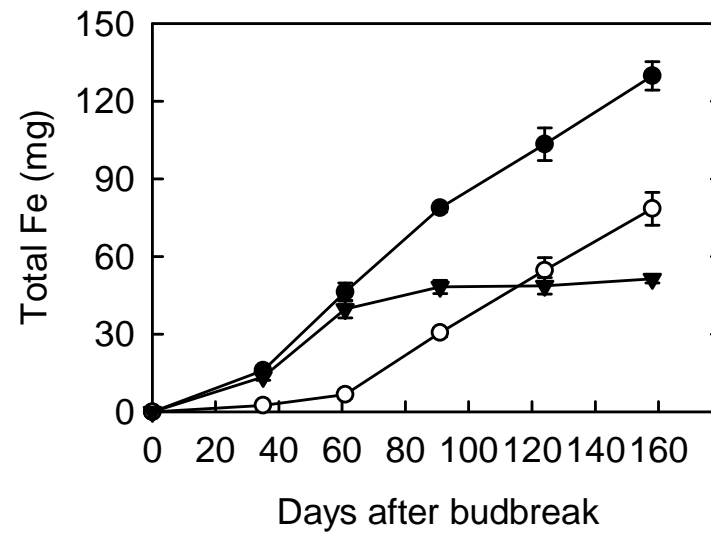
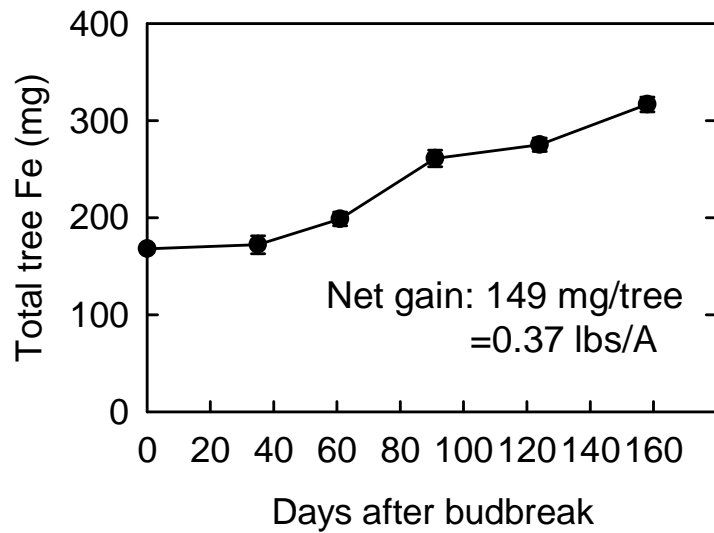
Total Zn in the Whole Tree & the New Growth (fruit + shoots and leaves)



Total Mn in the Whole Tree & the New Growth (fruit + shoots and leaves)



Total Fe in the Whole Tree & the New Growth (fruit + shoots and leaves)



Gala/M.26 Nutrient Requirements

(52.5 t/ha or 1110 bushels/acre)

Macronutrients (lbs/acre)

	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
Net gain	50.0	8.2	89.4	35.4	10.9
New growth	50.7	8.0	86.5	27.5	9.9

Micronutrients (lbs/acre)

	<i>B</i>	<i>Zn</i>	<i>Cu</i>	<i>Mn</i>	<i>Fe</i>
Net gain	0.23	0.15	0.12	0.46	0.37
New growth	0.22	0.09	0.05	0.34	0.32

'Gala' Fruit Nutrient Requirements or Nutrient Removal by Harvest (52.5 t/ha or 1110 bushels/acre)

Macronutrients (lbs/acre)

<i>Study</i>	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
Palmer (2006)	18.7	4.6	57.8	3.0	2.7
Cheng (2009)	19.1	4.9	61.6	3.9	3.1

Micronutrients (lbs/acre)

<i>Study</i>	<i>B</i>	<i>Zn</i>	<i>Cu</i>	<i>Mn</i>	<i>Fe</i>
Palmer (2006)	0.12	0.02	0.07	0.02	0.07
Cheng (2009)	0.17	0.03	0.03	0.06	0.19

Nutrient Requirements in Relation to Yield

Macronutrients (lbs/acre)

<i>Fruit yield (b/a)</i>	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>	<i>S</i>
500	22.1	3.7	40.2	15.9	4.9	1.8
750	33.2	5.5	60.2	23.9	7.3	2.7
1000	44.3	7.4	80.3	31.8	9.8	3.6
1250	55.4	9.2	100.4	39.8	12.2	4.5
1500	66.4	11.1	120.5	47.7	14.7	5.4
1750	77.5	12.9	140.6	55.7	17.1	6.3

Summary

- **Nutrient requirements (at 1110 b/A): N: 50, P: 8.5, K: 90, Ca: 36, Mg: 11, B: 0.23, Zn: 0.15, Cu: 0.12, Mn: 0.46, and Fe: 0.37 lbs/acre.**
- **Highest N demand occurs from bloom to the end of shoot growth, followed by a lower but steady demand; many other nutrients shows relatively constant demand from bloom to harvest.**
- **Differential requirements by fruit and leaves**
 - **Timing: bloom to end of shoot growth for leaves; end of shoot growth to fruit harvest for fruit;**
 - **Amount: fruit needs more P, K, B, and Fe than leaves.**



References

- **New York Fruit Quarterly 2009, 17(4): 5-10**
- **New York Fruit Quarterly 2010, 18(4): 25-28**
- **Journal of American Society For Horticultural Science 2009, 134(1): 3-13**

Acknowledgments

- **Rich Raba, Andrea Mason, Louise Gray & Scott Henning for technical assistance**
- **Dr. David Zimmerman (Cornell Pomology Ph.D. 1954), New York Apple Research and Development Program & Hatch Funds**
- **Van Well Nursery for providing the trees**