Updating Nutritional Strategies for Today's California European Pear Industry

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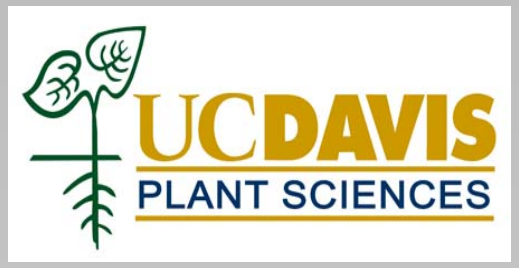


Objectives 2010-2012

- Seasonal tissue N (where, when, how much) vs tree productivity and growth (reassess CV's and tissue measurement).
- 'Typical' vs reduced N (compare standard and 'customized' BMP)
- Effects on crop load and fruit quality due to nutrient 'balances'
- Refine BMP to maintain productivity and fruit quality and reduce excessive N use

California Research and Recommendation Development

- Shoot leaves are the most commonly used tissue worldwide
- Only in California are non-bearing spur leaves used and only since 1983 has that been the official recommendation
- Historic Calif research -- shoot leaves
- *Research 1940's, 50's, 60's and 90's all showed N insensitivity*
- only fruit set was highly correlated with CV's in June (2-2.3) or September (1.7-2)
- Response to applied N only when leaf N < 1.7%
- 1.7% - 2.2%, local influences might cause a response
- Above 2.2% *any response to applied N would be unlikely*
- *Our findings support historic findings*

Elliot 1 (60 or 120 #N vs 0 N): Results

- Small changes with N fertilization
  - Most treatment differences in shoot and bearing spur leaves (few in non-bearing spur leaves)
  - No inadequacies
- No difference in vigor (pruning weights)
- 0N for 3 years did not reduce yields or fruit quality
- Cumulative tonnage per acre for 2010-2012 was 63.7 ('High N') vs 67.6 ('Low N')
- 'High N' treatment slightly increased fruit size by decreasing overall yields.
- Yield efficiency (yield on a per tree basis)
  - High N -- 0.077
  - 0 N -- 0.079

Elliot 1: Conclusions

- Yield efficiency better indicator of N response than either tissue analyses or vegetative growth responses.
- Applied N should be managed on a 'as needed only' basis with 2 lb N/ton/A
- Variable bearing capacity of this orchard is due to local conditions (bloom weather, preharvest crop loss, tree variability)
- Higher N tended to increase fruit size while reducing yield slightly (consistent with Westwood et. al., 1964)

McCormack: Customized N level

- North half of orchard is low vigor, lower yields, smaller fruit and later harvest
- South half has better soil and a higher water table

The grower's goals:

- Increase reproductive and vegetative vigor in North half
- Advance maturity in North half so more fruit are ready

Low vigor

High vigor

McCormack: Results

- Differences between leaf types was greater than that between orchard halves
- Pruning weights only reflected inherent difference in vigor between orchard halves.

2010-2012 Yields:

- No difference in fruit size within size grade, % of the crop that were #1 fruit in total yield

2011 and 2012: %Yield in the first harvest was not different by treatment – maturity was advanced in 'first pick' for N half by increasing fruit size earlier

McCormack: Conclusions

- Leaf N analysis – of what use if wide range of high N applied (107.5-313.5 lb/A) isn't reflected in leaf analysis and no inadequacies are likely with high fertilization rates?
- High percentages of #1 fruits with good yields for inherent tree vigor
- Advance of 1st pick harvest in 'weak' half of orchard appears to have been achieved

Elliot 2: Nutrient balance effects on fruit quality and yield

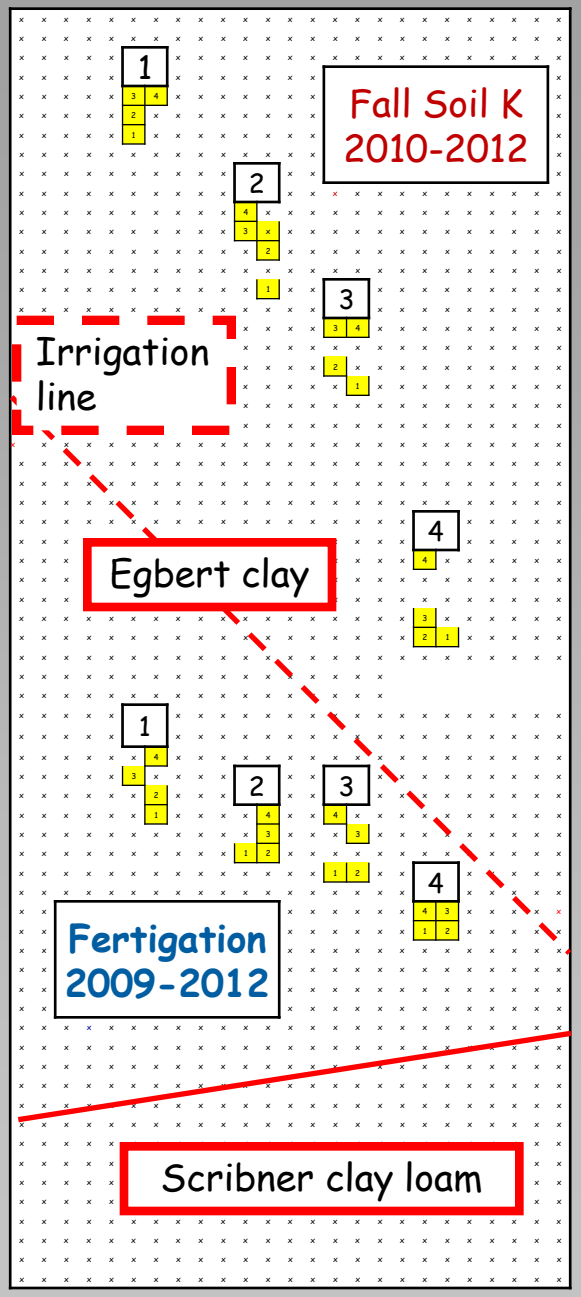
500# K_2O (muriate of potash) = 150 #K /A/yr applied to soil in fall

versus

K fertigation $K_2S_2O_3$ (Kmend) =28 #K/A/yr, 3 times in spring (84 #K/A/yr)

Prior to different K treatments, April 2010, after small fruit drop

- Near Scribner clay loam, K, (K+Mg)/Ca and K/Ca are higher, N/K and Mg are lower than in Egbert clay <u>across tissues sampled</u>
- <u>Among leaf types</u> **bearing spur** leaves tended to show the most extremes.
- **Shoot** leaves showed highest correlation with 'fruit quality' nutrients
- **Fruit** had the highest number of nutrient extremes for both locations combined, and several extremes for each location.



July Nutrients and Postharvest Fruit Quality, 2010

- 'Fertigation' 2009+2010 vs 'Soil' (Fertigation 2009)
- Both shoot and bearing spur leaves showed most important nutrient differences.
- Fertigation plot had reduced firmness before and after storage and increased fruit disorders after storage (internal browning and senescent scald).
- Firmness correlated with April nutrient levels:
- higher levels in (K+Mg)/Ca, K/Ca and Fe in bearing spur leaves
- lower Ca and higher K in bearing spur and shoot leaves
- April 2010 K/Ca and N/Ca in fruit was high – predictive of potential fruit quality problems

Nutrients and Postharvest Fruit Quality, 2010

- Spring 2010 Fertigation had not occurred by the April sample timing
- Tree uptake of nutrients already influenced by soil textural differences for soil type transition from Scribner clay loam to Egbert clay loam.
- Spring fertigation with $CaNO_3$ and K increased the N/Ca and K/Ca imbalances during fruit development.
- N is highly mobile, Ca is not (to get it into fruit it must be applied to the fruit itself).
- Leaf Ca does not = fruit Ca
- Ca moves in the water stream and not from leaves to fruit

Elliot 2: Harvest and Fruit Quality

2010-2011:

- Fruit size slightly better with Spring fertigation, but more #1 fruit with Fall K

2012:

- No differences in yields or fruit quality by K treatment in 2012.

Cumulative: The %change in yield over time from the same limbs and trees—none

Elliot 2: Conclusions

- Soil type influential in affecting trees' ability to take up individual nutrients
- Single nutrient levels were not as important to fruit quality as nutrient balances
- Sampling in early spring (small fruit) and mid-season (shoot and bearing spur leaves), provided good prediction of potential for fruit disorders
- Nutrient balances should be calculated and used to assess need for fertilizers before application.
- When potential imbalance is seen
  - Postpone (fall K, N) or avoid application
  - Apply Ca foliarly as soil Ca uptake can be compromised

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