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)

- ON 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)
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
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 $K_2S_2O_3$ ($K_{mend}$) = 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 across tissues sampled

- Among leaf types 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.
'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
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 CaNO₃ 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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