Development of Leaf Sampling Methods and Nutrient-budget fertilization

Sebastian Saa Silva, Saiful Muhammad, Patrick Brown
UC Davis, Department of Plant Sciences, One Shields Ave, Davis, CA 95616; phbrown@ucdavis.edu

Objectives

- Determine variation in leaf nutrient status between sites, within tree canopy and throughout the year
- Develop a phenology and yield based nutrient model for almond
- Develop fertilizer response curves for fertigation systems
- Determine nutrient use efficiency of various N and K rates and sources

Methods

Variability assessment

Four representative orchards
Belridge (Kern), Madera (Madera), Modesto (Stanislaus), Arbuckle (Colusa); 54 trees

Leaf samples from non-fruiting spurs (NF), and spurs with two fruit(F2); nut samples; individual tree yields

Fertigation trial at Belridge (Kern County)

Nitrogen treatments
all at 200 lbs/ac K as SOP+KTS
Two N sources: CAN17 and UAN32
Four nitrogen rates: 125, 200, 275 and 350 lbs/ac

Potassium treatments
all at 275 lbs/ac N as UAN32
Three K sources (SOP, SOP+KTS and KCl) at 200 lbs/ac
Three rates of SOP+KTS (100, 200 and 300 lbs/ac)

Two irrigation systems: Fan Jet and Drip

5-6 times experimental units @ 15 trees (6 trees sampled); Leaf and nut samples; individual tree yields

Samples taken 5 times during the season for four years (3 completed); Samples analyzed for N, P, K, B, Zn, Ca, Mn, Mg, Fe, S, Cu at UC Davis DANR lab
Spatial interpolation, analysis of variance, regression analysis

Results

Variability Assessment

Site	Real F2 Nitrogen (%) in July 2009	Predicted F2 Nitrogen (%) in July 2009
Arbuckle	1.86	1.99
Arbuckle	2.065	2.03
Arbuckle	1.62	1.87
Belridge	2.36	2.21
Belridge	2.18	2.06
Belridge	2.06	2.23
Madera	2.28	2.17
Madera	1.95	1.95
Madera	2.16	2.05
Modesto	2.47	2.42
Modesto	2.42	2.42
Modesto	2.39	2.35

Table 1. In Season Prediction using N-P-K- Ca from F2 leaves collected in April 2009.
Model selected through Stepwise method using RMSE criteria. R^2 = 0.62 RMSE = 0.12 .

- Leaf samples collected from fruiting spurs are more sensitive than non fruiting spur leaves in predicting July leaf N
- Model selecting techniques allow accurate N prediction early in the season (Table. 1)
- Leaf nutrient concentrations follow a similar patterns between season and between locations (Fig.1)
- Mg and Ca concnetrations are closely associated withleaf age and/or water use (Fig. 1)

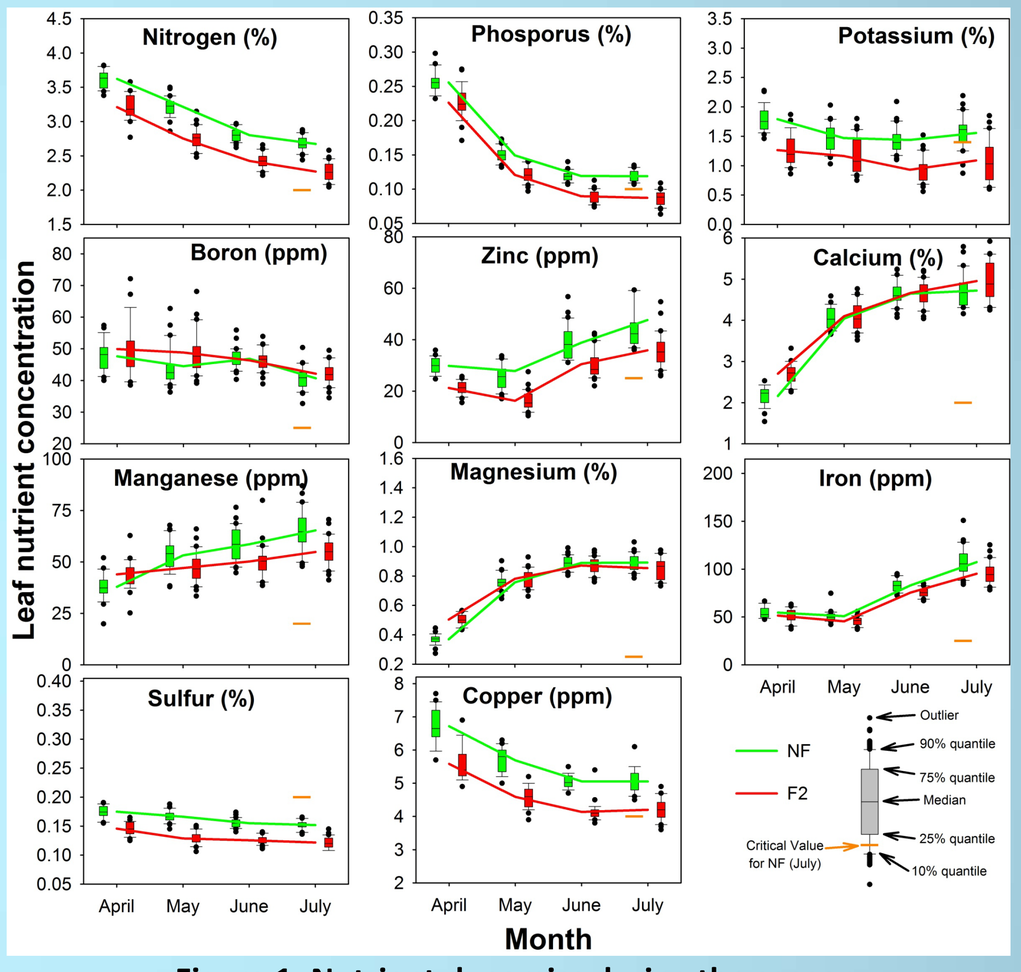

Figure 1. Nutrient dynamics during the season.
Data for Belridge during 2010 season

Fertigation Trial

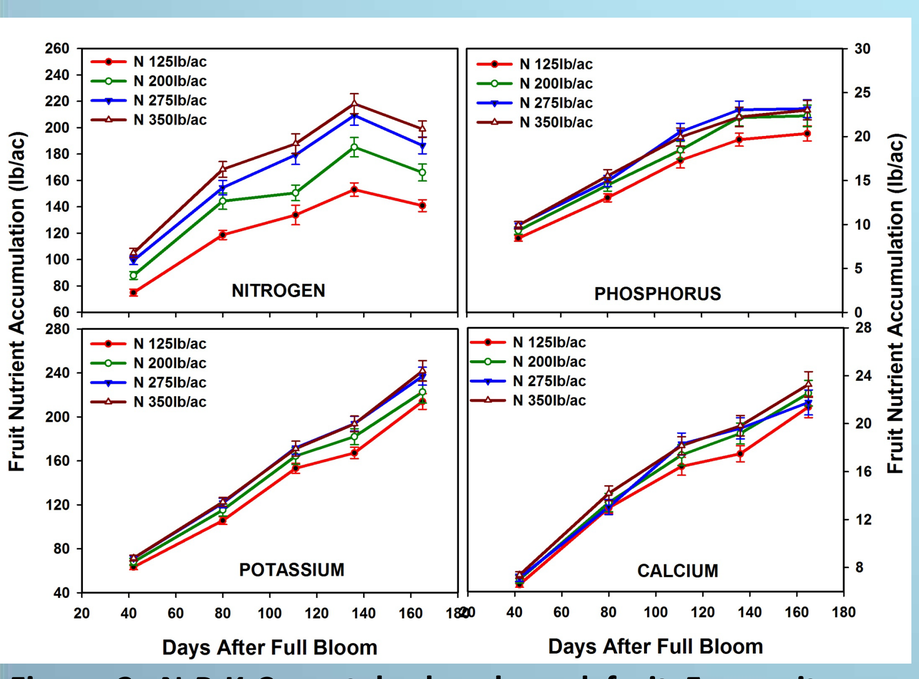

Figure 2. N-P-K-Ca uptake by almond fruit From nitrogen rate treatments in 2009.

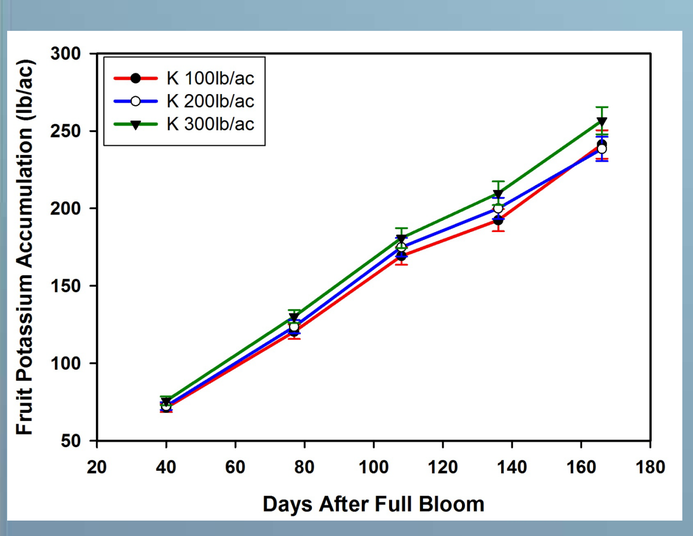

Fig. 3. Potassium removal by almond fruit from potassium rate treatments in 2009

Data for two sampling seasons have been fully evaluated, two additional years of data collection are planned.

- There is significant N treatment effect on yield and fruit nitrogen removal in 2009 (Fig. 2)
- Remobilization of N from fruit to perennial parts was observed after hull split (Fig. 2)
- Fruit K removal is > N removal in all treatments however no significant effect of K rate on yield been detected (Fig. 3)
- Nitrogen rates show significant effects on fruit yield in 2010 (Table 2)
- Nitrogen efficiencies of 50 to > 75% have been observed in this trial.

Irrigation	UAN 32 (lb/ac)				CAN 17 (lb/ac)			
	125	200	275	350	125	200	275	350
Drip	10,997	11,815	13,964	14,442	10,092	11,397	13,224	14,268
	C	BC	AB	A	C	BC	AB	A
Fan Jet	11,049	12,789	13,137	13,485	11,223	12,180	13311	13920
	B	A	A	A	B	AB	A	A

Table 2. Effect of different nitrogen rates and sources in 2010-fruit-yield (total field weight).
Different letters represent significant differences.

Preliminary conclusions

Results presented here represent only part of a long-term experiment and must be interpreted with caution.

- **Substantial variability in nutrient concentrations within field, between field and within trees was observed.**
- **Data from fruiting spur leaves suggest that selection of these leaves is superior to selection of non fruiting spur leaves.**
- **Significant N remobilization from fruit to tree at fruit maturity may contribute to spur health and survival**. The significance of these findings is being examined.

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