Development of a Nutrient Budget Approach to Fertilizer Management in Almond

Project No.: **07-ENVIR3-Brown**

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Paramount Farming Company California
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Interpretive Summary:

It has been many years since an in depth integrated analysis of almond fertilization has been conducted and evidence from the recent CDFA-FREP nutrition focus groups and survey of industry consultants, growers and Farm Advisors suggests our current approach to managing plant nutrition in almond is inadequate to meet production goals. Ninety percent of growers and consultants felt that UC Critical Values (CV's), especially for N and K, were not appropriate for current yield levels and that the links between the

results of leaf and soil sampling and specific fertilizer recommendations are poor. The survey suggests that growers would like to know exactly what the use of the nutrients are in the tree and when. How much the optimum tree needs of every element and the time of year as a growth curve from beginning to the high point or multiple peaks of development. Currently nutrient management in trees is based on Critical Values (CVs). The alternative approach is to use knowledge of growth and development to derive nutrient demand curves that guide the quantity and timing of nutrient application. The experiment has been set up on Paramount Farm, Bakersfield, under fan jet and drip irrigation systems with 12 treatments each replicated in five units. Collection of tissue samples are in progress and crop will be harvested in August.

Objectives:

1. Develop a phenology and yield based nutrient model for almond.
2. Develop fertilizer response curves to relate nutrient demand with fertilizer rate and nutrient use efficiency.
3. Determine nutrient use efficiency of various commercially important N and K fertilizer sources.
4. Validate current CVs and determine if nutrient ratio analysis provides useful information to optimize fertility management.
5. Develop and extend an integrated nutrient BMP for almond.

Materials and Methods:

In order to develop a phenology and yield-based nutrient model for almond, four trials have been initiated in four sites (Arbuckle, Salida, Madera and Bakersfield) in 8 to 9 years old microsprinkler-irrigated almond orchards of good productivity planted to Non-Pareil (50%) on uniform rootstock in soils representative of the region. All plots are contigious blocks of 10-15 acres. Leaf samples have been collected in April, May and June, and two more samples will be collected in July and September. In addition to the four sites, leaf and nut samples are also being collected from the N and K treated blocks to allow for determination of the effect of tree nutrient status on nutrient uptake and whole tree nutrient budgets.

Tissue determination for the major elements (N, P, K, S, Ca, Mg, B, Zn, Fe, Mn, and Cu) in all the collected nut samples and leaf samples is being processed by the DANR analytical laboratory at UC Davis. All nutrient and biomass data will be cross-referenced to individual tree yield, phenology, environment, and other variables to develop a phenology and yield-based nutrient model for almond.

The experimental trial has been set up on Paramount Farm in Bakersfield. The orchard is eight years old and planted on 50% Non-Pareil and 50% Monterrey. Plants are spaced 24’ between row and 21’ between plants, accommodating 87 trees per acre.

Experimental plots have been set up both under fan jet and drip irrigation systems (Plot Map attached). Fifteen individual trees and their immediate 30 neighbors are being considered as a single, uniformly treated unit with all measurements taken on the central six Non-Pareil trees individually. Eight treatments (ABDEFHIJ) have been replicated in 5 units, while 4 treatments (CGKL) have been replicated 6 times for each irrigation system; a total of 64 experimental units and 384 experimental trees under each irrigation system. There are 128 experimental units and 768 trees in the whole experiment. A fertigation system has been installed and a digital flow meter has been installed which allows a constant concentration of fertilizer during fertigation. The basal SOP application was made in early February, and fertigation was done in February, April and June. The last fertigation will be done in August after harvest. All the fertigations have been done according to the irrigation schedule to avoid nutrient leaching.

Products are being fertigated during an irrigation cycle in four applications optimized based on current knowledge of tree demand cycle. Treatments include 4 rates of N (125, 200, 275, 350lb/ac, all other elements held constant) applied through UAN32; 3 rates of K (100, 200, 300 lb/A, applied as 60% SOP as basal and 40% KTS fertigated; all other elements held constant), plus 4 contrasting rates of CAN17, one KCl, and one SOP treatments. Effectiveness of each treatment will be determined by changes in leaf tissue analysis, yield, and soil residual N and K over a 3-5 year period.

Specific treatments are as follows applied in the following increments (Late February 20%, April 30%, June 30%, August 20%):

Treatment A: Nitrogen Rate Trial 1
UAN32, applied at 125 lb N/A in 4 intervals K at 200 lb/A.

Treatment B: Nitrogen Rate Trial 2
UAN32, applied at 200 lb N/A. K at 200 lb/A.

Treatment C: Nitrogen Rate Trial 3
UAN32, applied at 275 lb N/A. K at 200 lb/A.

Treatment D: Nitrogen Rate Trial 4
UAN32, applied at 300 lb N/A. K at 200 lb/A.

Treatment E: Nitrogen Material Trial 5
CAN17, applied at 125 lb N/A. K at 200 lb/A.

Treatment F: Nitrogen Material Trial 6
CAN17, applied at 200 lb N/A. K at 200 lb/A.

Treatment G: Nitrogen Material Trial 7
CAN17, applied at 275 lb N/A. K at 200 lb/A.

Treatment H: Nitrogen Material Trial 8
CAN17, applied at 350 lb N/A. K at 200 lb/A.

Treatment I: Potassium Rate Trial 1
K at 100 lb/A: SOP 60lb/A banded and 40lb/A KTS fertigated. N at 275 lb/A.

Treatment C: Potassium Rate Trial 2
K at 200 lb/A: SOP 125lb/A banded and KTS 75lb/A fertigated. N at 225 lb/A.

Treatment J: Potassium Rate Trial 3
K at 300 lb/A: SOP 180lb/A banded and KTS 120lb/A fertigated. N at 225 lb/A.

Treatment K: Potassium Material Trial 4
K at 200lb/A: SOP banded. N at 225 lb/A.

Treatment L: Potassium Material Trial 5
K at 200lb/A: KCL Fertigated. N at 225 lb/A.

The fertigation of each experimental block and also the non-experimental trees have been controlled by valves at the joining of the take off and lateral line, which allows fertigation at the desired treatment time. An automatic bypass valve allows experimental plots to receive normal irrigations water.

Leaf and nut samples have been collected at three different dates, i.e April, May and June and will also be collected in July and September, to contrast tissue nutrients levels to different fertilizer treatments and tree yield.

Leaf and nut samples were collected in six individual trees from each replicate unit in all treatments in May and a second sampling will be done in July. Leaf and nut samples were also collected in April and June in all the N and K rate treatments in Fan Jet and Drip, and will also be collected in August after harvest. Total annual samples for this project will be 3972.

Tree yield will be determined by harvesting the individual tree in each treatment in August.

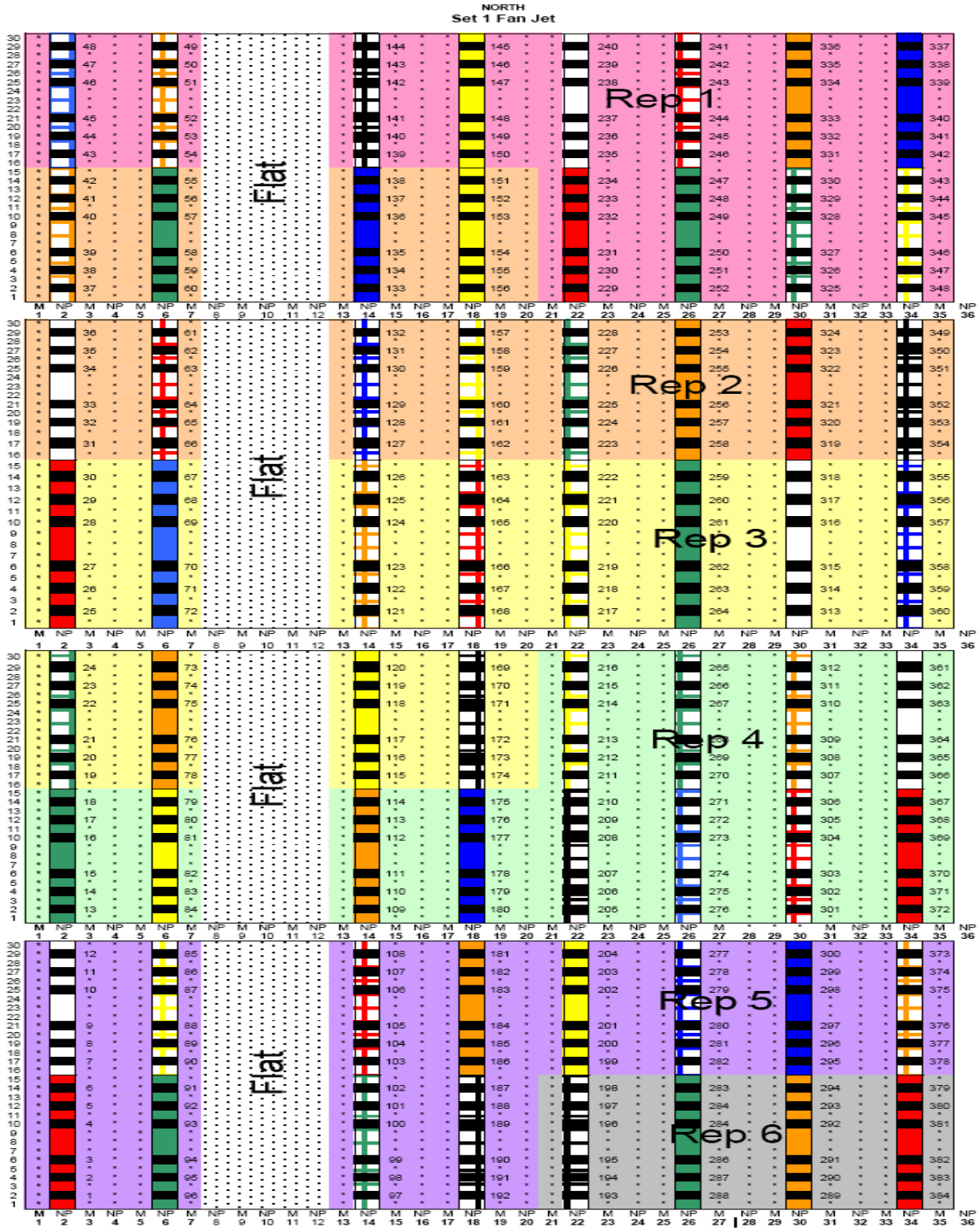
Results and Discussion:

Currently the first three rounds of sampling have been completed and results of the tissue analyses from the DANR laboratory are pending. Upon completion of the tissue analysis and individual yield harvest statistical analysis will begin. Harvest of individual trees is now being planned

Recent Publications:

Preparation of publications for this project will commence after data from year one has been compiled and analyzed.

Plot Map


NORTH
Set 1 Fan Jet
Rep 1
Rep 2
Rep 3
Rep 4
Rep 5
Rep 6
Flat
Flat
Flat
Flat
Flat
Flat