HEALTHY FOOD SYSTEMS • HEALTHY ENVIRONMENTS • HEALTHY COMMUNITIES • HEALTHY CALIFORNIANS
University of California
Agriculture and Natural Resources
Making a Difference for California
UCCE
In a Nutshell
Tulare County

N Budgeting Following the 4 R's

Katherine Pope, UCCE Orchard Advisor Yolo, Solano, & Sacramento Cos.
Bruce Houdesheldt, Sacramento Valley Water Quality Coalition

Nitrogen management, for farm planning or regulatory compliance, boils down to one fundamental concept – matching supply with demand. When supply is greater than demand, nitrogen (N) can be lost from the root zone and leached into groundwater aquifers. Matching supply with demand relies on the 4 R's of nitrogen management – applying nitrogen at the Right Rate, at the Right Time, in the Right Place and using the Right Source. When timing or amount of supply doesn't match demand, yield can be reduced compared to yield under properly fertilized conditions.

Right Rate. UC research led by Dr. Katherine Pope funded by CDFA and the California Walnut Board has found on average, 27 lbs N in every ton of walnuts (in-shell, 8% moisture), looking at six mature, moderate to high yielding orchards (3 Chandler, 3 Tulare) over two years. Nitrogen used in the hulls, leaves and other scraps that are removed at harvest, plus some nitrogen for new growth adds about another 8 lbs N per ton walnuts. Thus, for a healthy orchard with a filled in canopy, estimate 37 lbs N per ton will be removed from the orchard or permanently tied up in new growth. More research this season will work to put more exact numbers to N in scraps removed at harvest and new growth.

Right Time. To match delivery with tree N use, it's ideal to apply N four times during the season. Research from the same project as above showed that the uptake of nitrogen by growing nuts was steady over the growing season. Data still being analyzed for 2014, and data to be collected in 2015 will yield a more precise division. For now, dividing your N applications evenly over the growing season (25% in May, June, July and August) will increase nitrogen use efficiency. Whatever number of applications you apply, remember that N can only be taken up when there are leaves on the tree, the first month of growth uses stored N, not N from the soil, and demand during the rest of the season is evenly spread out.

Right Place. For the trees to take up N, it needs to stay in the root zone. Most walnut roots are in the top 3 feet of the soil. Managing irrigation to decrease leaching also keeps nitrogen where the tree can use it.

Right Source. In experiments by Dr. Patrick Brown in almonds, there was no difference in yield between equal annual amounts of N as UAN 32 or CAN-17. Material choice is more a function of price per unit N, and other needs particular to your orchard, like pH impact.

ESTIMATING DEMAND

The 4 R's of nitrogen management combine to estimate crop demand. To figure out how much N your trees need in any given year, combine (a) estimated yields with (b) N removed in the crop and (c) your estimated nitrogen use efficiency.

a) To get **estimated yields**, a good approach is averaging your last 5 years of yield, then decreasing or increasing that number based on considerations like conditions during bloom, a very heavy or light crop last year, etc.

b) As discussed above, 1 ton of walnuts uses 37 lbs N (0.0185 lb N for every 1 lb in-shell nut). A 3 tons/acre harvest will remove 111 lbs N/acre from the orchard.

c) Your **nitrogen use efficiency** (NUE) – how much N is taken up by the trees per lb of fertilizer N applied - depends on how closely you follow the 4 Rs. If you are budgeting 37 lbs N per ton in-shell nuts, dividing your fertilizer N applications into the four equal applications and irrigating to match ETc, (keeping water in the root zone), you can achieve NUE levels of around 70%. To use the percent NUE in calculations, convert percent to decimal by dividing by 100. Most walnut orchard range 30-50%.

The three components above can be combined to produce a recommended nitrogen application for a block, using the following equation:

N Demand (lbs/ac) = __[Est. Yield]__ (ton/ac) x 37 (lbs N / ton) ÷ __[NUE Factor]__

Example: A 3 ton/acre crop contains 111 lbs N/acre. If N is delivered into the tree with 70% efficiency, then the grower should apply 159 lbs fertilizer N to meet crop N demand – assuming no other N source(s).

ESTIMATING SUPPLY

In addition to synthetic fertilizers (urea, UN32, CAN-17, etc.) there are other potential suppliers of N, such as manure, compost and irrigation water. To figure out how much synthetic fertilizer may be necessary for your expected crop, subtract the non-synthetic supply from the estimated demand.

a) Exactly how much **nitrogen in manure/compost** is available to plants and when it's available is complex and continues to be researched. Each soil type and climate responds differently to these amendments, so use your own experience and judgment when putting the following numbers to use. If you don't use manure or compost often, only some of its N will be available the year it's applied - 5-10% for cured compost, 15-30% for dried or aged manure (poultry or bovine).* If you apply about the same amount of the same N content manure or compost annually, it should reach a steady state of turn-over, where N in this year's application roughly equals N released from previous applications. Convert percent to decimals for calculations below. Always use dry weight of manure/compost and %N on dry weight basis.

N in Manure/Compost =

Apply every year _[Dry lbs manure/compost per acre]_ x _[% N]_

Apply just this year _[Dry lbs manure/compost per acre]_ x _[% N]_ x _[% Available]_

b) Estimating **N in irrigation water** requires a nitrate lab test. The result then must be converted into pounds N in an acre-inch of water, and multiplied by the acre-inches of irrigation water applied (or expected to be applied). Results may come back from the lab as NO_3N-N or NO_3. These two types of reporting (NO_3N-N or NO_3) use different conversion factors to get to N/acre-inch*.

N in Irrigation Water (lbs/ac) =

NO_3N-N _[NO_3N-N]_ (ppm or mg/l) x 0.225 x _[Acre-inches of Irrigation]_

NO_3 _[NO_3]_ (ppm or mg/l) x 0.051 x _[Acre-inches of Irrigation]_

The Nitrogen Management Plan template from the Sacramento Valley Water Quality Coalition calls for many of the numbers calculated above. If you did not receive a template, need help filling it out or have other questions about implementation of the Irrigated Lands nitrogen plans, contact Bruce Houdesheldt at the Sacramento Valley Water Quality Coalition: bruceh@norcalwater.org or (916) 442-8333. The water coalitions are still hammering out official numbers for filling out these forms. The numbers given above are a starting point. Official numbers from the Coalitions should be established by late this fall.

*Based on numbers from UC ANR publication #21623, Guide to Efficient Nitrogen Fertilizer Use in Walnut Orchards (2006) by K. Kelley Anderson, J. Grant, S. Weinbaum & S. Pettygrove.

University of California
Cooperative Extension
Tulare County
4437B S Laspina St
Tulare, CA 93274-9537

Nonprofit Org
US Postage Paid
Visalia, CA 93277
Permit No. 240

In-A-Nutshell

December 2015

Elizabeth Fichtner
Farm Advisor