4. Applying Nitrogen: For Crop Needs *Only*

The overuse of nitrogen and problems associated with it have already been discussed. After achieving optimum soil mineral balance, the key to high quality fruit production with fewer pest & disease problems is controlling vigor through nitrogen management. Most studies agree that several small applications of chemical N results in less leaching and fewer problems due to excess uptake of soluble forms than from one large application. Stevens, in Peterson and Stevens (1994, p. 205), addresses the over fertilization of orchards: "Split applications will increase the producer's ability to direct the nitrogen to different purposes in the tree. Split applications will also decrease the amount of residual nitrate in the profile available for leaching at any time." Many times the total nitrogen requirement for a season is applied in only one or two large applications.

Increasing the efficiency of applied nitrogen is presently a high priority in agricultural research. Other practices that are used to better manage the soluble N in soil include fertigation (timed applications through irrigation systems), the use of chemically coated fertilizer pellets for slow release, and fertilizers formulated with nitrification inhibitors (chemicals which slow bacterial conversion to soluble forms). These methods and materials are really just attempts to duplicate the activity of healthy humus and an active nitrogen cycle.

Vogtman and Bliederman (1985) reviewed the problem of nitrates from commercial fertilizers and manures, and showed an active humus system to be an important tool in managing excess nitrates in crops and groundwater. Garcia-Serna, Juarez, Jorda & Sanchez-Andreu (1996) fopund that humic acid (which occurs naturally in active organic matter) slowed the release of urea.

The timing of N fertilizer applications has been changing the last 20 years. Since tree fruits and vines come out of dormancy with rapid shoot and leaf growth followed by flowering and fruit set, common practice sought to provide available N to the roots prior to and during the rapid growth period. In northern California, this meant that urea was traditionally applied in late February or early March. The cold wet conditions during this period are not conducive to the biological activity needed to convert urea to nitrate. Our tissue analysis results, often showed "spikes" of higher nitrogen in the middle of the season, although N status in deciduous crops should be highest at full bloom and taper off through the season. The winter applied urea converted to nitrate only after soil has warmed, resulting in a flush of nitrogen rich growth during May and June - which aggravates many disease problems. Grapes are subjected to heavy mildew, bunch rot, and leafhopper pressure at full bloom. Pear fireblight and scab can strike during this period; leaf sucking insects such as psylla begin rapid reproduction. Other pest and disease problems which are associated with excess N, deficient minerals, or soil conditions are shown in Appendix D. About 1976 studies from New Zealand found nitrogen applied in summer and fall resulted in best fruit set and yield the next year. Now, most experts agree that N fertilizers applied during the dormant season stimulate vegetative growth, which is only desirable for young trees. Applications during the summer, after current season shoot growth has been completed, result in N reserves in the wood, and more and better fruit buds the following year in mature trees and vines (see Peterson & stevens, 1994).

Optimum nitrogen application strategy requires accurate timing and placement of lower amounts of N fertilizers, and the activation of a healthy humus system with subsequent slow release of N from the soil - allowing plants to take up what they need when they need it. Vogtmann & Biedermann (1985, p. 232) offered a concise solution:

> N-fertilization should no longer be seen as a simple measure to maximize yield, but as part of an N-cycle, which is part of an ecosystem and which includes the soil humus fraction with its vast N-reservoir.

I have outlined the soil chemical properties for best nutrient availability, aeration and biological activity, achieving a diverse soil microbial system is the next step.

5. Foliar Fertilization

Foliar feeding is the application of essential plant nutrients to the above ground parts of plants. Nutrients are sprayed on the crop where they are absorbed for use. The A & L Agricultural Laboratories Resource Handbook: Foliar Applied Plant Nutrition provides a good summary of the research into foliar feeding. This source cites two main reasons for foliar fertilization (p. 2):

1) It is a highly efficient and timely method of applying nutrients likely to be limiting factors in crop production.
2) It is a means of compensating for soil or environmentally induced nutrient deficiencies.

I would add a third:

3) It can be used to augment resistance of the crop to pests and disease, when applied at appropriate times.

All known essential nutrients are absorbed by plants through either leaves, stems, flowers, or fruits. Rates of nutrient absorption vary from 1-2 hours for nutrients such as N, K & Mg to 20 days for iron and molybdenum. Appendix F shows the times for absorbtion of specific plant nutrients. Proper timing of the sprays are obviously important for best response.

I will discuss specific applications of this technology to local crops in a later chapter. Perhaps the most important principle of foliar feeding is: it is intended to augment, not replace proper soil management and fertilization.