FINAL REPORT

Title: Nitrogen Nutrition of Apples Grown Under Differing Soil and Environmental Conditions

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Justification:
Many of us believe that as we strive to become more efficient, fertility programs will become more complex. We need to know how important the tree storage, non-fertilizer soil sources, and fertilizer N pools are for apples grown under different conditions. The most appropriate strategy for an orchard in a clayey soil in Wenatchee may be quite different than what we want to do in a loam soil at Yakima. We believe that management strategies can be designed to meet the economic and environmental demands that face our industry, but there is not a one-size-fits-all solution.

A first step in the pursuit of developing management approaches for different soil and environmental conditions, is determining how much variability we are dealing with. We proposed to evaluate fertilizer efficiency, and the relative importance of tree storage, non-fertilizer soil sources, and fertilizer N pools at multiple Northwest locations under different soil environments. We previously initiated experiments in Parma, Idaho. Additional trials are ongoing at Hood River and Corvallis, Oregon. All of these experiments are being conducted with non-WTFRC funds. Since considerable effort was already being made, the small additional funds allowed us to pursue questions that were not in the original non-WTFRC work. Additional funds for the apple work were proposed to pay for an increase in analytical costs (^{15}N analyses).

Specific hypotheses are listed below.

1) The ^{15}N estimates of fertilizer recovery may overestimate the real efficiency of plant uptake especially in high-organic matter systems.

2) Some apple growing systems can be defined as N saturated (more N available from fertilizer and soil mineralization than plants require). Under these conditions, increasing the efficiency of fertilizer or reserve utilization may decrease the use of N mineralized from the soil. Even though plants respond to N, we have more than we need.
3) The source of the N that can potentially contaminate groundwater varies for different apple growing systems and climates.

4) Mineralized N that is released from soil organic matter may be less efficiently used than fertilizer N, and the use of mineralized N will vary with apple variety and soil or environmental conditions.

Objectives:

1. Determine the relative importance of tree storage, soil and fertilizer N pools in meeting the nitrogen needs for apples grown under different soil and environmental conditions.

2. Determine uptake efficiency for apples grown under different soil and environmental conditions.

3. Investigate how soil texture, site-specific weather conditions, and soil organic matter may modify the uptake storage and utilization of fertilizer applied N at different locations.

4. Develop possible management strategies that incorporate soil and environmental factors into N fertilizer recommendations.

Activities and Accomplishments:
In order to evaluate all three sources of N (soil organic matter, fertilizer, tree reserves) in a given year, we need to have a set of labeled trees. Therefore this process takes a minimum of two years. After their initial ^{15}N treatment, all treated trees are fertilized with unlabeled N in the second year. A different set of trees is fertilized with labeled N in the second year. Dormant trees from both treatments are destructively sampled 2 years after the first exposure to ^{15}N. Evaluation of the second year data is ongoing at this time.

The percentage of N from the fertilizer can be determined by analyzing new growth for ^{15}N in trees that received labeled N during the current season. The rate that the label disappears in trees that were labeled in the previous season can be used to estimate the importance of the reserves. When we know how much N came from reserves and fertilizer we can estimate the importance of the soil source by subtraction.

It was possible to obtain some information on fertilizer N use in the first year. This data is similar to numerous other reports that we have made in the past. Although we will report on all currently available results during the research review, most of the important data will be produced this winter as we analyze data from excavated dormant trees. A final report will be written when data analyses is complete.

Budget: (Approximately 50% has been spent to date)

Analytical Services (~1200 samples @ $12.50)	15000.00
TOTAL	$15000.00

Project Termination
We can save the tree fruit industry a huge amount of money by terminating our proposed multi-year project. We will learn a great deal from the 2 years data that we have. When we combine the data we have collected as part of this WTFRC sponsored project, with additional data that is being collected from research funded by non-WTFRC sources, we will have substantial publishable work. Although continued funding is possible I am afraid we may enter a time period of diminishing returns.