**Kearney Foundation Fellowship**
**Final Report Summary - Due November 30, 2008**

**Fellowship Recipient's Name: Ann Tan**
**Project Title:** Site-Specific Irrigation to Improve Water Use Efficiency and Crop Quality in Vineyards
**Mentor Professor's Name: Jean-Jacques Lambert**
**Reporting Period: Summer 2008**

## 1) Project Objectives and Status

When I was offered a chance to gain research experience as a freshman in college, I was elated. Soon after however, I realize that research is harder than it looks. What do I know about the scientific world after taking just a year of college courses? Luckily I was fortunate enough to have a mentor who showed me the ropes and through that, allow me to experience what it was like being a research scientist for a summer.

In this project I worked with gathering preliminary data on a project that deals with irrigation practices in vineyards. The major research objective of this project was to quantify soil spatial variability and variation in water usage by grape vines planted in two contrasting soil types within the same vineyard block, throughout the growing season. My summer project was involved in only the first phase of the project, which included performing a detailed vineyard soil survey.

Already I had an interest in the soil, but because I didn't know much about it, I had to read research papers in order to understand what was going on in the scientific world. What I learned was that in theory, soils should be an important factor in a plant's productivity. From this, we hypothesized that vineyard block variability is important due to soil variability. This should result in different plant development and fruit production.

To test this hypothesis, we identified two vineyards, each containing two contrasting soil types planted with the same grape vines. In order to compare the differences within the vineyards, we used many different methods to measure chemical and physical differences in the soils. We had to look for differences in soils within a single vineyard block. We first identified vineyards that were located on two different types of soil, and we did that by selecting two sites in California where each vineyard was found by the owner to have strong variability in plant vigor and yield. Then characterized the soils at each site and noted the variations within each vineyard. We used soil pits to determine the composition of the soil at Rancho Seco, and auger holes in a staggered grid pattern to characterize the soil variability in the Thornton site. The Thornton site was located in the basin rim area of the Sacramento Delta. The topography was level. Two main soil types were present. The older soil was an Alfisol with a loamy topsoil over a clay loam subsoil horizon. The younger soil was a silty clay loam over a sandy loam subsoil. The Rancho Seco site was set on a dissected old alluvial fan of the Laguna formation. The two soils present at this site were on a level terrace. The first soil was an Alfisol with a clayey subsoil and no coarse fragments. The second soil was a younger Alfisol with a sandy loam subsoil and contained 35-85% coarse fragments, decreasing its water holding capacity.

Besides looking at the physical properties of soil, we noted a lot of other differences as well. We measured the pH and electrical conductivity of the soils using a saturated paste extract. After passing the fine earth fraction through a 2mm mesh sieve, we weighed 160 grams of soil in a Buechner funnel and wetted the soil until saturation was reached. We then extracted the soil solution using a vacuum and collected the solution that was filtered. We measured the pH and

electrical conductivity of the solution and we stored the samples for further cation and anion analysis by the UC Davis analytical laboratory. Some samples were sent to the DANR laboratory for complete soil analysis including cation exchange capacity, texture, exchangeable cations, pH, and organic carbon. The results have been received from the DANR laboratory, and data are now being analyzed.

For the plant analyses, we collected vine leaf and petiole samples at veraison (the point when the grape berries change from green to red) and at harvest time. Leaf and petiole samples were ground to pass through a 40-mesh sieve and sent to the DANR laboratory for analysis. The analysis is still ongoing.

During the growing season, we measured plant water potential and leaf water potential with a pressure bomb. With this we had to cover the leaves with a Mylar sheet so that they would be at equilibrium with the whole plant's water potential. Once a leaf has been covered, it stops transpiring so that the water potential is at equilibrium with the overall water potential of the plant. This makes for a more realistic measurement. For the leaf water potential, we simply took a leaf that was exposed to the sun and measured the stress experienced by the leaf immediately. In addition, we took leaf porometer measurements to determine leaf stomatal conductance in the shade and in the sun.

At harvest time, we collected grape clusters, brought them back to the laboratory, determined their weight and counted the number of berries on each cluster. We counted and weighed 30 to 40 grape clusters for each of 8 groups of 10 observation vines in each vineyard. This number of observations was necessary for statistically meaningful results.

We helped other researchers in our group to set up surface renewal stations to monitor evapotranspiration. This included monitoring air temperature, air/wind speed, soil temperature, vine canopy temperature, and solar radiation. In both vineyards, we found that evapotranspiration varied between the two sites containing contrasting soil types.

**Summary of progress:** Although our analyses are still in progress, we have already seen definite trends suggesting that there are substantial differences in terms of plant vigor and grape yield that correspond to differences in soil properties at the scale of a single vineyard.

**2). Describe the major challenges and opportunities or other pertinent information important in the overall achievement of your project.**

The major challenge that I faced in this project was my inexperience in research. But with the help I received from Jean-Jacques, I learned a lot about different methods used in soil science and viticulture research. This project opened many doors, but was also quite intimidating at first. Words I had never heard before were used, concepts I didn't understand littered the papers I read, and I felt overwhelmed at times. However, when I started working, and Jean Jacques began explaining the project and how it related to what I had read, things began to make sense.

I've learned in my geology class that agriculture in California uses up to 80% of all surface water, and maybe more ground water. When I first heard this, I felt very helpless – no matter how much water I can save by myself, I'm just one person. For this project however, we were trying to figure out how to design an irrigation system that can provide enough water to the plants without decreasing yield or quality, while saving water at the same time. I learned that watering too much would actually lower the quality of the grapes because it would lower the sugar content, and that underwatering would stress the plants too much. It was very exciting to find that what we learn in the classroom can potentially make a huge difference in the world, in this case by increasing water conservation in a scientific way.