



**Research Title:** Advanced Sensing and Control Technologies to Optimize Resource Management in Specialty Crops: Studies of Water and Nitrogen Management in Deciduous Crops under Normal and Resource-Limited Conditions

**Principal Investigator:** Manoj Shukla

**Sponsor:** University of California, Davis

**Summary:**

Nut production from pecans, almonds, and pistachios figures heavily in the economies of California, Texas, and New Mexico, and several other states. Production depends upon irrigation, but water supplies for irrigation in the near term appears likely to be cut severely in California (15-50% of normal) and surface irrigation water supplies have been reduced in low runoff years in New Mexico. Only the supplication of the surface water with ground water has allowed the pecan growers to apply full irrigation amounts to the pecan trees. In the long term, both climate change and relentless population growth and associated diversion of water to municipal and industrial growth will reduce irrigation water supplies permanently.

Crop modeling in general is a major research tool in horticulture with simulation models being used to understand the integration of physiological processes and mechanisms of tree response to stress. Tree growth models usually include four main carbon processes: photosynthesis, respiration, reserve dynamics, and carbon allocation. In forestry, over 27 tree growth models have been developed, each with the main carbon metabolism processes described but each having a different representation of these processes—from empirical relationships to mechanistic models of instantaneous leaf photosynthesis—to account for the major environmental variables. These same processes and deficiencies occur in the smaller number of developed fruit and nut tree models, developed for pecans, apples, peaches, and avocados.

The overall goal of this research is to develop an improved management model to monitor and predict nutrient demand and nutrient status in pecan trees along with the interaction of nutrient and water stress on nut yield. Specifically the objective is to develop an optimal schedule (timing and amounts) of irrigation and N fertilization that maximize yield when irrigation water is cut to 50% (or other specified fraction) of normal and the nitrogen application efficiency is increased from 50% to 80% by using a complex photosynthesis pecan tree model to develop the nitrogen and water use efficiency functions needed by a simpler pecan growth model.