# SPAR CURRENT RESEARCH PROJECTS

**1.) Responses of crop plants to Ultraviolet-B radiation and to interactive effects of climate variables.** Agency: USDA UV-B Monitoring Network, Colorado State University, Fort Collins, Colorado.

**Rationale**: The responses of crop yields to climate change including ultraviolet-b radiation vary widely, depending on crop species, cultivar, soil conditions and other locational effects. As agriculture production and climate are intimately connected, its future is critical to regional and national economies and to global food/fiber security. Therefore, understanding agricultural response to climate change of earth system is pivotal in providing decision support for stakeholders such as farm mangers, governments and planners to meet the food and fiber needs of growing world population. This project addresses our long-term goal of understanding the interactive effects of environmental factors including UV-b radiation on crop.

**Objectives**: We propose to use a process-level crop model for this integration and impact assessment studies and naturally-controlled environment facility for experimental studies. The objectives of this project are:

- To improve accuracy of processes affected by environment in cotton simulation model – GOSSYM, study climate change impacts and drive GOSSYM using remotely-sensed environmental variables.
- Delineate the effect of climate changes on cotton more accurately; study the effects of UV-B and its interactions with other environmental variables on corn and soybean.
- Provide economic assessment of climate change impact on cotton/agriculture production.

**2.) Responses to climate change of C4 and C3 species native to South-central region.** Agency: National Institute for Global Environmental Change (NIGEC) as part of DOE.

**Rationale:** Climate change models project an increase in atmospheric $CO_2$ concentration, air temperature, surface ozone and UV-B radiation, and variation in precipitation patterns in the current century. Global climate change would alter the vegetation patterns on earth's surface. The impact studies of projected climate change were mainly restricted to crop species. Studies conducted so far to determine changes in vegetation pattern of natural ecosystems, either through experimentation or modeling, were based on the vegetative growth or biomass determined by photosynthesis of the species. Several other plant physiological processes respond to changing

climates that determine plant adaptation. Under natural environments, distribution and succession of a species is through reproduction, and products of reproduction (seeds) play an important role in population establishment. Research was not carried so far to study the effects of climate change on reproduction of native species in US South-central region in general and Mississippi in particular that include both C3 and C4 types. Although increase in $CO_2$ is known to increase biomass, we hypothesize that increase in intensity, frequency and duration of temperature would reduce the reproductive ability of the species native to Mississippi.

**Objectives**:
- Quantify photosynthesis, growth and seed-set as affected by elevated $CO_2$ and high temperature in selected C3 and C4 species native to Mississippi.
- Quantify the interaction effects of $CO_2$ and high temperature on C3 and C4 species native to Mississippi.
- Identify differential responses of C3 and C4 species to climate change.

**3.) Agricultural Response to Global Climate Change and its Impact on Decision Support**. Agency: NASA, Center through MSU-Geo-Resources Institute, Mississippi State, MS, USA

**Rationale**:
Agriculture production and climate are intimately connected. Its future is both critical to ecosystem services in the US and to global food/fiber security. Therefore, understanding of agricultural response to climate change of earth system is pivotal in providing decision support for governments and planners to meet the food and fiber needs of growing world population. Recent advances in remote sensing technology have incorporated sensors into satellite payloads to detect climate variables spatially and temporally at very fine resolution that were unachievable by GCMs. Spatial scale inputs derived from satellite-based data such as solar radiation, carbon dioxide, temperature, rainfall and soil moisture are necessary to drive crop simulation models and for accurate yield estimates. The predicted changes in $CO_2$, temperature, rainfall and UV-B in future climates can be imposed on the high resolution global data sets of these variables. The data sets so developed can be used to provide input variables to crop models to predict growth, development and yield more accurately. The coupled crop/climate models with remotely sensed data can be used to effectively detect the regions that will be vulnerable to projected change in climate and help planners to devise strategies for mitigating the impacts of climate change. We propose to use a process-level crop model for this integration and impact assessment studies.

**Objectives**:

- Improve accuracy of processes affected by environment in cotton simulation model - GOSSYM.
- To study climate change impacts and drive GOSSYM using remotely-sensed environmental variables.
- Delineate the effect of climate changes on cotton more accurately.
- Provide economic assessment of climate change impact on cotton/agriculture production.

**4.) An approach to positively shift the production of rainfed soybean by foliar application of glycine betaine**. Agency: Mississippi Soybean Promotion Board, Mississippi Agriculture and Forestry Experiment Station, Mississippi State, MS.

**Rationale**: Abiotic stresses are serious threats to sustainable food production. Drought is the number one barrier to profitable soybean production in the USA and particularly in the humid southern parts of USA. Several reports have shown that drought stress, both short-term and long-term, will severely reduce crop yield and soybean is not an exception. Yet, no solution to this problem has been forth coming.

**Objectives:**
- To understand whether drought stress occurring during crop critical growth stages can be alleviated by foliar applications of glycinebetaine.
- To understand on how glycine betaine application alters soybean crop physiology, by measuring total leaf betaine content, stomatal conductance, leaf water potentials, photosynthesis and osmotic potentials and yield which are crop drought stress indicators.
- To examine whether any new stress proteins are produced in the leaves and in the harvested seed of soybean varieties.