

**PROPOSED**

State of California  
AIR RESOURCES BOARD

**RESEARCH PROPOSAL**

Resolution 12-8

January 26, 2012

Agenda Item No.: 12-1-1

WHEREAS, the Air Resources Board (ARB) has been directed to carry out an effective research program in conjunction with its efforts to combat climate change, pursuant to Health and Safety Code sections 38500;

WHEREAS, a research proposal, number 2728-272, entitled "Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems" has been submitted by the University of California, Davis;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

Proposal Number 2728-272, entitled "Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems," has been submitted by the University of California, Davis, for a total amount not to exceed \$400,000.

NOW, THEREFORE, BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 38500, hereby accepts the recommendation of the Research Screening Committee and approves the following:

Proposal Number 2728-272, entitled "Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems," has been submitted by the University of California, Davis for a total amount not to exceed \$400,000.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed \$400,000.

## ATTACHMENT A

### “Evaluating Mitigation Options of Nitrous Oxide Emissions in California Cropping Systems”

#### Background

The agricultural sector is the largest contributor of nitrous oxide (N<sub>2</sub>O), a potent greenhouse gas, both globally and in California, accounting for about 60 percent of anthropogenic N<sub>2</sub>O emissions. Since N<sub>2</sub>O is produced in soil through microbial processes involving nitrogen compounds, its emissions from agricultural soils are closely related to soil nitrogen content but highly variable due to numerous environmental factors that govern microbial activities. The complex interactions of microbiological processes and soil conditions (e.g., soil nitrogen (N) content, soil water content, organic carbon availability, and temperature) control N<sub>2</sub>O dynamics in the soil and thus its emission fluxes. Therefore, agricultural management practices that are intended to manipulate the above soil factors for the benefit of crop production will affect N<sub>2</sub>O emissions.

This project is the second phase of the N<sub>2</sub>O research program that was initiated in 2007 as part of the AB 32 Scoping Plan. The first phase, to be completed in 2012-2013, has been characterizing baseline N<sub>2</sub>O emissions from major California cropping systems under conventional management practices. The proposed project will evaluate the effects of alternative management practices on N<sub>2</sub>O emissions from three major cropping systems: lettuce, tomatoes, and corn. The proposed alternative management practices will include: use of alternative nitrogen fertilizers, use of nitrification inhibitors, fertigation via subsurface drip irrigation (SDI), organic farming, and conservative tillage. This project is expected to provide data needed for the development of agricultural offset protocols pursuant to AB 32.

#### Objective

The purpose of this project is to identify alternative management practices that can reduce N<sub>2</sub>O emissions from the following California crops: lettuce, tomatoes, and corn. Specific objectives are to 1) identify experimental sites and establish standard and alternative management practices for the crops; 2) measure N<sub>2</sub>O fluxes and estimate emission differences between the standard and alternative management practices; 3) characterize key variables controlling N<sub>2</sub>O emissions; and 4) measure crop yields to evaluate yield-based N<sub>2</sub>O emission factors and cost-effectiveness.

#### Methods

The project will conduct field experiments to monitor N<sub>2</sub>O fluxes from three selected California cropping systems maintained under conventional and alternative management practices. Static chambers of stainless steel (50 cm length x 30 cm width x 10 cm height) or PVC (20 cm diameter x 10 cm height) will be built in the fields. Air samples from the chambers will be taken manually or automatically to measure the N<sub>2</sub>O concentration by gas chromatograph, and N<sub>2</sub>O flux will be calculated based on changes in N<sub>2</sub>O concentrations. The sampling frequency will vary, depending upon the expected

N<sub>2</sub>O fluxes, and will be more intensive after N fertilizer applications and during rainfall events. Short-term time series of N<sub>2</sub>O fluxes will be monitored to characterize diurnal variation of emissions. Ancillary data on related environmental and crop parameters such as soil N availability, soil water content, soil organic carbon content, soil and air temperatures, and crop yields will also be collected to facilitate data interpretation and determine their impacts on N<sub>2</sub>O emissions. Statistical analysis will be carried out to assess the significance of emission differences between conventional and alternative management practices, and the N<sub>2</sub>O emission reduction potential or lack thereof will then be calculated for each alternative practice.

**Expected Results**

This project will identify and quantify the N<sub>2</sub>O emission reduction potential of alternative management practices for important California commodities. The results of the project are expected to provide data needed for the potential development of agricultural offset protocols pursuant to AB 32.

**Significance to the Board**

AB 32 requires the State to reduce greenhouse gas emissions to 1990 levels by 2020. Agricultural soil management is recognized as the largest source of N<sub>2</sub>O in California. This project will identify opportunities to mitigate N<sub>2</sub>O emissions from California agricultural soils, and help California achieve its AB 32 goal.

**Contractor:**

University of California, Davis

**Contract Period:**

36 months

**Principal Investigator (PI):**

Martin Burger, Ph.D.

**Co-Principal Investigators: (co-PIs):**

Professors William Horwath and Johan Six

**Contract Amount:**

\$400,000

**Basis for Indirect Cost Rate:**

The State and the UC system have agreed to a ten percent indirect cost rate.

**Past Experience with these Principal Investigators:**

The Principal Investigator and Co-Principal Investigators of this project are known experts in the state on nitrogen management and cycling in agricultural ecosystems. The investigators have been involved in field studies of nitrogen fate, including N<sub>2</sub>O, in many projects. Dr. Burger is the project manager of several ARB funded N<sub>2</sub>O and NO<sub>x</sub> studies in agricultural fields, and has demonstrated the capability to deliver quality

products in a timely manner. Both investigators have published extensively in leading technical journals regarding soil processes of nutrients management.

**Prior Research Division Funding to University of California, Davis:**

Year	2011	2010	2009
Funding	\$1,394,560	\$508,267	\$1,588,387

## BUDGET SUMMARY

Contractor: University of California at Davis

"Assessment of Baseline Nitrous Oxide Emissions in California Cropping Systems"

### DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$	197,492
2.	Subcontractors	\$	80,000
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	11,484
5.	Electronic Data Processing	\$	0
6.	Reproduction/Publication	\$	660
7.	Mail and Phone	\$	156
8.	Supplies	\$	14,705
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>70,553</u>

Total Direct Costs

\$375,050

### INDIRECT COSTS

1.	Overhead	\$	24,950
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>

Total Indirect Costs

\$ 24,950

### TOTAL PROJECT COSTS

\$400,000

## Attachment 1

### SUBCONTRACTORS' BUDGET SUMMARY

Subcontractor: University Corporation at Monterey Bay (on behalf of California State University Monterey Bay)

Description of subcontractor's responsibility: The research project requires frequent visits at the experimental site in Monterey County. It would be nearly impossible and much too costly for UC Davis staff to travel to this site on a routine basis. Therefore a local team from the State University of Monterey is performing the task of N<sub>2</sub>O monitoring at this site as subcontractor.

#### DIRECT COSTS AND BENEFITS

1.	Labor and Employee Fringe Benefits	\$	49,323
2.	Subcontractors	\$	0
3.	Equipment	\$	0
4.	Travel and Subsistence	\$	4,450
5.	Electronic Data Processing	\$	0
6.	Reproduction/Publication	\$	0
7.	Mail and Phone	\$	0
8.	Material & Supplies	\$	12,894
9.	Analyses	\$	0
10.	Miscellaneous	\$	<u>0</u>

Total Direct Costs \$66,667

#### INDIRECT COSTS

1.	Overhead	\$	13,333
2.	General and Administrative Expenses	\$	0
3.	Other Indirect Costs	\$	0
4.	Fee or Profit	\$	<u>0</u>

Total Indirect Costs \$13,333

#### TOTAL PROJECT COSTS

\$80,000