

DryLand BioIce

Agricultural sources of atmospheric ice biocatalysts in dryland farming systems

ABSTRACT

The main objective of this project was to train a student for research on the identification of agricultural sources of biological ice nuclei in the atmosphere and of agro-climatic conditions that favor emission of aerosols containing these biological ice nucleators. We focused on the dry land cropping systems of the Mediterranean region and in particular the regions covered by the ICARDA regional programs. The second objective was to assist the student in developing PhD level research on this subject through a fellowship for graduate studies at Montana State University (MSU). Via this project we sought to initiate ICARDA in research on this subject thereby favoring future collaboration between INRA, Montana State University and ICARDA.

The main actions consisted of training a Master's level student, Mr J. Samsatly from the American University of Beirut, at INRA-Avignon (Sept. 2009). Via this experience, Mr. Samsatly then organized a sampling campaign for April 2010 to screen dry land crops for biological ice nucleators, and for bacteria in particular. The crops to be screened consisted of a broad range of the different species and cultivars at the Tel Hadya field station in Aleppo, Syria and wheat cultivated between Aleppo and the northern border of Syria with Turkey. In collaboration with the head of the ICARDA Seed Pathology laboratory (Dr. Siham Asaad) in which the work was conducted, he also made sure that all of the necessary equipment for the research was available. The project coordinator (C.E. Morris, INRA) and the MSU partner (D.C. Sands) participated in the April 2010 field campaign to further re-enforce the training of Mr. Samsatly and to effectively transfer the needed competence for this work to the Seed Pathology laboratory of ICARDA. During the field campaign we also identified the strategy to secure a scholarship for Mr. Samsatly's doctoral training.

The achievements of this project were as follows.

1) The screening work in Syria revealed that there was not any plant species that was particularly stronger than any other in harboring naturally-occurring biological ice nucleators. This led us to decide that the future orientation of this work should be to develop techniques to assure an increased and constant abundance of biological ice nucleators on one of the dominant cultivated plant species in the region, wheat.

2) The preliminary work realized in this project allowed the Seed Pathology Lab at ICARDA in Aleppo to acquire all of the necessary technology to conduct this work. In addition, we have determined that the principal technique to assure abundance of biological ice nucleators on wheat will be via seed inoculation. The ICARDA partner has significant competence to assure this work. Furthermore, a student entering into a Master's program at the University of Aleppo (Mr. A. Mukahhal) was among the laboratory assistants for the April 2010 experiments. He became enamored with the subject and will be conducting his research on developing seed inoculation techniques for ice nucleation active bacteria onto wheat.

3) This work has led to the development of a long-term research project with ICARDA's Seed Pathology lab, INRA and MSU. The initial objective of the 'Seed the Skies' project is to demonstrate the effective transfer of biological ice nucleators from seed-coatings to the atmosphere. For this project we will use non pathogenic ice nucleation strains of *P. syringae*. Current work in the greenhouse deploys strains from France. Sampling of wild plants from the mountains near Latakia, Syria has led to the isolation of Syrian strains that are non pathogenic and ice nucleation active that are currently being characterized by the INRA partner to validate the absence of pathogenicity before field trials will be conducted.

4) Preliminary field observations in Syria, conducted during a period of intense attack of wheat by stem rust, suggested that wheat plants with symptoms of bacterial blight (*P. syringae*) had markedly lower intensities of attack by rust. This suggested that, in addition to exploring how rust spores could be

vectors of dissemination of *P. syringae* as ice nucleators, we should also consider how this bacterium might have biological control action against rust.

5) Mr. Samsatly has submitted applications for two sources of funding to conduct his graduate studies at MSU. His Fulbright fellowship application was refused for reasons of geographic choice for his studies. His application for a scholarship from the MSU Molecular Bioscience Program is currently being evaluated.

Keywords : Invasive species, Dispersion, epidemiology, Mediterranean

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Project number : 0901-002

Type of funding : AAP

Project type : AAP

Research units in the network : EMMAH

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End date : 2010-11-30

Flagship project : no

Project leader : Cindy Morris

Project leader's institution : INRA-INRAE

Project leader's RU : PATHO

Budget allocated : 22576 €

Total budget allocated (including co-financing) : 22576 €

Funding : RTRA

PERSPECTIVES

There are 2 main prospects for this work. Firstly, we will continue collaboration with the ICARDA Seed Pathology lab to develop and validate a technique to assure that wheat harbors surface populations of ice nucleation active bacteria that can become aerosols. This will involve the training of a Master's student at the University of Aleppo. The second prospect will depend on success of Mr. Samsatly in obtaining funding for his studies. If he is successful, this will allow pursuit of further collaborative work between ICARDA, INRA and MSU on establishing plant sources of ice nucleation active bacteria, formation of aerosols, and their interaction with atmospheric processes.