

UW College of Agriculture and Natural Resources

Report

Global Perspective Grant

Award Period: Fall 2011

Principle Investigator(s): Axel Garcia y Garcia

Department: Plant Sciences **Email:** axel.garcia@uwyo.edu

Project Title from Application: Impact of climate variability on winter wheat overwintering and frost kill in two major production regions: The USA West Mountain region and Northern Europe

Amount spent: \$7,500.00

Summary

Wheat is the most grown cereal crop in the world across a wide range of geographic and climate regions. Wheat is grown during both, spring and winter periods. Winter wheat production in Northwestern USA and Norway has many similarities, such as the extreme weather conditions and consequently the winter hardiness. Notable differences, such as precipitation patterns, are also observed. The two regions are both located on the current borders of the global winter wheat production region. Both UW-Plant Sciences and Bioforsk, the Norwegian Institute for Agricultural and Environmental Research, conduct research on winter wheat production. This project aimed to initiate a possible collaboration between UW-Plant Sciences and Bioforsk-Norway with the objective of understanding the potential impacts of a changing climate on crops yield, including mitigation and adaptation strategies. Those efforts generally rely on the analysis of long term information, which usually is not readily available for a period long enough for such analysis. Crop modeling and decision support system tools, such as the FROSt TOLerance (FROSTOL), which simulates LT50 on a daily basis from sowing onwards, and the Decision Support System for Agrotechnology Transfer (DSSAT), which simulates crops growth and yield, are used to overcome this limitation.

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Overall Procedure

Hosted by Dr. Tomas Persson, researcher at Bioforsk-Klepp, Stavagner, Norway, Dr. Axel Garcia y Garcia visited with scientists at Bioforsk, Norway to discuss actual research on dryland winter wheat at UW and Norway. Dr. Garcia y Garcia gave two seminars: a) Research at the UW-Research & Extension Center in Powell, WY and b) Sustainability of Dryland Winter Wheat Production in the High Plains of Wyoming, USA. Additionally, Garcia y Garcia and Persson worked with the FROSTOL model using preliminary data from Wyoming. Actual and future collaborative research between UW and Bioforsk was also discussed. Bioforsk organized some research site tours, meetings with researchers and extension folks and visits to farmers' fields.

Following Dr. Garcia y Garcia's visit to Norway, Dr. Persson visited the UW College of Agriculture and Natural Resources. Dr. Person's visit included short meetings with various leaders and faculty members of the College of Agriculture and Natural Resources, including Dr. Steve Herbert, Head of the Department of Plant Sciences, and Dr. Bret Hess, Director of AES. Then, Dr. Persson attended a couple of graduate students seminars and became member of a MS student Committee. Dr. Persson gave a seminar on Dryland Winter Wheat Research in Norway. Discussions on mutual research interests, tours to UW Research & Extension Centers at Powell and Lingle, and attendance of a Forage Field Day were also part of Dr. Persson's activities in Wyoming.

Discussions of potential collaborative research between both institutions were conducted in Norway and USA. Both researchers were interested on strengthening collaboration in the fields of water conservation, carbon sequestration (UW) and winter hardiness (Bioforsk/UW). The use of modeling as a tool to support research was also discussed through the assessment of actual information needed as inputs.

Main results of activities planned in the proposal

A positive dialogue between the University of Wyoming (Department of Plant Sciences) and Bioforsk regarding a collaborative research program was initiated. The main subjects of interest of this effort include studies on dryland winter wheat genotype-environment interactions, crops adaptation to climate change, and assessment of crop simulation models performance under extreme conditions. Commitment to start a preliminary assessment of the last two subjects of interest was shown by both sides.

Tomas Persson and Axel Garcia y Garcia visited various ongoing field studies on dryland winter wheat in Wyoming and Norway, respectively. Large differences, mainly due to rainfall, were observed between both sites. Rather than greenhouse experiments, both researches agreed to focus on field research in future collaboration. A preliminary analysis and discussion of existing data was successfully completed. Limitations with the use of the FROSTOL and DSSAT models, mostly due to the lack of complete sets of data inputs, were discussed. Limitations included lack

of observed solar radiation and limited wind speed records. Options to overcome those limitations and procedures to work with limited data were successfully established.

Future plans

Researchers from UW-Plant Sciences (Garcia y Garcia) and Bioforsk (Persson) are working on the preparation of a manuscript that will be submitted for publication consideration as a peer review publication in 2013. We committed to collect research data to assess the performance of crop simulation models under the extreme conditions of Wyoming and Norway; our preliminary plan is to have data collected by mid of 2013. Both researchers expect to write a peer review article on the subject.

Potential Impacts to a) the College of Agriculture and Natural Resources, b) the University of Wyoming, and c) the State of Wyoming

It's expected the information gained from this collaboration to be used to support existing teaching efforts related to soil and water and water use efficiency, both taught by Dr. Garcia y Garcia as part of the course Irrigated Agriculture (PLNT 3000) as well as other teaching efforts, including Agroecology seminar (AECL 4990).

Strengthening collaboration between the University of Wyoming and Bioforsk-Norway is seeing as an open opportunity for students and faculty from both institutions. Internships and research collaboration for US/Norway students and researchers, respectively, could contribute with the internationalization of the College of Agriculture and Natural Resources of the University of Wyoming.

Both, the State of Wyoming and Norway are characterized by the extreme weather conditions and consequently the winter hardiness. Although some notable differences, such as precipitation patterns, the two regions are both located on the current borders of the global winter wheat production region. Sharing research ideas and capabilities from both institutions may strength our abilities to develop procedures for a sustainable dryland winter wheat production in the state.

People met by Dr. Garcia y Garcia

Tomas Persson, Researcher, Postvejen, Klepp (Interest: Winter wheat survival, Global warming, Crop modeling); **Geir Paulsen**, Researcher, Postvejen, Klepp (Interest: Forages, including sainfoin and alfalfa); **Hans Martin**, Restoration/Remediation, Postvejen, Klepp (Interest: Water stress tolerance, Infra-red technology); **Trine Eggen**, Senior Scientist – Postvejen, Klepp (Interest: Pollutants, Medical components in the environment, Plant's uptake of unwanted components vs, transpiration); **Mats Hooglund**, Senior Researcher, Modeler, Postvejen, Klepp (Interest: Modeling, Timothy model, Frost tolerance, Winter survival); **Oddmund Hognested**, Farm Manager, Ølesneved VGS Community College, Klepp; **Anne Kari Bergjord**, Researcher, Cereals and Oilseed Rape, Kvithammer, Stjørdal (Interest: Modeling, FROSTOL/DSSAT models, Frost tolerance, Dehardening/Hardening processes); **Anne Kgersti Bakken**, Director Sustainable Agriculture, Kvithammer, Stjørdal; **Njaal Stokka**, farmer at Naerboe.

Pictures



Dryland winter wheat at Bioforsk-Kvithamar, Trondheim, Norway. Rainfall makes a difference!

Dryland winter wheat at the University of Wyoming SAREC Res & Extension Center located near Lingle, WY



Bioforsk Experimental Station at Kvithamar, Norway.



A typical landscape around Bioforsk Vest Særheim, Postvegen, Klepp Stasjon – Norway. The white dots are grass-hay bales.



Axel García y García and Anne Kari Bergjord, Bioforsk's Researcher, discuss dryland winter wheat growth at a field experiment in Kvithammer, Stjørdal.



From left: Jenna Meeks, Assistant Research Scientist, Gurpreet Kaur, MS student, and Dr. Persson, visiting dryland winter wheat fields at SAREC.



Dryland winter wheat and ryegrass experiments at Bioforsk Research Station in Kvithammer, Stjørdal.



Inorganic (left) and organic (right) fertilization of forage grass. Bioforsk Research Station in Kvithammer, Stjørdal.



Environmental monitoring. Bioforsk Research Station in Kvithammer, Stjørdal.



Research on berry production under high tunnels . Bioforsk Research Station in Kvithammer, Stjørdal.



Dr. Garcia y Garcia's seminar at Bioforsk Vest Særheim, Postvegen, Klepp Stasjon – Norway.



Dr. Persson's seminar at the College of Agriculture and Natural Resources of the University of Wyoming.



The Extension Service headquarters at Postvegen, Klepp Stasjon – Norway. The Extension Service is managed by producers and is located near the Research Station.



Greenhouse studies at Bioforsk Vest Særheim, Postvegen, Klepp Stasjon – Norway.



Øksnevad VGS Community College at Klepp, Norway. Technical degrees in agriculture and other fields as well as path to College are offered.



Oddmund Hognested, Farm Manager at the Øksnevad VGS Community College and Axel Garcia y Garcia, check at a Timothy grass field.



Alfalfa experiment at the Øksnevad VGS College. Although they would like to, alfalfa is not produced at all. Issues with low pH and excessive rainfall may be the main reasons.



Oddmund Hognested, Farm Manager at the Øksnevad VGS Community College and Axel Garcia y Garcia, check at ryegrass field. Soils with abundant stones are typical in the region.



Dr. Geir Paulsen, right, shows Axel Garcia y Garcia a ryegrass field fertilized with manure.



Dr. Geir Paulsen shows improvements on soil structure and development of ryegrass root system due to the application of manure.



Manure application at a forage grass field in Nærbø, Norway. The manure is mixed with 50% water and then spread in the field.



Field after the application of manure. Site in Nærbø, Norway.



Horticultural crops around Klepp, Norway



Mix of horticultural and forage crops around Klepp, Norway



Protected crops production. The plants (brassica type) grow covered until air temperature is warm enough. The field in the picture was located at around 200m (700 ft) from ocean.



Famers market in Stavanger, Norway.