

Agronomic, Biochemical, Social, and Economic Impacts of Biotic and Abiotic Stress on Pacific Northwest Flavor Crops

Report to USDA NIFA Specialty Crops Research Initiative • Presented 9-9-2010

Our Project

Hops and mint are both perennial crops that depend upon the presence of complex flavor components for marketability. Both are specialty crops produced predominately in the Pacific Northwest states of Washington, Oregon, and Idaho. Stakeholders in both industries have clearly stated their need for economically sustainable control of specific arthropod pests, weeds, and diseases, and their concern about the impact of water shortage on the viability of their crops. With this mandate, we began a multi-state (Washington, Oregon, Idaho), multi-institutional (WSU, OSU, UofI, USDA-ARS), transdisciplinary (entomology, plant pathology, weed science, irrigation engineering, food science, economics, sociology, communication/Extension) Coordinated Agricultural Project in September 2009 to investigate the impacts of certain biotic (spider mite, aphid, powdery/downy mildew, weed) and abiotic (water-shortage/drought) stresses on these two high-value-added specialty crops. This report summarizes the progress made and the tasks completed in the first year of this five-year project.

Our Progress

Our team is on target with the goals and objectives set forth for the first year of the project.

- Research protocols have been refined in each discipline.
- Grower-cooperators secured for commercial-scale research plots.
- New peppermint plots were planted in the spring of 2010 and are being uniformly established.
- A hop yard was renovated with new plants and infrastructure in preparation for deficit irrigation trials in 2011.

continued next page...



ENTOMOLOGY

In addition to serving as the overall **Project Director**, entomologist **Doug Walsh** (WSU) is directing the activities relating to insect pests in both hop and mint. **Co-PD James Barbour** (UofI), also an entomologist, works in both hops and mint, providing perspective on the microclimatic differences between Washington and Idaho. With guidance from the hop and mint industries, Walsh and Barbour are targeting



twospotted spider mite and hop aphid in hops and twospotted spider mite in mint. Their first-year activities are on schedule, having successfully manipulated mite populations in the test plots, applied controls across the irrigation treatments and mite densities, and monitored presence of subject pests.



WEED SCIENCE

Weed scientist and **Co-PD Rick Boydston** (USDA-ARS) is directing weed management for the project. Mint and hops are subject to a wide complex of weeds including prickly lettuce, bindweed,

and pigweed. Boydston and his staff have evaluated weed control and yields of mint hay and oil following several dormant-applied herbicide treatments in peppermint grown under the various levels of irrigation in the study. They also buried nylon packets containing three species of weed seed in the fall of 2009 and will begin recovering them at various time intervals to determine weed seed longevity under different irrigation levels.

IRRIGATION ENGINEERING

Co-PD Troy Peters (WSU), has completed the critical first-year task of establishing deficit irrigation systems in both crops. Having completed preliminary (sprinkler) irrigation trials in mint and received input from industry, a drip irrigation trial is now under development for 2011. Drip irrigation has been established in hops by renovating an older system, installing a system to control irrigation levels, and installing probes for moisture measurement.



PLANT PATHOLOGY

Washington Agricultural Weather Network (AgWeatherNet, WSU) Director Emeritus and **Co-PD Gary Grove** is a plant pathologist with extensive experience in disease modeling and management.



Together with **Co-PD David Gent** (USDA-ARS and OSU), they are assessing the dynamics of downy mildew and powdery mildew in hops. In this first year of the project, a beta version of a downy mildew forecasting model was established on AgWeatherNet and improvements were made to the existing powdery mildew model. These models predict the seasonal appearance of these disease pests and aid growers in determining timing of control measures. In other outreach efforts, information on fungicide resistance management and efficacy has been added to the Hop Information Network Sharepoint Service and Hop Information Network has been expanded to Facebook.



- Neutron probe tubes were installed throughout the new hop yard to measure soil moisture. The yard was irrigated to field capacity in 2010 and measurements were taken in preparation for 2011 trials.
- The buried drip irrigation system in the hop yard was repaired and tested, and a new distribution system was designed for automatic irrigation level control based on timing.
- Preliminary deficit irrigation trials have been conducted in spearmint and peppermint.
- Insect, weed, and disease controls were applied across the various irrigation treatment levels and pest presence was quantified by the entomologists, weed scientists, and plant pathologists.
- Data from pest quantification is being prepared for analysis in the fall and winter.
- Yield assessment in mint has been ongoing; yield assessments for hops will be taken at harvest.
- Mint oil quality is under analysis; hop acid constituent analysis will begin after harvest in early fall.
- Single-hopped ales have been brewed from 2009 hops and will be brewed from 2010 hops for sensory analysis.
- Initial interviews with mint and hop growers and farm workers have taken place.
- Economic literature reviews and crop production budgets have been prepared in both hops and mint to form the basis for the project's economic analysis component.
- First-year data and analyses have been drafted as a manuscript currently under internal review prior to submission to a peer-reviewed journal.
- Partnerships with both the hop and mint industries have been strengthened via two-way communication: industry is receiving progress reports and actively functioning in an advisory role for the project.
- SCRI funds are being leveraged with applications for additional funding from industry and other sources. Matching funding was obtained from the Washington Mint Commission (\$55K) and the Hop Commission/Hop Research Council (\$180K).



FOOD SCIENCE

Agronomist **Steve Kenny** and sensory scientist **Co-PD Carolyn Ross** (WSU) are in charge of the quality analysis of the flavor crops subjected to the various deficit irrigation and pest management regimens.



Utilizing HPLC (High Performance Liquid Chromatography), Kenny's lab quantified the alpha and beta acids in the various hop treatments from the 2009 growing season last fall and is prepared

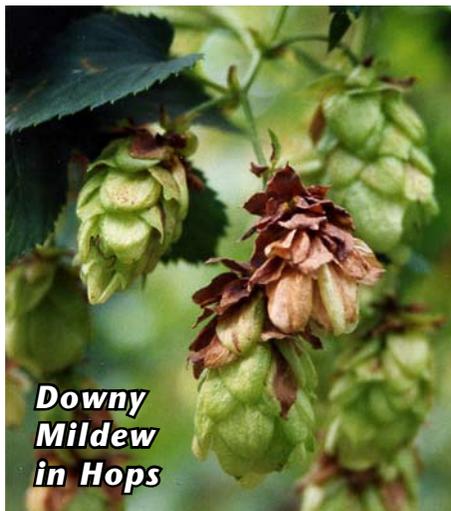
to analyze the 2010 crop samples after harvest. Chemical constituent analysis of mint oils is also underway. Ross' staff has completed a thorough literature review on volatile compounds in beer and on previous sensory studies conducted in beer. Sensory analysis of beer brewed from our project's hops will begin this fall.



SOCIOLOGY

Rural sociologist and **Co-PD Jennifer Sherman** (WSU) and her graduate student have begun conducting in-depth interviews among stakeholders involved with the subject crops. Working with commissioners

of both the hop and mint industries, Sherman selected growers and arranged interviews. Fifteen interviews with growers (11 in hops, 4 in mint) and 5 with farm workers have been completed. The interviews, which form the basis of the sociological component of the project, will be transcribed and analyzed this fall and winter to help guide years 2 and 3 of this component of the project.



Downy Mildew in Hops



Healthy Mint Field

ECONOMICS

Economists and **Co-PDs Thomas Marsh** and **Karina Gallardo** (WSU) are conducting economic analysis of the subject crops, with Marsh focusing on hops and Gallardo on mint. In the past year, Marsh's group has collected economic literature and current data on hops production and marketing and, working with industry, has completed a hops production cost budget. Gallardo's



group has completed a study of production costs for native and Scotch spearmint under rill and center pivot irrigation systems, examining the costs for an establishment year and those for a production year. The study will serve as a base for cost benefit analyses for changes in production practices tested in the project's experimental field studies under various irrigation and pest management regimes. Gallardo is currently gathering data from NASS-USDA and interviewing domestic mint oil dealers toward conducting an analysis of mint oil prices.



COMMUNICATION/ EXTENSION

Communication specialist and **Co-PD Sally O'Neal** (WSU) provides support for the team in their outreach efforts as well as producing reports and preparing grant applications to leverage the SCRI funds for additional support. Preliminary project results have been communicated to industry partners and stakeholders at field days in all three states, industry meetings, and numerous formal and informal individual and group discussions with producers. Additional financial and in-kind support for the project has been sought and received from industry.

