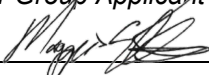


<b>PROJECT TITLE:</b> Integrated Pest Management on Hops While Mitigating Pesticide Residues	
<b>APPLICANT:</b> WA Hop Commission Contact: Maggie Elliot Phone: 509.452.4749 Email: melliott@wahops.org	<b>PI/RESEARCHER:</b> Name: Doug Walsh, Institution: WSU-IAREC Phone: 509.786.9287 Email: dwalsh@wsu.edu
<b>DETAILS:</b> Is this an OP Alternative Proposal? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Treatment Method (Select one): <input checked="" type="checkbox"/> Pesticides <input type="checkbox"/> Alternative to Pesticides Crop: Hops Pest: Arthropods, Disease, Weeds Registration: 10% Non-Registration: 90%	
<b>CATEGORIES:</b> Good Laboratories Practices Research (Select all that apply): <input type="checkbox"/> GLP <input checked="" type="checkbox"/> Not GLP Impact Categories (Select all that apply): <input type="checkbox"/> A1 <input type="checkbox"/> A2 <input type="checkbox"/> A3 <input type="checkbox"/> A4 <input type="checkbox"/> A5 <input type="checkbox"/> B1 <input type="checkbox"/> B2 <input type="checkbox"/> B3 <input type="checkbox"/> B4 <input checked="" type="checkbox"/> C1 <input checked="" type="checkbox"/> C2 <input checked="" type="checkbox"/> C3 <input checked="" type="checkbox"/> C4 Project Type (Select all that apply): <input checked="" type="checkbox"/> Efficacy Trial <input checked="" type="checkbox"/> Residue Study <input type="checkbox"/> Pesticide Resistance Study <input type="checkbox"/> Phytotoxicity Study <input checked="" type="checkbox"/> Integrated Pest Mngmt <input type="checkbox"/> Other:	
<b>FUNDING:</b> (Must match budget form) Start Date: 1/1/2023 End Date: 6/30/2024 WSCPR Request: \$24,994 Fund Contributions Cash: \$12,000 From: WA Hop Commission Fund Contributions Cash: \$18,000 From: Hop Research Council Total Project Cost: \$54,994	
<b>PROJECT SUMMARY:</b> The European Union is moving forward with bans to imported hops containing residues of pesticides common to and critical to Washington hop growers. Other key export nations including Canada, Korea, Japan, and China are also increasing regulations. Alternatives, or alternative use patterns, for key tools must be found to maintain export market viability. These could include registration of new pesticides or changes in the use patterns of currently registered pesticides that result in residue levels below the Maximum Residue Limits (MRLs) of concern. This objective involves both basic and applied science. It will include manipulation of pre-harvest intervals (PHIs) of certain controls. Data generated will be used to move the most efficacious controls toward registration via the IR-4 program or encouraging growers to adopt new use patterns, making them available to hop growers and allowing them to maintain and expand their hop exports. We are also testing applications of ozonated water and hydrogen peroxide solutions to determine if these products can reduce pesticide residues. Other alternatives will be considered.	
To the best of my knowledge, my signature certifies that the information in this application is true and correct.	
Maggie Elliot	Science & Communications Director
User Group Applicant Name (Print)	User Group Applicant's Title
	11/22/2022
User Group Applicant Signature	Date

## **Integrated Pest Management on Hops While Mitigating Pesticide Residues**

Doug Walsh, Director, IR-4 Magnitude of Regional Pesticide Residue Program  
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**Description of the Problem:** Washington State hop growers are facing nothing short of a crisis regarding export markets, a vital component of the industry's profitability accounting for 60% of U.S. production. The European Union is moving forward with bans to imported hops containing residues of pesticides common to and critical to Washington hop growers. Other key export nations including Canada, Korea, Japan, and China are also increasing regulations. The fungicide quinoxyfen, the suite of neonicotinoid insecticides (e.g., imidacloprid, thiamethoxam, etc), bifenazate, myclobutanil, and flutriafol are among compounds considered essential to the U.S. hop growers, but facing increased scrutiny in these key export markets. To address current and anticipated MRL restrictions on hop exports, we will conduct experimental plot studies to identify alternative pesticides and alternative use patterns.

For studies with powdery mildew, the key fungal pathogen on Washington hops, we will focus on quinoxyfen. Quinoxyfen is the fungicide most widely applied by hop producers in Washington State and is the cornerstone of hops current disease management program. Quinoxyfen is especially efficacious and important in management of the cone phase of powdery mildew when applied during the juvenile stages of hop cone development. For insecticides we will focus on the neonicotinyl insecticides imidacloprid and thiamethoxam. We believe that bifenazate is a lost cause.

Dr. Matt Hengel, Director of the Trace Analytical Laboratory at the University of California at Davis, has developed a multiplex method in which he could complete residue analysis on over 40 specific pesticides on whole cone hops in a dual test. This methodology has been commercialized and now screens for over 65 pesticides in this dual test. In this study we will work with our primary advisory group, the Hop Industry Plant Protection Committee, to detail a list of pesticide applications of many pesticides in a greater than average but realistic spray program. These pesticides will be applied to our research hopyards that contain 13 named hop varieties in replicated plots at WSU IAREC by boom for herbicides and by airblast sprayer for fungicides, insecticides, and acaricides. Hops will be harvested from this block in August and September 2023 and shipped to Matrix Sciences' Agricultural Laboratory in Sherwood, OR to quantify the pesticide residue present on these hops. Once we receive the residue data we will compare them to permitted MRLs in key export markets. If residue levels are below specific MRLs we will remove that pesticide from further study. If residues are above a specific level we will include that pesticide in future studies with a reduced application rate or a prolonged pre-harvest interval. We have one block in particular in which the hop aroma varieties Centennial, Mt Hood, Chinook, and the super-alpha variety Columbus are replicated in-row. Traditionally we have used this block for herbicide efficacy and crop safety studies, but the existence of this block permits us to replicate specific treatments that include ozonated water and hydrogen peroxide close to our

harvest dates that could potentially reduce pesticide residues on these treated hop varieties. Time can also prove to be a factor in pesticide residues. We plan to harvest and dry hops and then test them for residue while retaining some hops in the freezer for timed intervals to quantify the rate of pesticide degradation in the freezer.

**Required Information:**

**Crop farmgate value (2021):** In 2021, 115,631,000 lbs of hops were produced in the PNW on 60,872 acres for a crop farmgate value of \$662 million. Washington State accounts for 72% of this acreage and production. It would be reasonable to estimate losses could exceed \$3,000 per acre on average for all PNW hop production.

**Acres impacted:** Greater than 40,000 in 2021.

**Aggregate impact to industry:** about 60% of the hops grown in the PNW are exported. Loss of access to these export markets due to pesticide MRL issue would prove devastating to PNW hop growers and merchants.

**Effect of problem on industry:** Growers would be restricted by hop merchants from applying critical pesticides necessary for crop production and quality.

**Effect of problem on consumers, society, environment, non-target species, or human health:** Impacts would likely be minimal except for Europeans that would like to consume hop-forward beer like India Pale Ales brewed with PNW hops.

**Description of alternative methods:** The Washington Hop Commission and Hop Research Council in tandem with the Hop Industry Plant Protection Committee have funded research and regulatory programs based on domestic issues and have developed a long list of pesticide recommendations. Loss of access to these tools will lead growers to use less effective products and incur greater economic loss

**Funding Categories:** This project fits in Category A5, Other projects that would benefit Washington State pest management needs, if the ozone and hydrogen peroxide applications reduce pesticide residues on hops. This technology should translate to other PNW export crops under MRL scrutiny. This project also meets all 4 subcategories of Category C, Significance to Regional Economy.

**Project Objectives:**

- 1) Investigate factors contributing to export market viability for U.S. hops, including anticipated loss or lack of MRLs for key pest management tools in key export markets.
- 2) Test the application of ozonated water and Jet-Ag via airblast sprayer towards reducing pesticide residues.
- 3) Test the impact of time in cold storage on the residues of pesticides on candidate hops.

**Project Description:**

**Objective 1. Export viability / pesticide residues.** To address current and anticipated MRL restrictions on hop exports, we will conduct experimental plot studies to identify alternative pesticides and use patterns. We will conduct a series of residue studies based out of research hop yards at the WSU Prosser Irrigated Agriculture Research and Extension Center. In spring and summer 2023, a wide variety of pesticides (>25), including imidacloprid, indaziflam, oxathiapiprolin, clofentezine, myclobutanil,

quinoxifen, spiroticlofen, spinetoram, carfentrazone, tiafenacil, acequinocyl, flutianil, bifenazate, and fenazaquin will be applied to our research hop yards of multiple hop varieties at rates, timings, and frequencies typically employed by growers. This differs from the IR-4 program's protocol of applying at the maximum rate for the maximum number of allowable applications. In fall 2023 hops from these research plots and cone samples will be sent to Matrix Sciences for pesticide residue analysis using methods designed to detect multiple residues (Hengel et al. 2011). Those pesticides with issues regarding established MRLs for key export markets will be included in subsequent studies in which the pre-harvest interval (PHI) of application will be moved back such that residues have additional time to degrade. These studies will be combined with efficacy analysis of longer PHIs to determine optimal application timing for both pest management and acceptable MRLs.

***Objective 2. Ozonated water and hydrogen peroxide to reduce pesticide residues.***

Multiple studies in other crops and in stored product facilities have demonstrated that the application of ozone can degrade pesticide residues. In 2023 we will initiate pilot studies by treating candidate hop varieties with ozonated water and hydrogen peroxide (organic sanitizer Jet-Ag or similar) just prior to harvest in August. Following harvest and kilning we will send samples of hops from specific candidate varieties in Objective 1 that were treated with the ozonated water and hydrogen peroxide and companion samples from the same candidate varieties that were not treated to the pesticide analytical laboratory. We will also send samples to Yakima Chief for an analysis of the brewing qualities of the treated and untreated hops to determine whether the ozone and hydrogen peroxide treatments have any impact on the brewing qualities of the hops. This will be a comprehensive study to quantify whether the use of these simple technologies can result in reduced pesticide residues on hops without impacting brewing quality.

***Objective 3. Time in cold storage impact on pesticide residues.*** To quantify the amount of pesticide degradation in hops that results from time in cold storage we will store candidate varieties from the hops detailed in Objective 1 and hold them in our GLP freezers. We will determine the lengths of time by consulting with hop merchants regarding intervals they would deem appropriate for the hops they are marketing. We would then send these hops into the appropriate pesticide residue lab for analysis.

Reference

Hengel, M. J. Expanded Method Development for the Determination of Pesticides in Dried Hops by Liquid Chromatography with Tandem Mass Spectrometry. J. Am. Soc. Brewing Chemists 2011, 69(3), 121–126.

**Who certified this budget for accuracy?**

Name: Samantha Bridger

Title: Pre Award Grants Administrator

Email: Samantha.Bridger@wsu.edu

- Accurate Table 1 Calculations       Accurate Table 2 Calculations  
 Table 1 Totals = Table 2 Totals       Totals = Funding Totals on Application Form

**TOTAL PROJECTED [ESTIMATED] EXPENDITURES:**

TABLE 1	WSCPR Request	FUND CONTRIBUTIONS			TOTAL
		Cash	Cash	In-kind Time	
Salaries <sup>1</sup>	\$24,994	\$5,385	\$8,154	\$	\$38,533
Benefits	\$	\$2,705	\$4,161	\$	\$6,866
Temp/Hourly Workers	\$	\$1,400	\$2,100	\$	\$3,500
Travel <sup>2</sup>	\$	\$750	\$1,125	\$	\$1,875
Equipment <sup>3</sup>	\$	\$	\$	\$	\$
Residue tests <sup>4</sup>	\$	\$1,760	\$2,460	\$	\$4,220
<b>TOTAL</b>	\$24,994	\$12,000	\$18,000	\$	\$54,994

<sup>1</sup> Includes Project Field Manager Dan Groenendale @ 10% FTE, Farmer 2 Antonio Moreno @ 25% FTE, and Ag Research Technician 3 Wilson Peng @ 10% FTE.

**PROJECTED [ESTIMATED] EXPENDITURES BY QUARTER:**

TABLE 2	2023 Q1 (Jan-Mar)	2023 Q2 (Apr-Jun)	2023 Q3 (Jul-Sept)	2023 Q4 (Oct-Dec)	2024 Q1 (Jan-Mar)	2024 Q2 (Apr-Jun)
WSCPR Funds	\$6,248	\$6,248	\$6,249	\$6,249	\$	\$
Fund Contributions	\$6,445	\$6,445	\$10,665	\$6,445	\$	\$
<b>TOTAL</b>	\$12,693	\$12,693	\$16,914	\$12,694	\$	\$

**Has this project been funded previously by WSCPR?**       YES       NO

- ↳ **IF YES:** What was the WSCPR Project #:
- ↳ **IF YES:** For how long and with what progress? (Summarize in less than 200 words)