Washington Red Raspberry Commission

2026 Research Proposals

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Plant Breeding

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Red Raspberry Cultivar Development

Duration (up to 3 years): 3 years Starting Year: 2026 Ending Year: 2028

Funding Requested: Year 1: $10,000 Year 2: $10,000 Year 3: $10,000

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Cooperators:	Wendy Hoashi-Erhardt, Michael Hardigan

Description (200 words max):
Include objectives and specific outcomes.

This project is to support the continued effort to breed raspberry cultivars adapted to the PNW. We will continue to cross and select from a diverse gene pool and evaluate selections with primary emphasis on machine-harvestable yield and fruit quality and secondary emphasis on soil-borne pests and diseases (primarily Phytophthora root rot but hoping to build off the NCSFR-funded nematode work on genomic prediction in future years). Specifically, we will:

1.) Evaluate BC, WA and OR raspberry selections in replicated machine-harvested yield trials.
2.) Perform crosses annually, emphasizing machine-harvestability in combination with improving other traits (e.g., fruit quality, yield, root rot, RBDV resistance, earliness) with a goal of producing 3,000-5,000 seedlings annually for evaluation.
3.) Evaluate seedling plots on foot and from machine-harvester for overall potential as well as the specific objectives of each cross.
4.) Establish and evaluate replicated yield-trial plots of BC, WSU, and USDA selections to identify the best performers.
5.) Advance promising selections to grower trials to determine suitability for release and commercialization.
6.) Continue development and testing of molecular tools to speed up the process of accurately selecting and identifying parents and seedlings in the program with durable disease resistance and outstanding quality traits.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

The red raspberry industry is facing challenges with diseases, increased production costs and competition from the global marketplace. For the last 30+ years raspberry yields (lbs/acre) in Washington have been slowly but steadily declining, losing an average of 0.76% annually between 1992 and 2022 (19.6% drop). Genetic improvement is one of the most sustainable ways for the raspberry industry to maintain its competitive edge in the long-term. Improved quality, yield, and resistance to pests and diseases to help alleviate these problems are realistic and achievable goals that will benefit raspberry producers in Washington State.

The BC breeding program has a long history of producing cultivars with excellent fruit quality characteristics and has been making steady progress in recent years to combine this with improved machine harvestability, resistance to Phytophthora root rot and RBDV. In 2012, we expanded our efforts to identify machine-harvestability in our selections by contracting with a local grower to machine harvest our replicated plots. This effort was so successful we expanded it to additional plots and evaluation of seedlings in 2013. This strategy has enabled us to put selection pressure on machine-harvestability at an earlier stage in the breeding cycle, resulting in a dramatic increase in the proportion of machine-harvestable progeny under selection in the field. We plan to continue this, because we believe this is the fastest way to identify selections with merit and weed out selections that lack potential for the majority of PNW growers and are now making further adjustments to our selection strategy to allow us to more accurately put selection pressure on yield and to more readily identify seedling selections with higher yield potential.

While there are currently other raspberry breeding efforts in Washington and Oregon, each program has its strengths and weaknesses inherent in the germplasm base and breeding lines they have established through their history. While the WSU program was the first of the three to start machine-harvesting selections, our program has been able to consistently harvest seedling plots for the last 8 years which has helped us to make significant progress for this trait in our program in a relatively short time. We will continue to collaborate and exchange information and selections with the programs in Washington and Oregon so that promising material gets evaluated in as many test locations as possible and so that we can continue to combine efforts to complement the strengths of each program.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project directly addresses the WRRC tier 1 priority to develop cultivars that are summer bearing, high yielding, winter hardy, machine-harvestable, disease resistant, virus resistant and have superior processed fruit quality

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

Each of the specific objectives listed above will be attempted during the project period and each is an ongoing process that will be addressed in this funding year and in future funding years. While many inferior plants can be identified and eliminated in the early stages of the process, selections must be tested rigorously over a period of several years by the project staff and producers before they can be recommended for release and commercialization. As a result, we work in a rotating system where each year we make new crosses, select seedlings from past years' crosses, and discarding selections which don't make the grade during testing and every year we have material in the program at each stage.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

The breeding program is an ongoing project that continually makes new crosses and selections each year with the objective of developing new cultivars to support the raspberry industry. The program operates on a cycle such that all activities in this project occur at some point in the season of every year. This includes:

• Making new crosses - emphasizing combining the highest yielding parents with machine harvestability, resistance to RBDV, and root rot tolerance

• Planting new seedling fields from previous year's crosses for future evaluation

• Selection of mature seedling plantings with an emphasis on family yield, fruit quality and machine-harvestability

• Establish replicated trials of selections to assess machine-harvestability, quality, and yield

• Test field plantings for RBDV to establish which selections are susceptible and which may be resistant

• Screen selections in replicated trials for root rot resistance in the greenhouse to establish potential for resistance

• Propagate promising selections for further trial at our substation and in producers' fields

• Conduct collaborative research and testing with USDA-ARS in Corvallis, WSU, AAFC, and elsewhere

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Specific benefits that will result from this project include:
1) Continued development of new cultivars and selections that will provide alternatives for producers with high fruit quality and improved yield and resistance to pests and diseases.
2) Continued development of technologies that will assist this and other breeding programs to more efficiently select promising genotypes in the future.
Results will be transferred to users through regular presentations at field days and local meetings such as the LMHIA Short Course and the Washington Small Fruit Conference with information on new releases and selections available for testing.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]			
Time-Slip	$10,000	$10,000	
Operations (Goods & Services)			
Travel[2]			
Meetings			
Other[3]			
Equipment[4]			
Benefits[5]			
Total	$10,000	$10,000	

The funding we are asking for will be used to hire summer labor to help with planting and care of breeding plots as well as for harvest of fruit from seedlings and yield trials. We need a crew of four people to run the harvester and weigh-station for all of the breeding plots from late June-early August, with some time before and after harvest season spent on vegetative data collection, planting, and field management.

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

Funding has been requested from the Province of BC, RIDC, Lower Mainland Horticultural Improvement Association, Agriculture and Agri-Food Canada for funding raspberry work (also pursuing funding from BC Blueberry Council, BC Strawberry Growers' Association, to support the blueberry and strawberry portions of our work). In 2023, we submitted our project to AAFC's "Sustainable Canadian Agricultural Partnership" program for funding through March 2028 as part of a package with other research projects the industry is trying to support in the berry space. Our funding has been approved by AAFC but cannot be publicized until the Government of Canada makes a formal announcement. The breeding project is split between blueberries, raspberries, and strawberries, with raspberries accounting for ~$35% of time/effort. The total budget from April 1, 2023 - March 31, 2028 is $2,494,251, with $1,068,672 of this for the raspberry work. This budget requires 50% industry matching funds as a 1:1 ratio of government:industry funding. The funding we are asking from WRRC will help to offset the required industry contribution and will be used specifically to help hire summer labor for planting, harvest, and field care.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Red Raspberry Breeding, Genetics and Clone Evaluation

Duration (up to 3 years): continuing Starting Year: 1987 Ending Year: continuing

Funding Requested: Year 1: 79,514 Year 2: _____ Year 3: _____

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Cooperators:	Rader Farms, regional growers; Northwest Berry Foundation; Michael Hardigan, Mary Peterson, Amanda Lake, Cristian Olaya, Ioannis Tzanetakis, USDA-ARS; Scott Lukas and Pat Jones, OSU; Michael Dossett, BC Berry Council; Tom Walters, Walters Ag Research; Julie Enfield and Lisa Jones, Northwest Plant Co.

Description (200 words max):
Include objectives and specific outcomes.

The program will develop new red raspberry cultivars for the commercial raspberry industry in the Pacific Northwest, focusing on the breeding objectives of high yield, machine harvestability, superior processed fruit quality, root rot tolerance, nematode tolerance, and raspberry bushy dwarf virus (RBDV) resistance. The program will produce seedling populations, make selections, and evaluate the selections through multiple stages of performance assessments for yield, plant horticultural characteristics, disease/pest tolerance, and fruit quality, including firmness, color, flavor, and size. Traditional breeding methods will be used, as well as molecular tools that become available and are efficient and affordable. Selections will be evaluated for adaptation to machine harvestability by planting selections with cooperating growers. Promising selections will be propagated for grower trials, leveraging grower trial data toward cultivar release and commercial licensing.

Justification and Background (400 words max):

Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Washington's growers lead US production of processed red raspberry. They compete closely with product from other areas of North America and internationally. Washington's growers benefit from new cultivars emerging from the WSU breeding program, which is one of three US public programs breeding floricane-fruiting red raspberry and the only one with major focus on machine-harvested yield potential and excellent fruit quality for the processing market.

New cultivars emerge through an annual cycle of germplasm collection and maintenance, new crosses, new selections from previously planted seedlings, successful propagation, and extensive selection evaluations for machine harvestability, yield, harvest season, fruit quality, and response to disease and abiotic stresses. These evaluations occur in research-scale plots at WSU-PREC and other research facilities and in commercial-scale plantings across the region. The program proposes continuing annual plant breeding activities as well as contributing to collaborative projects that explore the genetic basis of emerging research needs or interactions with relevant horticultural practices for Washington's red raspberry industry.

WSU's small fruit breeding program has made significant genetic gains with machine harvestability, excellent fruit quality, and root rot tolerance over the last 20 years. Additionally, the program successfully leverages investment from the WRRC to obtain new funding for research valuable to WRRC growers, such as evaluating available germplasm to develop molecular breeding tools for traits that are difficult to achieve gains through traditional breeding.

WSU's plant breeding program is a vital collaborator with British Columbia, Oregon, Washington private and public plant breeders, plant pathologists, and horticulturists who work cooperatively to test important germplasm, conduct regional evaluations, and explore emerging research needs.

Relationship to WRRC Research Priorities (150 words max):

Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project addresses a first-tier priority of the WRRC to develop cultivars that are summer bearing, high yielding, winter hardy, machine-harvestable, disease resistant, virus resistant and have superior processed fruit quality.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

• Achieve the next stage of development of new summer-fruiting red raspberry cultivars with improved yields and fruit quality, and resistance to root rot and raspberry bushy dwarf virus;
• Conduct on-farm and disease evaluations to accelerate the release of advanced selections adapted to machine harvesting.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

1. Parental/germplasm material. PREC, NWREC, establish new accessions and maintain existing plantings.
2. Crosses. PREC. Select parents based on 2025 data and research priority. Perform crosses spring 2026; Seed germination and seedling propagation, Sept 2026 to spring 2027.
3. Seedlings. Lynden cooperator. Identify excellent individuals (selections) to enter cultivar development pipeline from 2024 crosses; establish 2026 seedling field and maintain 2025, 2024, and 2023 seedling fields at Rader Farms.
4. Observational machine harvest (MH) trial. Lynden cooperators. New selections are propagated and tested for machine harvestability, yield, and fruit quality. Status: 2023 and 2024 trial at Rader's will be evaluated in 2026; 2025 MH trial maintained for evaluation next year; 2026 MH trials will be established with Brad Rader.
5. Replicated yield trial. Lynden cooperators. High performing selections from MH trial are evaluated in replicated plots for yield and fruit quality. Status: 2023 and 2024 rep trial will be evaluated for yield and fruit quality; 2025 rep trial will be maintained for evaluation next year; 2026 planting to be planted with Rader Farms.
6. Root rot trial. PREC. Root rot response is evaluated in comparison with standard cultivars for 3 years. Status: Root rot plots planted in 2023, 2024, and 2025 will be maintained and evaluated for tolerance in 2026. A new planting will go in in 2026.
7. Regional replicated trials. Dossett/BC, Hardigan/OR. Selections from replicated yield trials are evaluated in replicated plots for yield and fruit quality across growing environments.
8. Grower Trials. Walters, Pond/NBF; Gerbrandt, Sky Blue Horticulture; Northwest Plant. Two to six elite selections will be propagated, cleaned, sent to the nursery, then tested by growers to assess for yield, fruit quality, and traits important to commercial production, like establishment, water use, disease susceptibility, and winter hardiness.
9. Propagation. PREC. Generate multiple plants of single, genetically unique selections through tissue culture and greenhouse methods for all the plantings listed above.
10. Plant IP preservation. PREC. Maintain and preserve core and experimental germplasm, transfer plant material and document IP status for cultivars and advanced selections.
11. Virus testing. PREC, Olaya/USDA and commercial providers. Propagate, initiate testing, and maintain records on selections and propagules and their virus status for timely propagation for grower trial. Year-round management of records and selection propagation status, collaboration with virologist at USDA.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

The program will continue annual plant breeding activities that lead to genetic gain for economically important traits and to the release of elite red raspberry cultivars. Additionally, the program will preserve germplasm, develop cooperative evaluation and phenotyping protocols, further transition plant breeding activities to Whatcom County, leverage royalties for associated research, and transfer WSU germplasm for genomic research. These objectives also increase the value of collaborative relationships and active projects between regional breeders, horticultural researchers, extension specialists, and nursery and grower cooperators. Results will be transferred through regular meetings with the WRRC, field days, Small Fruit Update and Whatcom Ag Monthly newsletters, and grower conferences.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$19,451		
Time-Slip	$28,893		
Operations (Goods & Services)	$6,000		
Travel[2]	$2,900		
Meetings			
Other[3]			
Equipment[4]			
Benefits[5]	$22,270		
Total	$79,514		

1. Scientific Assistant. SA Brad Pugh will work soils, maintain equipment, design and plant plots, scout and treat pest problems, prune, trellis, run irrigation and fertilizer regimes, keep inventories and documentation, and supervise temporary employees, 0.18 FTE ($11,213).
Agricultural Research Technologist 2 (ART2)– NWREC. ART2 Emma Rogers will collect data and process fruit samples for 2 months full time in summer 2026 ($8,238).
Non-permanent scheduled ART3 - PREC. An ART2 will conduct tissue culture and greenhouse propagation, at a wage of $27.42/hr for 16 hrs/week for 52 weeks ($22,813)

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

Agency Name: Northwest Center for Small Fruits Research
Amt. Awarded: $148,899 for 09/01/2024-10/31/2027
Notes: Funds will be used to provide partial technical support for the program.

Agency Name: WSDA Specialty Crop Block Grant
Amt. Awarded: $178,245 for 09/30/2024-09/29/2027
Notes: Funds are to explore the genetic basis for fruit and yield traits, leading to the development of molecular tools for marker assisted selection in plant breeding.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: On-farm Trials of Advanced Raspberry Selections

Duration (up to 3 years): 3 years Starting Year: 2026 Ending Year: 2028

Funding Requested: Year 1: $5313 Year 2: $5579 Year 3: $5858

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Cooperators:	Julie Enfield, Northwest Plants; John Clark, Clark Farms, Rob Dhaliwal, Samson farms; Riley Spears, Rader Farms; Troy Kortus, Maberry Packing; Randy Kraght, Barbie's Berries; Eric Gerbrandt, BC Berry Council; Julie Pond, Northwest Berry Foundation

Description (200 words max):
Include objectives and specific outcomes.

Maintain an ongoing network of regional on-farm grower trials for evaluating red raspberry advanced selections and newly released cultivars from the WSU breeding program, the USDA-ARS/ OSU breeding program, and the British Columbia raspberry breeding program.

We will continue to evaluate WSU 2087 and WSU 2088 at three locations:

- A 2020-planted small plot trial on Bob Hall Road.
- Block trial on Van Dyk road
- Block trial on Noon road

In addition, we will coordinate planting of new grower trials of BC 1855.11, BC 1855.14 and BC 1855.37. We will coordinate trial management with growers, collect trial data directly and through the grower-cooperators, and disseminate trial findings to the industry at meetings, through the Small Fruit Newsletter and elsewhere.

Objectives are to evaluate these selections for plant and fruit traits important to growers, and to share our findings with plant breeders and growers. Specific outcomes will be comparative information on pest management, horticultural traits, and fruit quality traits distributed at the Small Fruit conference and through the Small Fruit Newsletter

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

The WSU, USDA and BC Berry Council breeding programs develop and trial advanced red raspberry selections, which growers can see at field days. However, before growers commit to planting a variety, they need to know more than what they can learn from a visit to a small-plot trial. Adoption of new varieties is therefore usually slow. On-farm trials of advanced selections give growers more opportunities to see plant and fruit performance firsthand in growers' fields, and to increase awareness of the best selections among growers.

The WSU breeding program has produced the largest number of selections for these trials. These trials contributed to the release of WSU's 'Cascade Legacy', and we will continue to collect information on WSU 2087, which is being considered for release. This coming spring, plants will be available of three exciting new selections from the BC Breeding program: BC 1855.11, BC 1855.14 and BC 1855.37. All have excellent fruit quality, and show promise for the processing market. Plants are being produced by Northwest plants for trial in the US.
Three growers will plant some or all of these in 2026. In addition, small plots are available for examination at the GWAS trial at WSU-Mount Vernon and at the mechanical harvesting trial at Rader Farms.

These on-farm trials work because the growers take excellent care of the plants, and bring their experience to evaluation. They work because Northwest Plants coordinates and produces excellent planting stock. They work because the Walters Ag Research team knows enough to evaluate traits that are important to growers. They work because we have an outstanding grower meeting, the Small fruit Conference. They work because we have a well-developed, well-read vehicle for information dissemination (the Small Fruit Newsletter).

This project is directly related to and in communication with Dr. Eric Gerbrant's cultivar evaluation projects in British Columbia, and to NBF's ongoing caneberry and strawberry evaluations in Oregon. Together, these projects provide a cohesive system for evaluating advanced selections, compiling data on a common system and disseminating the information to the grower community.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

These trials relate to WRRC #1 priority Cultivar Development – Key characteristics include summer bearing, high yielding, winter hardy, machine-harvestable, disease and virus resistant, and superior processed fruit quality, as well as season extension.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

In 2026, we will:

- Make continuing evaluations on the existing trials of WSU 2087 and its sister selection WSU 2088. Evaluations will include periodic pest monitoring as well as evaluation of fruit quality and harvest.
- Coordinate and establish new trials of BC 1855.11, BC 1855.14 and BC 1855.37 with Maberry Packing, Clark Farms, Barbie's berries. Also possibly with other growers.
- Evaluate existing trials of the BC selections in Mount Vernon and Lynden.
- Disseminate coordinated information from trials to growers

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

We will evaluate selections in the 2020 trials, including WSU selections 2087and 2088. These small plot evaluations will focus on winter injury, vigor, fruit quality, and response to other diseases and pests. Evaluations will take place April through August.

Specific diseases and pests that will be scouted for include:

- Cane botrytis. Evaluate floricanes with floral buds killed by cane Botrytis early in the season. Evaluate cane botrytis lesions on primocanes later in the season, beginning approximately mid-harves
- Cane Blight. Look for killed floricanes early in season through harvest, look for cane blight lesions in late fall.
- Spur blight. Look for lesions late harvest-September
- Leaf rust. Look for lesions through summer months
- Aphids. Look throughout season, especially before mid-July
- Mites. Look from pre-harvest through the end of harvest.

New trials of 1855.11, BC 1855.14 and BC 1855.37 will be established with grower-cooperators in 2026. Project guidelines:

- Tissue culture plants.
- 50-150 plants/selection/site.
- Sites will include both well-drained soils and sites with root rot.
- Plantings over four years old will have reached the end of their evaluation period within this program and may be removed. However, some may be left in for longer term observations.
- Advisory group will be communicating as needed to coordinate activities.
- Administrator will be giving periodic updates to participants and will disseminate and archivie information as needed.

Grower/cooperator arrangements

- Testing agreements will be created and approved by WSU and by USDA.
- Agreements will include: on-site visits by other growers and researchers (arranged and agreed to in advance); participation in the evaluation process; and a prohibition of any on-farm propagation of advanced selections.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

· Plant breeeders get feedback from growers on their selections, helping them decide which ones to advance, and how to focus future efforts.
. Growers get an advance look at how pending varieties perform in their fields before commiting to planting them.
· The results will be transferred to growers through presentations at the Small Fruit Conference, and through the Small Fruit update newsletter. .

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$2000	$2100	$2205
Time-Slip	$1000	$1050	$1103
Operations (Goods & Services)	$1725	$1811	$1902
Travel[2]	$588	$618	$648
Meetings			
Other[3]			
Equipment[4]			
Benefits[5]			
Total	$5313	$5579	$5858

Comments: 1) Walters, 2% FTE including benefits
2) 6 trips/year, 140 miles/trip, $0.70/mile
3) Outreach will be accomplished by Northwest Berry Foundation giving periodic updates to Washington red raspberry growers and the industry. Disseminating and archiving information as needed through meeting presentations, newsletters, and production of

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

In-kind support provided by Northwest plants in the form of discounted plant costs.

Entomology

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Spotted Wing Drosophila Control with Sterile Insect Releases (SIR)

Duration (up to 3 years): 3 Starting Year: 2026 Ending Year: 2028

Funding Requested: Year 1: $13,945 Year 2: $14,503 Year 3: $15,083

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Cooperators:	Lisa DeVetter, Washington State University, NWREC. 16650 State Route 536. Mount Vernon, WA. 360-848-6159. lisa.devetter@wsu.edu.

Description (200 words max):
Include objectives and specific outcomes.

Spotted Wing Drosophila (SWD) is a major pest of Washington's red raspberry industry, with a strong preference for raspberries over other hosts like blueberry, strawberry, and cherry. Because alternatives are limited, growers rely almost entirely on insecticide sprays. Sterile Insect Release (SIR) offers a promising solution, having successfully controlled pests in cotton (pink bollworm), apples (codling moth), and livestock (screwworm). In 2025, a newly developed SIR method for SWD was tested by the WSU Entomology Lab (PI Nottingham) in Mount Vernon, showing impressive control in blueberry plots.

We propose to build on these results with three objectives:
1. Evaluate field efficacy of SWD SIR.
2. Determine optimal sterile male release rates.
3. Assess sterile male viability after shipment.

These objectives will confirm 2025 findings and provide critical data, such as release rates and sterile male counts per box, to improve implementation and reduce reliance on insecticides.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Spotted Wing Drosophila (SWD) invaded Washington in 2009 and quickly became the top pest of blueberries and raspberries. Because packers and consumers will not tolerate infested fruit, growers increased insecticide sprays from 2-5 per year to 8-12. The most effective products, pyrethroids, organophosphates, and carbamates, face regulatory scrutiny and resistance issues. Newer insecticides are costly and often lack export market tolerances. To prevent resistance and reduce costs, effective IPM tactics are essential.

One promising option is Sterile Insect Release (SIR), which involves mass-rearing and releasing sterile males to suppress wild populations. SIR has a long record of success, from screwworm eradication in livestock (Radcliffe et al. 2009), to modern programs targeting codling moth (OK-SIR 2024), mosquitoes (Guo et al. 2022), and Mediterranean fruit fly (CDFA 2025).
A Saint Louis based company, Agragene, recently developed an SWD-specific SIR method called Knockout, using CRISPR to produce sterile males. These are shipped in diet media and emerge within 1-2 days after arrival. USDA lab trials (2018–2023) showed Knockout males reduced offspring and fruit damage to zero compared to controls.

In 2025, the Nottingham lab conducted field trials in Washington and collaborated with Michigan State and Minnesota. Results were striking: Knockout-treated plots had less than 1% infestation versus 50-100% in untreated controls. Lab tests showed ~60% emergence of sterile males per box, though variability (30-90%) suggests room for improvement.

For 2026, we propose to replicate 2025 field and lab studies, add a screenhouse trial to determine optimal release rates, and, if possible, include a second field site in raspberries. Current regulations limit expansion, but we remain committed to delivering benefits for both raspberry and blueberry growers in Washington and surrounding states. We will also facilitate engagement between the Washington berry industry and Agragene to ensure alignment of goals.

To our knowledge, no similar projects are underway in Oregon, Idaho, or British Columbia. There are similar studies on Agragene's Knockout SIR technology taking place at Michigan State University (in both cherries and blueberries).

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

Tier 1: Spotted wing drosophila management options.
- Sterile insect release (SIR) for SWD is a new technology that directly suppresses SWD infestations in raspberries and other small fruit. SIR will add a non-insecticidal tool to the grower toolkit for controlling SWD, which will slow the rate of insecticide resistance (to SWD and other pests), help growers avoid MRL conflicts, and reduce spray costs.

Tier 3: MRLs
- SIR is a non-insecticidal technique and can be used near harvest when SWD is most injurious. Therefore, SIR can reduce near-harvest sprays (and overall spray needs) and make MRL related conflicts easier to avoid.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

(all objectives will occur in the first funding year, 2026)
1. Test the efficacy of Knockout (SIR) males against SWD in field grown berries.
2. Determine optimal release densities of sterile males to wildtypes in a replicated screenhouse trial.
3. Evaluate health of knockout males (emergence) following shipment.
4. Facilitate engagement between the Washington berry industry and Agragene to ensure alignment of goals.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Objective 1 (Jul–Sep 2026): Field Efficacy of Knockout SIR.

We will replicate 2025 methods in a research blueberry and/or raspberry field at NWREC with two plots: one untreated and one receiving weekly Knockout releases. Both plots will remain unsprayed once releases begin. Agragene will ship sterile SWD males weekly from July through September, and releases will occur within 24 hours of arrival to ensure viability.
To monitor SWD populations and Knockout dispersal, adult flies will be trapped using Scentry lures in propylene glycol jars. Knockout males will be identified by their fluorescent protein marker under UV light. Berry dissections will be performed weekly to measure larval infestation. Monitoring will begin two weeks prior to releases to establish baseline populations.
This objective will confirm field-level efficacy under commercial-like conditions.

Objective 2 (Jun–Sep 2026): Optimal Release Rates.

Thirty-two mature blueberry plants in three-gallon pots will be placed in individual mesh cages within a screenhouse at NWREC. Plants will be assigned to four treatments (50:10:10, 10:10:10, 5:10:10, and 0:10:10 sterile:wild male:wild female ratios) in a randomized complete block design. Weekly releases will occur throughout fruiting. Ten to 20 ripe berries per plant will be collected weekly or biweekly and dissected for SWD larvae.
This experiment will identify the most cost-effective release ratio for commercial adoption.

Objective 3 (Jun–Nov 2026): Sterile Male Fitness and Emergence.

We will compare mortality of Knockout versus wild males in screenhouse cages by collecting dead individuals weekly and identifying them under UV light. Emergence success will be assessed by counting sterile males exiting Knockout boxes versus dead adults, pupae, and larvae remaining inside. We will also assess mortality of sterile males vs wild-types outside the boxes.
These data will inform improvements to shipping protocols and overall sterile male viability.

Objective 4 (Mar–Dec 2026): Industry Engagement.

To ensure alignment between Agragene and Washington berry industries, Nottingham's lab will facilitate at least one stakeholder meeting to discuss strategies, commercialization pathways, and grower priorities. This engagement will accelerate adoption and maximize benefits for raspberry and blueberry growers.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Spotted Wing Drosophila (SWD) remains the top pest threat for Washington raspberry growers, driving high spray costs, resistance risk, and MRL challenges. With regulatory pressure and rising costs, growers urgently need non-chemical solutions.

This research will advance Sterile Insect Release (SIR) as an effective technique to suppress SWD while reducing challenges associated with high insecticide use. By testing SIR in field, screenhouse, and lab settings, we will generate critical data on field efficacy, release rates, and sterile male viability - information essential for regulatory approval and successful commercial implementation.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$12,260	$12,750	$13,260
Time-Slip			
Operations (Goods & Services)			
Travel[2]			
Meetings			
Other[3]			
Equipment[4]			
Benefits[5]	$1,685	$1,753	$1,823
Total	$13,945	$14,503	$15,083

Comments: (1) Salaries:
-WSU assistant professor salary (Nottingham, $9,915/mo) for 2% FTE × 1.04 COLA for years 2 and 3
-WSU graduate student summer stipend (19/hr × 40hr/wk × 13 wk) × 1.04 COLA for years 2 and 3

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

Other Funding:
1. WCIPM: $24,860 requested year 1 (2026) of 3.
2. WBC: $27,726 requested for year 1 (2026) of 3.
3. NCSFR: $75,000 to be requested for 3 years, 2026-2028.

Washington Red Raspberry Commission
2026 Research proposal

Title: Genomic tools for the identification and management of resistance in Spotted Wing Drosophila

Principle Investigator:
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Co-Investigator:
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Dr. Alan Schrieber, Ph.D., 2621 Ringold Rd., Eltopia, WA, 99330, ashreib@centurytel.net
Kristin Butcher, M.S., Twist Bioscience, 26600 SW Parkway Ave, Wilsonville, OR 97070

Description:
Spotted Wing Drosophila (SWD) is the top economic pest of Washington's Raspberry industry. SWD are controlled only through exceptional rates of insecticide application at great cost to growers. This rate of insecticide use increases the potential for resistance evolution (*1*, *2*), which would further increase costs and issues with MRLs Early reports indicate the evolution of significant resistance in Whatcom County SWD. This project will identify the genetic basis of resistance and develop a high-throughput genetic screen for resistance to be used by field entomologists.

We will identify the alleles associated with SWD resistance through two complimentary approaches. First, we will conduct genomic xQTL mapping using spinosad (Entrust) and diamide (Exirel) to identify genetic markers associated with resistance to two key insecticide classes recommended for control of SWD in the region. Second, we will work with entomologists conducting bioassays (Drs. Nottingham and Schreiber) to conduct genomic sequencing of resistant and susceptible populations in WA.

Outcomes:

(1) Identify alleles contributing to resistance to key compounds using xQTL procedure
(2) Determine genetic basis of resistance in SWD from Whatcom County raspberries.
(3) Development of a genetic screening tool for resistance alleles

Justification and Background:
Spotted Wing Drosophila (SWD) is the top economic pest of Washington's red raspberry industry, and growers increasingly rely on repeated chemical applications to maintain marketable fruit—often weekly sprays during the growing season. Growers across the region increasingly report declining efficacy of key products—particularly spinosyn—creating concern that resistance evolution is emerging that may undermine current control programs. A major challenge is that growers have access to only a few insecticide groups (IRAC 1B, 3A, 5, and 28), and repeated applications over the growing season reduces rotation flexibility. Maximum residue limits create an additional challenge for growers, necessitating improved guidance on compound selection as part of effective IPM for SWD. BC and Oregon growers face similar constraints, and both regions have emphasized the urgent need for resistance-management tools that remain practical at the farm scale.

This project directly responds to those concerns by generating experimental, field-based evidence on the alleles contributing to resistance and developing a test for resistance alleles.

Identifying resistance loci offers three major benefits to WRRC growers: (i) rapid, low-cost genetic testing for resistance; (ii) spatial and temporal monitoring of resistance evolution to guide management decisions; and (iii) mechanistic insight into resistance pathways that can inform compound rotation and pyramiding strategies.

We will use xQTL mapping experiments, a fast, effective, and efficient method for identifying the genetic basis of resistance (Hanson et al. 2025 - also see attached figure), to identify alleles that significantly contribute to resistance to two key insecticides: spinosads and diamides. The xQTL procedure derives considerable statistical power by comparing allele frequencies from pools of individuals with extreme trait values (i.e., resistance) to those from whole trait distribution.

Working with Drs. Nottingham and Schreiber, both of whom are conducting bioassays across a wide range of berry grower field sites in eastern, NW and SW WA, we will identify whether resistance alleles from wild WA SWD populations exist. We will sample both control ('non-exposed') and resistant ('exposed-survived') SWD individuals from each of six localities in NW and SW WA. We will use population genomics techniques to identify loci contributing to resistance and intersect these results with loci identified through xQTL approaches. Together this data will form the basis for a genetic test for resistance in SWD. No current PNW research is using genomic data to study SWD resistance evolution, nor actively working on the development of screening tools for resistance alleles.

Relationship to WRRC Research Priorities:
This project directly addresses a Tier 1 Priority: Spotted Wing Drosophila—'Management options for control of SWD, including targeting larvae'. Our work aligns with this priority by leveraging genomic information to create a genetic screen for resistance alleles. Current costs associated with SWD control are considerable, but resistance evolution could multiply existing control costs, particularly for organic producers. High resolution data of resistance alleles is needed to track resistance, identify mechanisms that slow the spread, and provide guidance on the application of compounds.

WRRC has emphasized the need for tools that improve long-term sustainability of chemical programs. This project supports that priority by identifying genetic markers that can be incorporated

into industry monitoring programs as early-warning systems. Together, these components ensure the project advances WRRC's Tier 1 research need for improved SWD management.

Objectives:

Objective 1: Identify alleles associated with insecticide resistance in SWD using xQTL

- Establish field-based "extreme phenotype" (survivor-based) mapping experiments using wild-derived SWD populations.
- Generate high-resolution pooled-sequencing data to identify genetic variants linked to survival.

Objective 2: Use field bioassay experiments to identify resistance on WA farms

- Obtain 'control' and 'resistant' individuals from bioassays conducted by Drs. Nottingham and Schreiber.
- Sequences pools of individuals from each category and each locality.
- Conduct genomic scans for selection to identify resistance associated loci and intersect results with Obj. 1.

Objective 3: Create a genetic screening tool for SWD resistance

- Using results from Obj. 1 and 2, create a list of alleles that contribute to resistance.
- Design genomic probe set for sequencing of these resistance alleles.
- Validate efficacy of genomic probe screening tool for sequencing of resistance alleles.
- Create web-interface for use by growers and entomologists to monitor resistance alleles over space and time.

Objectives addressed this funding year:
Year 1 focuses on: Obj. 1 (field xQTL experiments, extracting pooled DNA, sequencing pools, and bioinformatic analyses) to identify resistance alleles. Early work for Obj. 2: finalizing sampling regime and obtaining initial samples from Drs. Nottingham and Schreiber.

Procedures:

This project combines two procedures to identify resistance alleles.

xQTL experiments to identify resistance alleles

The design of xQTL experiments follows protocols for maximizing both power and localization of genomic variants (Macdonald et al., 2022). We will use 150 isofemale SWD lines collected from SW WA to establish field xQTL experiments. We will expand the founder population to 10 indoor cages. Eggs will be collected from all 10 cages over a 24hr window and pooled. 12000 SWD eggs from the pool will be painted onto 400ml of media containing either: 1) a LC90 of spinosyn, 2) a LC90 concentration of diamides, or 3) no-exposure control. Each of these three treatments will be replicated 10 times. Each replicate will then be transferred to large experimental field cages and monitored for 20 days while eggs develop. Upon eclosion, pools of adult individuals from each replicate will be collected for genomic sequencing. If any replicates produce less than 100 surviving adults, they will be pooled with the next lowest replicate from each treatment.

We will extract DNA from each of the xQTL experiments using a modified sample homogenization protocol to account for large input volumes. Sequencing libraries will be prepared

(KAPA hyperprep) and sequenced on Illumina NovaSeq machines to 200x coverage. Sequencing and variant calling will follow established trimming, quality-filtered, and mapping methods to the latest SWD reference genome (Czech and Exposito-Alonso, 2021).

The analytical approach will follow the xQTL protocol established for Drosophilids (Macdonald and Long, 2022; Macdonald et al., 2022). SNPs and indels will be called jointly using *bcftools* and *mpileup*. The core signal of xQTL mapping experiments are differences in allele frequencies between 'controls' and 'extremes'. We will use beta-binomial GLMs run over windows of 10kb with step sizes of 5kb to identify resistance alleles (Macdonald et al., 2022; Hanson et al., 2025). We will identify significant xQTL as those with divergence exceeding FDR (see Figure below). xQTL outlier regions will be further refined to causal alleles through filtering and application of machine learning tools for predicting phenotypic effects of genomic variants (Beets et al., 2025).

Leveraging bioassays to identify resistance alleles

Working with Drs. Nottingham and Schreiber, we will obtain samples of control ('non-exposed') and survivor ('resistant above LC99') SWD individuals from 5-7 farm sites in early Fall. We will pool non-exposed and resistant individuals from each farm site and extract DNA. Library preparation will be conducted as above and we will prepare for sequencing and bioinformatic analysis in year 2.

Industry Benefits:

This project will provide WA raspberry growers with information and tools to monitor and manage resistance in SWD while maintaining reliable pest suppression. Identifying genetic markers associated with resistance provides the information necessary for (i) rapid, low-cost genetic testing for resistance; (ii) spatial and temporal monitoring of resistance evolution to guide management decisions; and (iii) mechanistic insight into resistance pathways that can inform compound rotation and pyramiding strategies. This is the groundwork for future monitoring tools capable of detecting resistance before control failures occur, improving long-term decision-making and preserving the efficacy of existing chemistries.

Results will be delivered directly to industry through WRRC reports, a year-end technical summary, and presentations at the WRRC annual meeting and relevant extension workshops. All protocols and findings will be made available to consultants, field staff, and growers to support immediate integration into SWD management programs across the region.

Budget: Depending on the results of the 2026 field season, this project will last three years or less.

	2026	2027	2028
Salaries	$7,100	$7,170	$7,240
Benefits	$2,700	$2,730	$2,760
Operations	$7,500	$7,000	$7,000
Meetings	$	$500	$500
Total	**$17,300**	**$17,400**	**$17,500**

Type of Personnel: Research Associate 8.5% FTE: Salary support is requested for 1 month for Co-Investigator (Dr. Shahmohamadloo) to complete xQTL experiments and genomic data analysis. This position is paid at a rate of $5,900/mo with an additional benefits cost of $2,300/mo.
Type of Personnel: Undergraduate hourly researcher 4% FTE: Funds requested are to support an undergraduate researcher to assist with xQTL experiments, DNA extractions, and genomic library preparations. The requested funds will support an undergraduate for four weeks working 20 hours/week ($19.50 hourly + 2.9% benefits rate).
Operations costs are primarily for DNA extractions, sequencing library preparation, and genomic sequencing (estimated costs for Obj. 1 in Year 1: $9,800). Additional operations funds (requested from other sources) are needed for experimental supplies for xQTL experiments, shipping of bioassay SWD samples, and DNA extractions from bioassay SWD samples.

Funding and in-kind support: We have submitted a USDA NIFA grant (A1112) centered on using genomic data to enhance SWD resistance management across North America. We are simultaneously requesting funds from WBC to support similar overall objectives proposed here. Twist Biosciences has awarded a pilot grant to defray costs of genomic tool development once xQTL and field sequencing projects are complete (hence, no funds requested here). Twist, WRRC, and WBC grants would together cover the majority of the true project costs of the work proposed with direct benefits to Washington State berry growers. Rudman is currently supported by a National Institutes of Health grant (#R35 GM147264) which will provide the remaining FTE funding for Co-Investigator Dr. Shahmohamadloo, and undergraduate assistants, through late 2027. Dr. Rudman is not requesting salary support from WBC or WRRC and will contribute 8% FTE to this project as in-kind support. Drs. Nottingham and Schreiber have offered to provide SWD samples at no-cost.

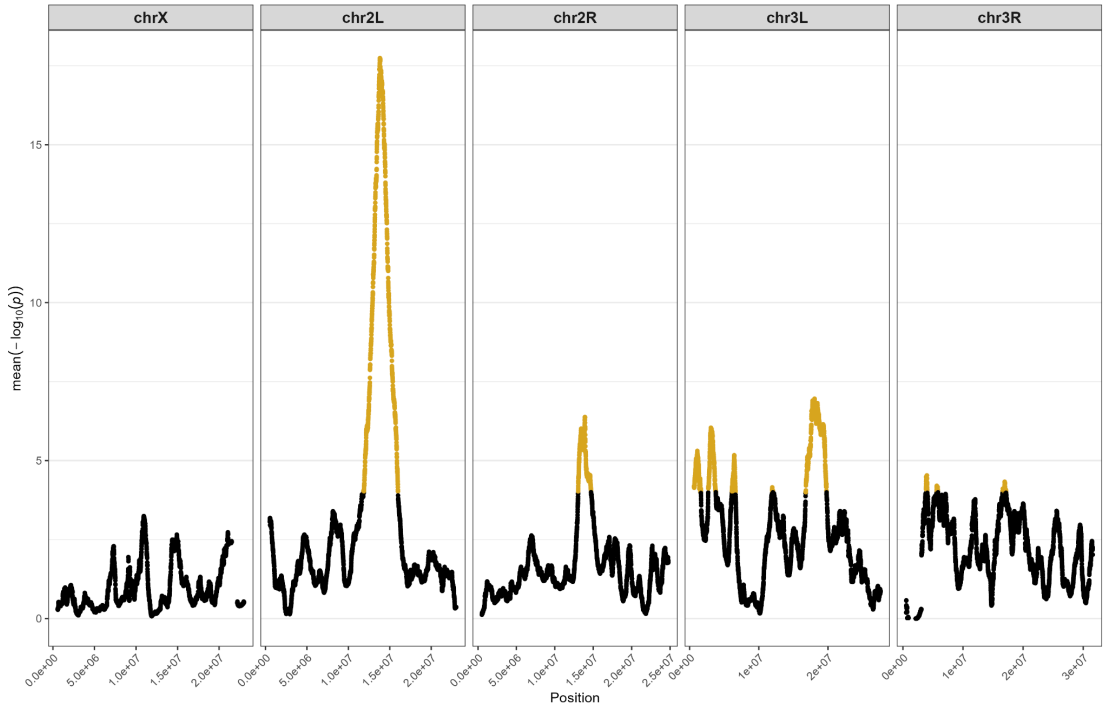

Figure 1: Preliminary results from an xQTL mapping experiment for spinosad resistance (Entrust) using *D. melanogaster*. Plot shows genetic variants by the strength of their association with resistance (significant sites in gold) by position on the chromosomes. This work has identified non-synonymous variants in the alpha5 nicotinic acetylcholine receptor subunit as most strongly associated with resistance to Entrust (peak on 2L above). This is a previously unknown mechanism of spinosad resistance in SWD.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Two-Spotted Spider Mite and Thrips in Raspberry

Duration (up to 3 years): 3 Starting Year: 2024 Ending Year: 2026

Funding Requested: Year 1: $17,000 Year 2: $17,000 Year 3: $17,000

	PI	Co-PI
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Cooperators:	Tom Walters, Walters Ag Research

Description (200 words max):
Include objectives and specific outcomes.

Based on feedback from the industry, there is an interest in an efficacy trial targeting thrips. There is an expectation that there will be a related proposal from Washington State University focusing on thrips biology and identification. Thrips have not historically been considered a pest of consequence in raspberry in Washington. However, we assume that the primary thrips involved is western flower thrips, Frankliniella occidentalis, or at least in the genus Frankliniella. The damage in 2023 was widespread in northwest Washington and was of great concern to growers and processors of raspberry. We propose to screen existing registered insecticides and additional unregistered products for efficacy against thrips. An additional complication is that in order to control thrips, applications will be required during bloom time limiting early season to products that are a low risk to pollinators. Many traditional thrip insecticides are not safe to use around bees.

Challenges associated with mites have increased so much that the WRRC has made this one of their top research priorities. The industry is interested in finding miticides that have new modes of action with 1day preharvest intervals and a high level of efficacy. Ideally, new application programs will have longer periods of residual control and be translaminar (products move into the leaf where a reservoir of active ingredient remains for a period of time providing longer control). And more ideally, the products can obtain MRLs in key export markets.

Justification and Background (400 words max):

Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Adult thrips are small (about 1-2 mm long at maturity), slender insects with fringed wings. They are generally white when young but brown or black when mature. The larvae are very tiny and difficult to distinguish without magnification. They feed by puncturing plant material, often blossoms, and sucking out the cell contents. Injured blossoms often turn into distorted fruit. When feeding on flowers, affected petals appear stippled or are scarred with brown streaks or spots. When unusually abundant in spring, thrips have been reported to cause blossom blasting. Fruit may be misshapen or distorted. Controls are most effective when applied at flowering; field control is not practical in eliminating thrips present at harvest. Applications at flowering has the additional challenge of applying insecticides that are safe to pollinators.

Historically, two-spotted spider mites (TSSM) have been a moderately important but manageable pest of raspberries. Red raspberries are naturally susceptible to mites. During harvest, machines travel through fields every 24 to 36 hours. Tractors applying pesticides twice a week and other field activities create a great deal of dust that exacerbate mite outbreaks. Growers spray for primocane suppression two to three times per season which forces mites living on weeds to move up into the canopy.

Recently, Washington red raspberry growers have had increased difficulty controlling two-spotted spider mites in commercial fields. The increased difficulty in controlling mites is thought to be due to one or two reasons. First, the “recent” movement of spotted wing drosophila (SWD) into raspberry fields has resulted in an increased number of insecticides applied during the 40 or so days of harvest. This pest is particularly challenging for growers of individually quick-frozen (IQF) fruit which has zero tolerance for SWD. This problem is even more acute for growers exporting fruit as maximum residue limits (MRLs) restrict products they can use. Some of the products that are considered essential to SWD control include pyrethroid insecticides which likely are fomenting mite outbreaks by disrupting the natural controls of mites. Second, the standard miticide available for use during harvest is Acramite (bifenazate), which may have developed resistance.

Current mite programs will use Vendex or Savey early in the season followed by two applications of Acramite and one application of Zeal in mid-season and abamectin postharvest. However, six populations of TSSM from Whatcom County raspberry fields were screened for bifenazate (Acramite) resistance as part of this project and all tested positive. New miticides have been registered for raspberry but lack the necessary MRLs to allow for export.

Relationship to WRRC Research Priorities (150 words max):

Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project directly addresses the WRRC RFP Category “Mite Management” which is a number one priority of the Commission.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

Objective 1. Collect information on TSSM biology – including a seasonal phenology on when mites first appear on raspberry to determine when the first applications should begin.

Objective 2. Generate data on miticide efficacy against TSSM in raspberry.

Objective 3. Generate data on insecticide efficacy on thrips in raspberry.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Biology Data. We propose to collect data on mites from six fields with applications starting at the first detection of mites until one month after harvest. Raspberry leaves and weed leaves from the base of the plant will be collected from fields, packaged and shipped to ADG where they will be put through a mite brush and counted for each life stage by species of mite. A seasonal phenology for mites on raspberries will be constructed. Since yellow spider mite, McDaniels spider mite, and European red mite have also been known as the pests of raspberries, mites will be counted by species as well as life stages (eggs, larvae, nymphs and adults). Predatory mites such as Neoseilulus fallacis will be noted.

TSSM Efficacy Data. We propose to conduct a raspberry efficacy trial against TSSM. The trial would be placed in a field with detectable levels of mites with applications beginning just as mites are first detected on the leaves. Applications would be applied by an over the row sprayer. The trial would be a randomized complete block design with four replications. The locations will be east of Lynden and east of Everson, WA where the PI successfully conducted trials in 2025. Products that are likely to be included are abamectin (Agri-Mek), acequinocyl (Kanemite), bifenazate (Acramite), etoxazole (Zeal), fenazaquin (Magister), fenbutatin oxide (Vendex), fenpropathrin (Danitol), hexythiazox(Savey), plinazolin, propargite (Omite), and some tolerance exempt miticides. The pyrethroids are being included to determine if their use flares mites as was demonstrated in WSCPR funded research on blueberries in 2020. Applications would follow labeled use patterns or proposed use patterns.

Thrips Efficacy Data. We are still working on the experimental design for this trial, specifically the products to be included in the trial. Insecticides registered on raspberry that are recommended by OSU for thrips control in caneberry include azadiractin, neem, Assail, Verdepryn, Admire Pro, Malathion, Delegate, and Transform. Other products registered on raspberry that have known efficacy against western flower thrips include Agri-Mek, Success, Exirel, Altacor, Sivanto, Actara, and Knack. Pyrethroid insecticides such as Mustang Maxx, bifenthrin, and Danitol are effective against thrips, however they have been shown by Schreiber to flare thrips in other crops. Additionally, pre-bloom and bloom time are key periods for controlling thrips and several of these products should not be used when pollinators are present or during bloom. There are several products that should provide suitable efficacy against thrips based on work that has been done with them on other crops such as potatoes and onions. Use patterns will probably require up to three applications for control.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Our goal is to develop biological information that will allow improved control of mites and thrips, identification of miticides appropriate for registration, submit miticides for registrations via the IR-4 Project and determine how widespread resistance to Acramite is present in mites in raspberry fields. This information will be communicated to growers by providing written reports for distribution by the Washington Red Raspberry Commission and in growers meetings such as the Co-op grower meeting and the Washington Small Fruit Conference.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$	$	$7,500
Time-Slip			
Operations (Goods & Services)	$	$	$990
Travel[2]	$	$	$650
Meetings			
Other[3]	$	$	$5,375
Equipment[4]			
Benefits[5]	$	$	$2,485
Total	$	$	$17,000

Comments: 3. Contract research for chemical applications and some evaluations by Tom Walters.

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

We have submitted a proposal to the Washington Commission on Integrated Pest Management to support the WRRC effort in the amount of $25,000.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Monitoring Raspberry SWD Populations for Insecticide Resistance

Duration (up to 3 years): 3 Starting Year: 2025 Ending Year: 2027

Funding Requested: Year 1: $10,000 Year 2: $10,000 Year 3: $10,000

	PI	**Co-PI**
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Cooperators:	Louis Nottingham, WSU Mt. Vernon Research and Extension Center

Description (200 words max):
Include objectives and specific outcomes.

Spotted wing Drosophila (SWD) appeared in Washington in 2009 and quickly became the most critical pest of berries. Initially the pest swamped the ability of growers to control the pest. Eventually growers learned to control the pest through the heretofore unheard of levels of insecticide applications to blueberry and raspberry. A typical conventional SWD program will have six applications of insecticides. The specter of resistance looms larger in raspberry due to the more susceptible nature of the pest and the few insecticides registered for use on the crop.

WSU's Louis Nottingham and Alan Schreiber successfully proposed to continue to screen organic and conventionally managed SWD populations for insecticide resistance in eastern and western Washington blueberry farms. No one has screened SWD populations in raspberries for resistance previously. Schreiber proposed to screen SWD populations in raspberry fields from fruit ranches that have the most insecticidally intense programs, at locations with the highest risk for resistance. There is some reason to believe that raspberry populations may be at high risk for development of SWD resistance. First, SWD prefer or can develop easier on raspberry than blueberry. Second, raspberries have access to fewer insecticides than do blueberries and strawberries.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

There is zero tolerance for the presence of SWD in raspberry fruit. A single detection can result in a semi load of the crop being rejected. Raspberry growers producing for the export market face tremendous pressure to have no SWD in their fruit. Additionally, growers of berries destined for the export market have very limited selections of products to use due to maximum residue limits (MRLs). Raspberry growers producing for the export markets rely on a limited number of insecticides. Widespread resistance in SWD to spinosad and malathion has been reported in California (Gress and Zalon 2019, Gress and Zalon in review) and to Exirel and deltamethrin in Italy (Civolani et al. 2021). Anecdotal information exists for resistance to Mustang Maxx and other insecticides in berries in California including raspberries.

A national effort exists to screen SWD for resistance to insecticides which has screened SWD populations in California, Florida, Georgia, Maine, Maryland, Michigan, New Jersey, and North Carolina. Washington and Oregon are not included in the survey. A recent effort to screen SWD for insecticide resistance in Washington berries by WSU's Elizabeth Beers was not successful.
A group of small fruit entomologists have developed a standard protocol for monitoring insecticide resistance in SWD. The method is called Rapid Assessment Protocol for Identification of resistance in SWD (RAPID). It uses a single discriminating dose that can easily and quickly test field populations for the presence of resistance genes. The discriminating dose for malathion, methomyl (Lannate), spinetoram (Delegate), spinosad and zeta-cypermethrin (Mustang Maxx) have been developed for use in the test. This method provides results in 24 hours. This effort originated out of a Specialty Crop Research Initiative that seeks to advance the development of sustainable, integrated management strategies for spotted wing drosophila, SWD, based on biology. Schreiber was on the advisory board for the grant. Additionally, Schreiber used a very similar method for monitoring resistance in field populations of insect pests for his Ph.D. dissertation.

Results from the first year, 2025, indicated that SWD adults were surviving at significant levels that would seem to indicate some level of tolerance to multiple insecticides. These results were unexpected and different from what was found in blueberries-there are differences between blueberries and raspberries that might explain some of the differences. Nevertheless, the results from the first year's screening in raspberries indicated that more work is needed.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project directly addresses the WRRC RFP Category "Management options for control of the Spotted Wing Drosophila."

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

Determine if SWD has developed resistance to major insecticides used for its control.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

In this project we will follow what is called the Michigan protocol for the RAPID test. The 20 ml scintillation vials will be treated with 1 ml each of five formulated insecticides Malathion 8F, Lannate 2.4LV, Delegate, Entrust 22.5SC, and Mustang Maxx 0.8EC. Recently produced insecticides less than one-year-old will be used in all bioassays. At the request of the industry, Exirel and Imidan were included in the survey. The identical product will be used as is used in the blueberry SWD resistance monitoring. To prepare for treating the vials, insecticides will be dissolved in acetone for malathion, methomyl, and zeta-cypermethrin, or if they will not dissolve in this solvent we will use water with 1% v/v Induce spray adjuvant for spinetoram and spinosad. Ten or more adult D. suzukii flies from a single population will be placed in each vial and re-sealed with the cap. Wherever possible flies will be loaded in a humid environment, ideally >50% relative humidity, to reduce mortality. After 6 h in the vial (8 hours for spinosad), the number of flies that are alive, moribund, or dead will be counted.

The flies will be live trapped from raspberry fields. We plan to start sampling with a bias of more towards the end of harvest, when presumably resistant flies would be more prevalent if they are to be detected. It took some time to figure out the best lure and trapping techniques in raspberry. We believe we know exactly what we need to do in 2026 based on what we learned in 2025. With the 2025 knowledge and experience, we plan to expand the number of fields samples significantly in 2026. We hope to compare SWD response to insecticides from fields with varying degrees of insecticide inputs.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

If SWD is developing tolerance to key insecticides used for its control, it will undermine existing control program. NW Washington berries have the most intensive SWD programs outside of California, where widespread insecticide resistance has developed. This information, hopefully positive data, will be communicated to growers by providing written reports for distribution by the Washington Red Raspberry Commission and in growers meetings such as the CHS grower meetings and the Washington Small Fruit Conference.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$6,000	$6,000	$6,000
Time-Slip			
Operations (Goods & Services)	$500	$500	$500
Travel[2]	$1,500	$1,500	$1,500
Meetings			
Other[3]			
Equipment[4]			
Benefits[5]	$2,000	$2,000	$2,000
Total	$10,000	$10,000	$10,000

Comments:

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

This is jointly funded by the WCIPM with Dr. Louis Nottingham for blueberries in NW Washington, Schreiber by the WBC for blueberries in eastern and southwestern Washington. This proposal to the WRRC covers raspberries.

Weeds

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Management of common weeds in the Polygonaceae family in red raspberries

Duration (up to 3 years): 3 Starting Year: 2025 Ending Year: 2027

Funding Requested: Year 1: 8672 Year 2: 10832 Year 3: 6665

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Cooperators:	

Description (200 words max):
Include objectives and specific outcomes.

Over the past decade, weeds in the Polygonaceae family such as ladysthumb (Persicaria maculosa), wild buckwheat (Fallopia convolvulus L.), and prostrate knotweed (Polygonum aviculare L.) have become increasingly more common in red raspberry fields. This project has two objectives: 1.) Evaluate the effectiveness of several herbicide programs consisting of currently registered active ingredients for red raspberries to manage ladysthumb, prostrate knotweed, and wild buckwheat, and 2.) Evaluate the effectiveness of different application timings of post-emergence applications (paraquat) on wild buckwheat. The outcomes of this project will be improved knowledge of these weeds (1 year), identified herbicide programs for management (2-3 years), and reduced presence of these weeds in red raspberry fields (5+ years).

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Weeds compete with raspberries for water, nutrients, space, and light, causing yield reductions and indirectly degrading fruit quality. The industry typically grows one of six varieties, all of which are floricane fruiting types. The first flush of primocanes is typically chemically removed ("cane burning"), but the second flush is allowed to grow up into the canopy alongside the floricanes. During this time, herbicides cannot be used as they would have a negative impact on the growing primocanes.

Over the past decade, growers have reported an increase of three Polygonaceae weed species (Persicaria maculosa, Polygonum aviculare, Fallopia convolvulus). Two of these weeds have prostrate or trailing growth habits that can intertwine within the raspberry plant canopy. Mature wild buckwheat seed has been shown to become 100% non-viable within six years of burial, with reductions of 15% in just three years. Prostrate knotweed follows a similar pattern, with <20% reduction in buried viable seed within three years, but the authors noted that burial depth is a factor, with seed buried deeper having higher survival1. Ladysthumb, unlike the other two already mentioned, can survive for decades in undisturbed soil, but it has also been shown to survive at much shorter intervals in regularly tilled soils. So, if seed production is eliminated or dramatically suppressed, populations can be effectively suppressed in a relatively short time for most of these species.

Based on phenological monitoring of these three species in 2025 with support from WRRC, it was identified that floricane fruiting red raspberries have two periods when they are most susceptible to the establishment and flowering of these weeds: 1.) after cane burning when subsequent flushes of primocanes are allowed to become established, and 2.) during harvest. Strategies to suppress these species prior to and during these periods should be the ultimate goal, and will need to rely on a combination of pre- and post-emergent herbicides. 2025 field trials found that rescue clean up sprays with post-emergent herbicides after harvest still resulted in viable seed production despite effective impact on established weeds. The proposed work has an updated timeline to finish in 2027, with the trials in objective 1 repeated across two years (2026-2027).

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

Weed Management is a #2 priority. This project specifically addresses the priority of "wild buckwheat" and "…in in-season post-emergent control". This project was developed after feedback from industry representatives, and this is a parallel project to one currently being funded by the Washington Blueberry Commission.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

1. Evaluate the effectiveness of several herbicide programs consisting of currently registered active ingredients for red raspberries to manage ladysthumb, prostrate knotweed, and wild buckwheat.
2. Evaluate the effectiveness of different application timings of post-emergence applications (paraquat) on wild buckwheat.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Herbicide Efficacy (Obj. 1)
One field in Whatcom County with a high population of ladysthumb, prostrate knotweed, and wild buckwheat will be utilized. Plots will be 20'X5', contain at least one target weed, and each treatment will be replicated five times and setup in a randomized complete block design. Herbicides will be broadcast using a CO2 sprayer (22 PSI, 52 GPA). Additionally, a weed-free control will be included to monitor weed emergence and development. Herbicides will consist of currently registered products (List placed in the linked table since it cannot be included in this PDF: https://docs.google.com/spreadsheets/d/10tGUqJ3nG0baCfVj_4sxlExqLORHgs7mp1BKhqSITV4/edit?usp=sharing). Treatments will begin in early spring and continue until harvest begins.

Weed density (of target weeds) and height will be quantified the day before herbicide applications by randomly placing two 2.69 ft2 quadrants in red raspberry rows for each replication. Fourteen days after application, weeds will be counted again, and biomass samples will be collected. Samples will then be weighed, dried in an oven (35°C) for 1 week, and then weighed again. Additionally, two ~65 ft2 areas within the row will be marked with flags and field paint. These areas will be used to provide a visual assessment of percent control at seven-day intervals after each application timing. Seed production assessment can also be performed by extracting seed from biomass samples after drying. 100 seed weights and total seed weights will be recorded to estimate total seed produced. A subsample of the 100 seeds will be assessed for viability by placing seeds in petri dishes with distilled water for 10 days, followed by the addition of gibberellic acid on day 10; at 14 days, tetrazolium stain will be applied.

Post-Emergent Herbicide Timing Trial (Obj. 2)
Continuing work performed in 2025, paraquat will be applied at 4 pts/A (22 PSI, 52 GPA) using a backpack-mounted CO2 sprayer. Applications will occur at various phenological stages (2, 3, 4, 6, 12, 20 leaves) and all compared to a hand-weeded control. Plots will be 20'X5' and each treatment will be replicated five times setup in a randomized complete block design.

Before herbicide application, individual weeds (minimum three per plot) will be identified and flagged. These plants will then be assessed for growth, maturity, and seed production throughout the course of the growing season. Plots will be visually assessed for suppression of polygonum weeds at seven-day interval after treatments.

Results will be presented at the 2026 Lynden Ag Show/Washington Small Fruit Conference.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Washington red raspberry growers face increased production costs and need to identify, adopt, and employ weed management strategies that help reduce these costs. This project will identify effective herbicide programs to suppress three common polygonum weeds and the proper application timing for post-emergent herbicides. This will result in reduced pressure and seed production of these weeds in raspberry fields. Additionally, raspberry producers will be able to make better-informed decisions as to when to apply herbicide to maximize impact on weeds. Results from this project will be posted in WSU's Whatcom Ag Monthly newsletter as well as presented at the Lynden AG Show.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	7456	4588	
Time-Slip	0	0	
Operations (Goods & Services)	0	0	
Travel[2]	0	0	
Meetings	0	0	
Other[3]	0	0	
Equipment[4]	0	0	
Benefits[5]	3376	2077	
Total	10832	6655	

Comments: 1/Salary, AP, 13% FTE for 12 months $7456
4/ Benefits @ 45.3% $3376
Only detailed for Year 1

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

None

Physiology

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Biostimulant Strategies for Enhancing Raspberry Stress Tolerance

Duration (up to 3 years): 2 Starting Year: 2026 Ending Year: 2027

Funding Requested: Year 1: $27,834 Year 2: $29,243 Year 3: 0

	PI	**Co-PI**
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Cooperators:	David Bryla, USDA-ARS Research Horticulturist

Description (200 words max):
Include objectives and specific outcomes.

Biostimulant application represents a promising strategy to help raspberry plants withstand environmental stresses such as heat and cold. Prior work in the DeVetter lab has shown encouraging results with certain biostimulant products in raspberry, blackberry, and blueberry. However, questions remain regarding the effectiveness of other commercial products and how well preliminary results translate to real-world, field conditions. The aim of this project is to evaluate and develop practical recommendations for the use of commercial biostimulants to mitigate heat and cold stress in raspberry production. This aim will be addressed through the following three objectives: 1) Screen multiple commercial biostimulants to determine their efficacy in reducing heat and cold damage; 2) Conduct field experiments assessing the effects of promising biostimulants on raspberry response to heat and cold stress; and 3) Disseminate project findings and recommendations to the raspberry industry. By systematically and objectively evaluating biostimulants and extending results to growers, this project will provide science-based information to reduce crop losses from extreme weather and strengthen resilience within the northwest Washington raspberry industry.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

This proposal builds on our collaborative research on heat and freeze damage mitigation, with a specific focus on biostimulants. Biostimulants are known to "prime" plants, enhancing their tolerance to environmental stress such as high temperatures (Hilker et al., 2016). Our previous work demonstrated that two products, Fruit Armor™ (97% glycine betaine) and KelpXpress (derived from Ascophyllum nodosum), were effective at improving thermotolerance in juvenile raspberry plants exposed to high temperatures in controlled greenhouse trials (Makonya et al., 2025). Treated plants produced 3–31% more biomass compared to untreated controls, and both products outperformed Optysil (a.i. silicon). In a separate field trial with 'Victoria' blackberry in Skagit, WA, foliar applications of Fruit Armor™ at the highest label rate one week before a forecasted freeze event reduced floral bud damage by 5.5% relative to untreated plants (Rojas-Barros et al., 2025). This reduction was estimated to translate into approximately 0.5 pounds of additional fruit per plant. Another trial in the Small Fruit Horticulture lab showed that KelpXpress improved pollen germination in 'Aurora' blueberry exposed to simulated heat stress in growth chambers compared to untreated plants (Evalt et al., unpublished).

Together, these findings provide strong evidence that biostimulants could be a practical tool growers can apply with existing farm equipment to improve plant stress tolerance. However, important questions remain. Specifically, it remains to be determined how these results translate under diverse field conditions, and whether other products offer similar benefits for floricane-fruiting raspberry in northwest Washington exposed to heat- and low-temperature stress. This proposal addresses those knowledge gaps by systematically evaluating a broader range of biostimulant products in both greenhouse and field environments. The project team will share results directly with growers and crop advisors through outreach events and publications, fostering information exchange and building confidence in adopting products with demonstrated effectiveness.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This proposal does not directly align with any specific WRRC research priorities; however, it was highlighted as a potential area of interest during the 2025 research review. It is most closely associated with Tier 3 priority, "Alternative Management Systems," as biostimulants represent an emerging tool for mitigating abiotic stresses such as heat and cold.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

The aim of this project is to evaluate and develop recommendations for the use of commercial biostimulants to mitigate heat and cold stress in raspberry production. Specific Objectives and Timelines are outlined below:

1. Screen multiple commercial biostimulants to determine their efficacy in reducing heat and cold damage (to be completed in 2026).
2. Conduct field experiments assessing the effects of promising biostimulants on raspberry response to heat and cold stress (to be completed in 2027 leveraging results from the 2026 screening).

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Objective 1. We will screen a broad set of commercial biostimulant products so that future field trials focus only on the most promising options. With input from growers and crop consultants, we will select representative products across nine categories: humic substances, organic waste materials, beneficial chemical elements, chitin/chitosan derivatives, seaweed extracts, inorganic salts, anti-transpirants, plant growth-promoting microorganisms, and free amino acids/nitrogen compounds. Screening will occur via two trials in 2026: one focused on heat stress, the other on freeze stress. 'WakeField' will be used given it has shown higher sensitivity to heat and cold in our research.

Trial 1 (Heat Stress): A randomized complete block design (RCBD) experiment with eight single-plant replicates and 10 treatments (nine products plus a water control) will be established at WSU NWREC. Potted plants will be acclimated in the greenhouse for one month, then treated per the manufactures' instructions at the highest label rate to elicit a response. One week after treatment, plants will be moved to growth chambers simulating a heat wave (daily ramp-up to 100°F, cooling to 65°F at night, repeated for four days). Plants will remain fully irrigated to isolate heat effects. Measurements include photosynthesis, chlorophyll fluorescence, and stem water potential. After two months, plants will be harvested to measure shoot and root biomass.

Trial 2 (Freeze Stress): A RCBD experiment will be established in a commercial field in Lynden using the same 10 treatments applied to ~30 ft-long plots replicated four times. Products will be applied at the highest label rate. One week later, canes will be collected for differential thermal analysis (DTA) to assess freeze tolerance.

Objective 2. Field trials in 2027 will build on Objective 1 results. The three most effective products plus a water control will be tested with a grower cooperator in Lynden, WA. Treatments will be applied to ~56 ft-long plots, replicated four times in a RCBD. Applications will occur one week before a forecasted heat wave or, if none occurs, heat will be simulated using convective units (95°F for 4 hours over two days). Measurements will include plant physiology, yield, berry quality (size, scald, shrivel, wilt), and juice chemistry. In early winter, plots will be re-treated and sampled to evaluate freeze tolerance using DTA.

Objective 3. Results will be shared annually at grower conferences, field days, and through publications such as WSU Whatcom Ag Monthly and the NW Berry Foundation Small Fruit Update.

Industry Benefits (150 words max):

Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

This project will provide objective, science-based information on the ability of commercial biostimulants to mitigate heat and cold damage in floricane-fruiting raspberry. The project team is committed to effective information transfer and will share results and subsequent recommendations through multiple channels. Presentations will be delivered at the annual Washington Small Fruit Conference and regional field days. To further expand access, the team maintains a dedicated outreach website on heat stress mitigation titled "Beat the Heat" (https://extension.wsu.edu/beat-the-heat/). Project updates and resources will be made freely available on this site, with regular announcements and newsletter articles also pushed through the WSU Whatcom Ag Monthly and the NW Berry Foundation Small Fruit Update to maximize reach and impact. By combining research with clear communication, this project will equip growers and crop advisors with practical recommendations, build confidence in biostimulant use, and strengthen resilience in raspberry production systems across northwest Washington.

Budget

Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$4,340	$4,493	
Time-Slip	$17,304	$17,996	
Operations (Goods & Services)	$2,035	$2,425	
Travel[2]	$350	$350	
Meetings	0	0	
Other[3]	0	0	
Equipment[4]	0	0	
Benefits[5]	$3,825	$3,979	
Total	$27,834	$29,243	

1/Salary for technician (Emma Rogers) in the Small Fruit Horticulture program at 100% FTE for 1 month each in Years 1 and 2. Monthly salary is $4,320. Rogers will support the graduate student with field and lab data collection and rates reflect annual 4% salary increases; Summer hourly timeslip wages for PhD student calculated at $33.28/hour x 40 hours/week x 13 weeks (the summer term is 13 weeks; spring and fall salary is secured).

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:

Include awarding agency name, amount requested/awarded, and any relevant notes.

Another grant, funded by the Washington State Department of Agriculture Specialty Crop Block Grant Program (WSDA SCBG), will expand prior biostimulant research in raspberries. The specific objectives of this WSDA SCBG project are to: 1) Identify the optimal timing for biostimulant applications aimed at protecting crops from heat stress, and characterize their effects on raspberry physiology and yield; and 2) Develop and disseminate evidence-based recommendations for using biostimulants to mitigate heat damage in raspberry production. This project will run from September 30, 2025, through September 29, 2027, and will be conducted in a raspberry field in Prosser, Washington, where heat stress is a consistent challenge. Specific products to be tested are Fruit ArmorTM (97% glycine betaine) and KelpXpress [primary ingredient is brown algae (Ascophyllum nodosum) extract], as these products showed efficacy in a prior greenhouse trial. This project was funded for the amount of $240,299. Work outlined in this commission proposal is not duplicative and expands ongoing work.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: From Farm to Freezer: Identifying Key Factors and Developing Screening Protocols for High-Quality Raspberry Fruits

Duration (up to 3 years): 2 Starting Year: 2026 Ending Year: 2027

Funding Requested: Year 1: $26,492 Year 2: $27,281 Year 3: 0

	PI	**Co-PI**
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Cooperators:	Germán Sandoya, Associate Professor at the University of Florida and future Endowed Raspberry Breeder at Washington State University. Other collaborators include Michael Hardigan and David Bryla; USDA-ARS; Michael Dossett, BC Berry Council; and Lisa Jones, Northwest Plant.

Description (200 words max):
Include objectives and specific outcomes.

Washington State's raspberry industry depends on producing premium fruit that meets strict quality standards for the individually quick frozen (IQF) market. Grades A and B IQF raspberries command the highest price premiums, yet breeding cultivars with consistently high IQF quality remains a challenge due to a limited understanding of the traits that influence fruit integrity and resistance to shattering. This project seeks to address that gap by identifying key factors associated with premium raspberry fruit quality and developing a practical method for breeders to evaluate this trait. This will be achieved through the completion of three project objectives: 1) Identify fruit traits associated with high-quality IQF raspberry; 2) Develop and validate an efficient, lab-scale phenotyping protocol for evaluating IQF quality; and 3) Disseminate project information to the caneberry industry and breeding community. Outcomes will include new knowledge of fruit traits linked to IQF quality and a freely available phenotyping protocol to support breeding programs. Results will be shared annually at the Lynden Ag Show/Small Fruit Conference, through breeder meetings, and via publication in an open-access journal, ensuring broad accessibility and impact.

Justification and Background (400 words max):

Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Washington State leads the nation in processed red raspberry production, with machine-harvested fruit contributing significantly to rural livelihoods and the regional economy. In 2024, 73 million pounds were harvested from 8,800 acres, with a three-year average production value of $429.5 million (USDA NASS, 2025). The long-term success of this industry depends on producing superior quality fruit that commands price premiums. Grades A and B IQF raspberries, which require less than 10% and 20% broken pieces by weight, respectively, are the most valuable categories in the raspberry processed market. However, breeding high-yielding cultivars with consistently high IQF quality and minimal shattering has proven elusive. Both public and private breeding programs would benefit from improved knowledge and protocols to enable more efficient selection of elite material with superior IQF performance. This project addresses that need by identifying traits associated with high-quality IQF raspberry and developing a method for breeders to assess this trait.

Raspberry fruit quality is often linked to firmness, which reflects maturity at harvest and cultivar genetics (Bañados et al., 2002). Yet firmness alone does not reliably predict IQF outcomes, as fruit may still shatter during the freezing process or in frozen storage. Earlier work by Robbins and Sjulin (1989) suggests that drupelet height and number, receptacle cavity dimensions, and pit weight contribute to cohesive strength, potentially influencing IQF quality and storage performance. Additional factors such as surface hairs from style remnants, drupelet number, and contact area between drupelets have also been implicated in fruit cohesiveness (Robbins et al., 1988). Calcium has also been associated with fruit integrity, but recent studies show accumulation primarily in the receptacle, with limited translocation into the fruit even when fertilizers are applied during peak uptake periods (Dias Da Silva et al., 2024; Rojas-Barros et al., 2025). Despite this physiological barrier, further investigation into the relationship between fruit calcium levels and integrity is warranted to clarify its role and inform fertilizer practices.

Overall, an in-depth exploration of morphological, anatomical, and physiological factors contributing to raspberry fruit integrity for IQF markets is lacking but achievable through phenotypic evaluation and predictive modeling. Developing a robust screening protocol for these traits will establish genotype-to-phenotype relationships and strengthen breeding efforts aimed at improving raspberry fruit quality.

Relationship to WRRC Research Priorities (150 words max):

Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This proposal addresses the Tier 1 priority, “Cultivar Development: Key characteristics include summer bearing, high yielding, winter hardy, machine-harvestable, disease and virus resistant, and superior processed fruit quality, as well as season extension.” Particular emphasis will be placed on elucidating traits associated with fruit integrity and processed fruit quality for IQF. In addition, the proposal addresses the Tier 3 priority, “Nutrient management: Update specs for timing, varieties, application techniques, calcium levels, and nutrient balance.” Tissue calcium concentrations will be monitored to assess whether fruit calcium levels are associated with improved integrity and reduced susceptibility to shattering.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

This project seeks to identify traits that contribute to premium raspberry fruit quality and develop an efficient method for breeders to assess for this important trait. Specific objectives and timelines are included below:

1) Identify fruit traits associated with high-quality IQF raspberry (to be completed in 2026 and repeated in 2027).
2) Develop and validate an efficient, lab-scale phenotyping protocol for evaluating IQF quality (to be completed in 2027 leveraging results from 2026).

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Objective 1. This objective utilizes a two-part approach to identify traits linked to fruit integrity and the impact forces fruits experience during commercial harvest and freezing. Part 1 will entail evaluation of a training population that includes 15-20 raspberry cultivars and advanced selections grown in northwest Washington (Lynden and Mt. Vernon's GWAS trial). Selected genotypes will represent a gradient of IQF performance, from excellent to poor, and include material from WSU, USDA-ARS, and BC breeding programs, as well as cultivars Kulshan, WakeField, and Meeker. Each cultivar will be measured for characteristics that past research has linked to fruit strength and firmness. These include fruit surface features (e.g., style remnants or “hairs”), drupelet height, depth, number, and cohesion, receptacle cavity size, pit weight, and cell wall structure using light microscopy. Fruit weight, firmness, volume, and overall shape (conical vs. round), along with calcium content will also be recorded. Measurements will be collected from ripe fruits in Year 1 and repeated in Year 2. Part 2 will focus on measuring impact forces during commercial harvesting and freezing. This will be done in Year 1 at 2-3 locations in Lynden using a protected berry impact recording device (Alpha AgTech, Athens, GA). This tool will quantify the forces fruits are exposed to during harvest and processing. Resultant data will guide the development of a labscale tool that mimics commercial harvest and freezing conditions.

Objective 2. At the end of Year 1, data will be analyzed to identify which traits most strongly influence fruit integrity, firmness, and potential IQF quality. Predictive models will be built using statistical packages in R and, if needed, machine learning tools to handle complex data. The most important traits will then be used to design a practical, lab scale phenotyping protocol that breeders can adopt. Validation will occur in Year 2 and will involve dropping frozen fruit to simulate harvest and IQF processing line impacts, as measured with the recording device in Objective 1, and comparing predicted versus actual shattering rates.

Objective 3: Results will be shared annually at grower conferences and field days, including the Washington Small Fruit Conference. Growers will benefit by learning which fruit traits contribute to IQF quality, and whether management like calcium fertilization can influence them. At the end of the project, a free, publicly available protocol will be distributed digitally to breeders and shared broadly through trade journals and scientific publications.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

This project will elucidate the factors that contribute to premium raspberry fruit quality for IQF, with the goal of generating a freely accessible phenotyping protocol. These outcomes will directly support raspberry breeding programs and, in turn, benefit the processed raspberry industry through the release of improved cultivars with superior IQF quality. Information will be shared annually at the Lynden Ag Show/Small Fruit Conference and through targeted meetings with breeders on the project team, ensuring timely communication with both industry stakeholders and the research community. The developed protocol will also be published in an open-access journal, providing unrestricted access to the methods and enabling broad adoption across breeding programs. The protocol will also be shared via the Genome Database for Rosaceae and North American Raspberry and Blackberry Association email listservs.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$2,160	$2,246	
Time-Slip	$17,304	$17,996	
Operations (Goods & Services)	$3,900	$3,800	
Travel[2]	$350	$350	
Meetings	0	0	
Other[3]	0	0	
Equipment[4]	0	0	
Benefits[5]	$2,778	$2,889	
Total	$26,492	$27,281	

1/Salary for technician (Emma Rogers) in the Small Fruit Horticulture program at 100% FTE for 0.5 month each in Years 1 and 2. Monthly salary is $4,320. Rogers will support the graduate student with field and lab data collection and rates reflect annual 4% salary increases; Summer hourly timeslip wages for PhD student, Ben Weiss, calculated at $33.28/hour x 40 hours/week x 13 weeks (the summer term is 13 weeks; spring and fall salary is secured).

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

A parallel grant was submitted to the Washington State Department of Agriculture Specialty Crop Block Grant (WSDA SCBG) program in 2026 but did not advance beyond the pre-proposal stage (no reason was provided; request was ~$250K). Portions of the work described in this proposal were also submitted to the Northwest Center for Small Fruits Research (NCSFR) in 2025 (total request was $200,418). Although the reviews were positive, none of the new proposals submitted to NCSFR that year were funded due to federal budget cuts. DeVetter intends to re-submit this proposal to NCSFR in 2026. Lastly, some of the genotypes used within the training population will be sourced from the WSDA SCBG Genome-Wide Association Study (GWAS) led by Hoashi-Erhardt, which is already funded for the period 9/30/2024–9/29/2027 (award amount ~$250K).

Pathology

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Control of Cane Blight in Red Raspberries

Duration (up to 3 years): 3 Starting Year: 2024 Ending Year: 2026

Funding Requested: Year 1: $15,000 Year 2: $15,000 Year 3: $15,000

	PI	**Co-PI**
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Cooperators:	Lisa Jones, Pacific Berries, Lynden Enfield Farms, Lynde Tom Walters, Walters Ag Research, Anacortes

Description (200 words max):
Include objectives and specific outcomes.

A raspberry cane blight project was initiated in 2019 to develop means to control cane blight. After the first year of research, the research site was removed by the grower. This resulted in an entire year setback on the project as the same applications need to be made on the same plots for both the primocanes and the subsequent year's floricanes to effectively evaluate the treatments' efficacy. 2022 was the final year of the original project. Overall, efficacy results against cane blight were disappointing with only one treatment providing effective control. However, use of Velum Prime for cane blight control using timings for nematode control provided a great deal of reduction in root lesion nematode numbers. Luna Tranquility (same active ingredient as Velum Prime) and Miravis were the most effective products for reducing cane blight in raspberry.

Justification and Background (400 words max):

Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Cane blight, which is caused by the fungus Kalmusia coniothyrium, occurs on a wide range of crops including raspberry, blackberry, and roses, and was only recently recognized as a major pest on Washington red raspberries. Cane blight infection requires a wound, such as those that occur during machine harvest, to infect a plant. Infections commonly originate on primocanes during summer. Shortly after infection the fungus colonizes vascular tissue. The fungus will produce small black pimple-like spore producing bodies in the fall and overwinter on the cane. The fungus will continue to grow in the spring and it will slowly girdle the cane. The girdled cane will start to wilt and collapse during early fruit development. Symptoms will develop quicker during hot and dry weather. Uninfected canes and roots are not affected. The fungus can also live on the dead tissue such as cane stubble or debris in the soil. Cane blight rarely is a problem in hand-harvested fields. Rain or overhead irrigation during harvest has increased disease incidence because spores are disseminated in splashing water. Young canes are more rapidly infected while older canes of raspberry are more resistant to infection in the fall.

Northwest Plant Company cultivars (WakeField, WakeHaven), Driscoll's cultivars and Chemainus appear to have a comparatively high level of sensitivity to this disease. In 2015, older WakeField plantings where cane blight had not been managed had up to 40% yield losses. WakeField represents about 30% of Washington's raspberry acreage and up to 50% of the state production. There are non-chemical control options that can reduce infections including pruning out infected canes, avoiding excess nitrogen, adjusting harvester catcher plates to reduce wounding, leaving cane stubble as short as possible and minimizing humidity during infection periods. However, despite the use of these tactics the disease has become a worsening problem. The primary means of controlling the disease is expected to be fungicides. Currently, the products recommended for control of cane blight are Tanos (famoxadone (Group 11), cymoxanil (Group 27)) and QuiltXcel (propiconazole (Group 3) and azoxystrobin (Group 11)), although cane blight is not on either label. Tanos requires rotation with fungicides containing different modes of action. The only products registered on caneberries that have cane blight on the label are copper and lime sulfur products (14 total products between the two types of products.) However, lime sulfur cannot be applied in season and copper is not thought to be very effective. One Washington raspberry grower found that alternating Tanos with Switch (Group 9 and 12) and Pristine (Group 7 and 11) seemed to reduce cane blight.

Relationship to WRRC Research Priorities (150 words max):

Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project directly addresses the WRRC RFP Category "Foliar and Cane Diseases".

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

Generate data on fungicide efficacy against cane blight.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Lisa Jones, a Ph.D. plant pathologist with Pacific Berries, has carried out field and laboratory investigations on cane blight including the first identification of the disease on Wakefield raspberry in 2015. She has conducted lab bioassays screening selected fungicides against cane blight and found that Switch and Pristine were most effective, with Kenja (isofetamid (Group7)) and Tanos being intermediate in effectiveness and Decree (fenhexamid (Group 17)) and PhD (polyoxin D) were relatively ineffective. A concern with applications of these products is that they occur during timings for Botrytis. Applications of products like Switch and Pristine have implications for resistance management. Drs. Jones, Walters and Schreiber propose to screen various fungicide use patterns for their ability to control cane blight in bearing raspberries in addition to collecting biological information on this disease. In 2021, this effort was expanded to include efficacy of Velum Prime against root lesion nematodes. This will be expanded in the 2024 initiated trial. This is the only research being conducted against this disease on raspberries in the Pacific Northwest.
Recent research out of the southeastern U.S. on cane blight indicates that the approach Schreiber took, which is the use of Botrytis fungicides and Tanos applied during harvest, was probably not the best approach. Applying products during harvest when entry points for the disease created by harvesters occurred was assumed to be the most effective means of control. Based on caneberry research in the southeastern U.S., the new recommendations for cane blight are to start applications much earlier, more often, and use some different fungicides than were previously used. The new recommendations have applications start at delayed dormant (not at pre-bloom as before), then apply at 6 inch shoot length and again before pre-bloom, early bloom, full bloom, petal fall, and cover sprays through harvest. This program is probably ten applications as opposed the previous approach of six applications. The products recommended by southeastern caneberry pathologists are Abound, Cabrios, Pristine, and Quilt Xcel. Captan was described as having fair efficacy. Since this product is commonly used in blueberries, and should be included, as well as Miravis Prime and Luna Tranquility.
We have locations to conduct efficacy trials in two susceptible raspberry varieties, most likely WakeHaven and WakeField or Chemainus at separate locations. Products to be included in the trial are but are not limited to Abound, Cabrio, Pristine, Quilt Scel, Captan, Miravis Prime, and Luna Tranquility. The trials will be in Whatcom County. The trials will have four replications and will have a RCB design. A minimum trial length is two years because applications have to be made to the primocanes in year one which turn into floricanes in year two. The same applications need to be made to the same plots in both years. The final results will be a reduction of symptoms on the floricanes in year two. We estimate that 10 or more applications will be required to control this pest. A third year of testing would double the amount of efficacy data available.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Our goal is to develop a set of recommendations for control of cane blight on raspberry. This information would be provided to growers through WRRC disseminated information, at the Washington Small Fruit Conference and at grower meetings.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$3,000	$3,000	$8,000
Time-Slip			
Operations (Goods & Services)			
Travel[2]	$950	$950	$950
Meetings			
Other[3]	$10,000	$10,000	$3,410
Equipment[4]			
Benefits[5]	$1,050	$1,050	$2,640
Total	$15,000	$15,000	$15,000

Comments: 3. Contract research for chemical applications by Tom Walters.

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

We have submitted a proposal to the WCIPM for $18,000 to support this effort.
Pacific Berries will donate expenses and lab capacity for the trial for Dr. Jones.
Enfield Farms will donate the trial sites and cooperate with coordinating applications in the field locations.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Managing Cane Botrytis of Raspberry

Duration (up to 3 years): 3 Starting Year: 2025 Ending Year: 2027

Funding Requested: Year 1: $17,142 Year 2: $17,142 Year 3: $17,142

	PI	**Co-PI**
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Cooperators:	

Description (200 words max):
Include objectives and specific outcomes.

Botrytis cane blight, caused by the same pathogen, Botrytis cinerea, that rots fruits, is common in Washington raspberries. Lesions can weaken or kill lateral buds and laterals. Some varieties, such as Cascade Premier, Chemainus, Kulshan and WakeHaven have experienced serious yield reduction due to this disease, when many of the fruiting laterals fail to develop. Furthermore, Botrytis cane blight produces inoculum capable of infecting growing tissues and developing fruit the following year, contributing to fruit rot losses. Cane botrytis was a more severe problem in 2024 than in any year in memory. There are at least three potential reasons for this.

First, certain new raspberry varieties appear to be more susceptible to the disease than traditional varieties such as Meeker. It is not clear if the increased problems associated with variety is due to genetically based susceptibility or the physical structure of the plant that foments disease development. Second, environmental conditions were more conducive for development of cane botrytis in 2024. Two inches of rain fell in a short period in August, and in general late summer and fall of 2024 were extremely wet and promoted disease development. A third possibility is the widespread development of fungicide resistance in botrytis infecting berries.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Investigations into fungicide resistance in Botrytis (Drs. Mattupalli (WSU), DeLong (USDA)) have recently shown there is widespread resistance to fungicides in FRAC groups 7, 9, 11 and 12 in blueberries and in raspberry. This dangerous situation will seriously constrain fungicide programs for Botrytis fruit rot, especially in years when conditions favor disease. It is critical that botrytis cane blight management not exacerbate fungicide resistance in Botrytis.

Botrytis cane blight lesions typically start to appear late in July. Lesions continue to develop and expand through late summer and fall, when overwintering structures (sclerotia) develop. The sclerotia produce conidia throughout the winter and spring, spreading the fungus to new tissues. We propose to evaluate interventions at all of these stages.

Harvest treatments: Cane Botrytis lesions often begin to develop during harvest, so we will evaluate the ability of treatments (e.g., Jet Ag, Oso, PhD, Cueva, biologicals) to prevent lesions when applied during harvest.

Post-harvest cultural practices: We will evaluate effect of pruning and training time (mid-August or dormant) on botrytis lesion expansion. Our hypothesis is that removing floricanes early to expose canes to sun and dry air will reduce lesion initiation and/or expansion.

Protection of new growth: We will evaluate treatments (lime sulfur, Jet Ag, Oso, PhD, Cueva, biologicals) to protect new tissue from dormancy to bloom.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project directly addresses the WRRC RFP Category “Foliar and Cane Diseases”.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

Generate data on fungicide and cultural practice efficacy against cane botrytis.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Harvest Treatments: Provided that we have a raspberry fruit rot Botrytis trial in 2026, we will leverage that trial to evaluate harvest treatments for efficacy against cane Botrytis. At a minimum, we will evaluate cane botrytis on treatments including Captan, Jet-Ag and PhD in the last two applications. Depending on resistance management restrictions, we may also include products with single site active ingredients, such as Merivon, Luna Tranquility or Switch. Treatments will be selected in consultation with growers, crop advisors and registrants. Frequency and size of cane Botrytis lesions will be evaluated at the end of harvest and again in mid-September

Post-harvest Treatments: We will establish a trial of post-harvest management to reduce cane Botrytis lesion initiation and/or expansion through late summer and fall. Treatments may include:
1. Removing floricanes shortly after harvest, tie primocanes to wire and apply sanitizing agent such as Jet-Ag or a protectant such as Captan
2. Removing floricanes as above, but delay tying primocanes until dormancy
3. Cut middle sections out of floricanes shortly after harvest, remove tops and tie primocanes when dormant
4. Remove floricanes and tie primocanes when dormant.

For these treatments, cane Botrytis lesion numbers and lengths will be evaluated in mid-September and again mid to late October.

Protection of new growth: We will evaluate several treatments to reduce infection of new growth from dormancy until fruit rot programs begin at bloom. Treatments and timing will be selected in consultation with growers, crop advisors and registrants as above. Our initial thoughts include: An application during dormancy, B-E biweekly from early growth until mid-May (just before bloom fungicide programs begin). Lime sulfur will be used for dormant treatments; products for other treatments will include Jet Ag, Captan, PhD and biologicals. This trial may be evaluated by rating Botrytis damage to leaves or other tissues at the beginning of bloom. It may also be evaluated by rating Botrytis damage on the blossoms, since petals are quite susceptible.

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Our goal is to develop a set of recommendations for control of cane botrytis on raspberry. This information would be provided to growers through WRRC disseminated information, at the Washington Small Fruit Conference and at grower meetings.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$5,000	$5,000	$5,000
Time-Slip			
Operations (Goods & Services)	$3,000	$3,000	$3,000
Travel[2]	$1,142	$1,142	$1,142
Meetings			
Other[3]	$6,000	$6,000	$6,000
Equipment[4]			
Benefits[5]	$2,000	$2,000	$2,000
Total	$	$	$

Comments: 2. 12 trips * 142 miles * 0.68 per mile
3. Contract research for field research by Tom Walters.

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

Enfield Farms will donate the trial sites and cooperate with coordinating applications in the field locations.

Soils

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Fitting new nematicides into the Raspberry toolbox.

Duration (up to 3 years): 3 Starting Year: 2026 Ending Year: 2028

Funding Requested: Year 1: $10,575 Year 2: $12,975 Year 3: $10,575

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Cooperators:	Alan Schreiber, Ag Development Group

Description (200 words max):
Include objectives and specific outcomes.

We are proposing two types of trials, both to find tools for postplant nematode management in raspberries. We are prepared to conduct both types, but if the Commission will only fund one, we will do that.

1) Evaluate 'soft' nematicides for the ability to reduce root lesion nematode numbers and enhance primocane growth in a mid-cycle (ca 5 year old) field. Many soft or biological products are available on the market for nematode control; some of these have shown promise in other systems. We hope to find some that will either manage root lesion nematodes or enable plants to continue productivity despite damage.

2) Evaluate nematicides (including those requiring crop destruction) in an establishment trial at the former Boxx farm. This trial will include destructive sampling to evaluate biomass gain; something we cannot do in a commercial field. Treatments will include a first evaluation of Sygngenta's new TYMERIUM product on raspberry.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Nematodes are an important pest of red raspberry, particularly the root lesion nematode Pratylenchus penetrans, which reduces growth and productivity of plants, and is one of the causes of field replacement in Washington raspberries. Nematode management focuses on preplant treatments, but these are not always completely effective, and growers need postplant tools as well. Newer raspberry varieties are coming out with resistance to root rot and RBDV; these may well have longer lifetimes, if nematodes can be managed.

Vydate is effective and can be applied under a Special Local needs label until 2028. However, Vydate cannot be applied within 12 months of harvest, so it can only be applied through June of the establishment year, a very narrow window.

In our earlier work, we verified that Velum Prime was effective against P. penetrans in red raspberry, but it is the only product with known efficacy. Alan Schreiber's work on root lesion nematodes in potato identified several promising products, including Bronte (Rhinotec, Profarm), Nemaclean (Certis), and Votivo (BASF). We have also seen promising results with an Abamectin product from Vive Crop Protection, and have heard about a Harpin protien product, Employ. Unlike Vydate, these products can be used in bearing raspberry, making them potentially useful for managing mid-cycle infestations with P. penetrans.

Syngenta's new active ingredient, cyclobutrifluram, marketed as TYMERIUM, is a SDHI inhibitor (group N-3 nematicide, group 7 fungicide) with specific activity against numerous plant-parasitic nematodes. It has the potential to function well in the raspberry production system, although its mode of action is similar to Velum's. Any trial with TYMERIUM will need to be crop destruct, but our hope is that if effective, it will ultimately be labeled for raspberry.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This project directly addresses the nematode part of #2 priority "Soil Fumigation techniques and Alternatives-Methods to control soil pathogens, nematodes and weeds".

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

1) Identify promising soft nematicides growers can use to reduce P. penetrans numbers or improve raspberry growth in a nematode-infested field. While preliminary results from year 1 will be good guidance, they should be confirmed in a second year's trial.

2) Compare plant growth and P. penetrans suppression in a destructive trial at the former Boxx farm. This trial will include treatments requiring crop destruction, that cannot be applied in a commercial field.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

Soft Nematicide evaluations:
Year 1: identify and treat a mid-cycle raspberry field infested with P. penetrans. Pre-treatment samples will be collected, 40 plots, Feb., establish plots, treat beginning in early April, continuing per registrant's programs, post-treatment sample 1 month after spring applications and 1 month after fall applications. Evaluate in Zasada lab. Evaluate primocane height 3 x during season. Also evaluate # primocanes tied to top wire. Should we evaluate pruning fresh weight also? Trial to include 5-7 treatmens total, including UTC, Velum, Abamectin, Bronte, Nemaclean, Votivo, Employ; possibly a chitosan. This trial may be continued into year 2 or be repeated elsewhere in year 2, depending upon year 1 results.

Destructively sampled nematicide trial at Boxx Farm:
Year 1: Choose the field directly to the N of buildings (field suggested by Troy).
Sample winter wheat now growing in this field at several locations to verify presence and number of P. penetrans. In year 1 (2026), if nematode numbers are adequate, we will prepare the site for a destructive trial to be planted in fall 2026 or spring 2027. If nematode numbersare not adequate to support a trial, we may establish a pot-in-pot system, and inoculate individual pots with roots collected from infected plants (a procedure that was implemented successfully to establish the GWAS trial at NWREC). This would have the additional benefit of allowing for a non-inoculated check. This trial would include TYMERIUM, the new Syngenta product and also include treatments from the soft nematicide evaluations. Additionally, either a non-inoculated control or a Vydate-treated control will be included.

Year 2: Follow growth of this trial, primocane height, and collection of roots and soil for nematode quantification. Remove pots with plants at the end of 2027. Record above and below ground fresh Weight and collect roots and soil for nematode extraction and quantification

Year 3: Replicate/followup trial?

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

Currently, Velum Prime is the only product available for mid-cycle use in raspberry with known efficacy against P. penetrans. We hope to identify more, to give growers more flexibility and to prevent development of resistance to fluopyram (active ingredient in Velum Prime).

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	3000	3000	3000
Time-Slip	1500	2500	2500
Operations (Goods & Services)	4400	5000	2600
Travel[2]	1675	1675	1675
Meetings			
Other[3]		800	800
Equipment[4]			
Benefits[5]			
Total	$10,575	$12,975	$10,575

Comments: 1) Walters, 3% FTE, benefits included
Services (Zasada) - $40/sample for nematode extraction and quantification
2) Walters, 8 trips Anacortes to Lynden, 120 miles/trip, $0.70/mile. Zasada, mileage for two trips/year @ $0.70/mile (round trip from Corvallis is 720 miles)
Other (Walters) Land rent at Boxx years 2 and 3

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

We will solicit in-kind donations of product from registrants for these trials.
We plan to apply to WCIPM for funding in future years, which would reduce the funding requirement from WRRC.

Washington Red Raspberry Commission

2026 Research Proposal

Project Title: Directed Energy System for plant-parasitic nematode management in red raspberry

Duration (up to 3 years): 1 year Starting Year: 2026 Ending Year: 2026

Funding Requested: Year 1: $11,468 Year 2: _____ Year 3: _____

	PI	**Co-PI**
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Description (200 words max):
Include objectives and specific outcomes.

Soil fumigation is a critical tool for managing plant-parasitic nematodes in Washington raspberry production and is essential for the successful establishment and productivity of perennial plantings. The industry relies primarily on 1,3-dichloropropene (1,3-D) and chloropicrin; however, increasing regulatory pressure, rising costs, and uncertain availability of 1,3-D threaten the long-term viability of this management strategy. These challenges highlight the need for effective, non-fumigant alternatives that can be used within established fields.

This project will evaluate a highly novel, non-chemical nematode management strategy: the application of short pulses of electrical energy to soil using Pulse Electric Field (PEF) technology. PEF has been studied extensively in controlled environments and has demonstrated pest suppression in perennial systems, with commercial adoption for pest control in golf courses and railroads. However, its application for nematode management in raspberry has not been defined.

This research will establish safe and effective PEF application parameters for nematode control in established raspberry. Two delivery approaches will be evaluated: (1) direct energy application to soil across the root zone and (2) energy delivery through the foliage to the root system. Results will define crop-safe treatment thresholds and nematode suppression efficacy, advancing the development of a non-fumigant, in-season nematode management tool for raspberry production.

Justification and Background (400 words max):
Describe the issue you plan to address, why you plan to address it, and how this project relates to others in BC, Idaho, and Oregon. For continuing projects, note whether project scope or timeline has changed from previous proposals.

Plant-parasitic nematodes, particularly root lesion and dagger nematodes, are well-documented constraints to red raspberry productivity in Washington. These pests reduce plant vigor, shorten planting lifespan, leading to significant economic losses for growers. Current nematode management in red raspberry relies almost exclusively on pre-plant soil fumigation. While effective, fumigation is becoming increasingly expensive, logistically restrictive, and vulnerable to regulatory limitations. Additionally, the lack of effective in-season nematode control options leaves growers with limited flexibility to manage nematodes after planting, creating a critical vulnerability in raspberry production systems.

This project addresses that critical gap by advancing Pulsed Electric Field (PEF) technology as a novel, non-chemical strategy for managing plant-parasitic nematodes in red raspberry. PEF involves the application of short, high-voltage electrical pulses delivered between electrodes to soil or plant tissue, disrupting nematode cellular integrity. Previous controlled-environment research conducted by our group demonstrated the strong potential of direct soil PEF applications, achieving greater than 97% nematode mortality. These results provide compelling evidence that PEF can function as a viable alternative to chemical fumigants.

We also evaluated early versions of this technology in an established raspberry field in Lynden approximately a decade ago. Although the applications to 'Wakefield' were unsuccessful, the technology at that time was energy-limited and lacked the precision and power now available. Since then, PEF systems have advanced substantially and are currently deployed at commercial scales for nematode management in golf courses and weed control on railroads, demonstrating both operational feasibility and durability.

Building on this foundation, the proposed research will shift PEF from pre-plant soil treatments toward a safe, effective in-season management tool. In addition to soil-based applications across the root zone, we will evaluate energy delivery through foliage into the root system. Our greenhouse studies with tomato infested with the root-knot nematode showed that PEF applications at transplanting and two weeks later reduced nematode egg densities in roots at all tested energy levels, with the greatest suppression at 25 J cm^3 and no observed phytotoxicity. These results suggest that PEF may interact synergistically with plant tissues and the rhizosphere, concentrating energy precisely where nematodes are most active.

However, critical knowledge gaps remain regarding crop-specific tolerance thresholds, optimal delivery strategies, and long-term plant responses. Addressing these gaps is essential to develop PEF protocols that are both biologically safe and agronomically effective. This work will provide the scientific foundation needed to transition PEF from experimental promise to practical field adoption, reducing fumigant dependence for nematode management.

Relationship to WRRC Research Priorities (150 words max):
Include the tier of the relevant priority. See Appendix A: 2026 WRRC Research Priorities.

This proposal address the WRRC Tier 2 priority of soil fumigation techniques and alternatives. Our research has demonstrated that PEF may have broad spectrum activity against other organisms including insects and weeds. Therefore, it can also potentially address other priorities related to insect and weed management.

Objectives (200 words max):
What specific objectives will this project achieve? Which of those objectives will be addressed this funding year?

The overall objective of this project is to develop a safe, effective, and non-chemical, in-season management strategy for plant-parasitic nematodes in Washington red raspberry using Pulsed Electric Field (PEF) technology. Specific objectives are to: (1) determine crop-safe PEF energy thresholds for established raspberry plants; (2) quantify nematode suppression achieved through direct soil-based PEF applications across the root zone; (3) evaluate the efficacy of foliar-delivered PEF for transmitting energy to the root system for nematode control; and (4) assess short-term plant responses to PEF treatments, including phytotoxicity, plant vigor, and root health. Collectively, these objectives will define optimal application parameters for PEF in raspberry production and establish its feasibility as an in-season alternative to pre-plant fumigation. Successful completion of this project will provide the scientific foundation needed to reduce reliance on chemical fumigants and support sustainable pest management in Washington red raspberry.

Procedures (400 words max):
Describe the expected procedures, including a timeline of the work.

We will try to identify an established red raspberry field with both the root lesion nematode (Pratylenchus penetrans) and dagger nematode (Xiphinema bakeri). If this is not possible, we will focus on the root lesion nematode for the experiment. PEF treatments will be applied using the Directed Energy System (DES) developed by Lisi Global (Richland, WA). There will be four treatments: nontreated control, soil-soil PEF, foliar-soil low energy PEF, and foliar-soil high energy PEF. The energy levels will be applied at 200 V mm^{-1} and 80 Hz to achieve either 10 and 25 J cm^{-3}, energy levels already established to kill nematodes. The modes of energy delivery will be soil–soil, both electrical pins inserted into the soil and soil–foliar, one electrical pin into the soil and one into the foliar. Individual plants will be an experimental unit and there will be 10 plants/treatment.

Prior to the application of treatments, soil and root samples will be collected using a 1-inch corer. One core will be collected from each side of the plant and the cores will be placed in a bag. In the lab, nematodes will be extracted from roots and soil using the established methods of intermittent mist and Baerman funnel extractions, respectively. Treatments will be applied in late spring/early summer to allow for the measurement of plant response to treatments after application. After treatment, the following data will be collected:
- At one month intervals after treatment (at least 3 times) the plants will be visually rated for vigor. Depending on what is observed, rating scales (0-3) will be assigned to encompass plant stress such as leaf scorch, wilting, etc.
- Also at monthly intervals, plant physiology measurements will be collected. Physiological responses will be assessed through measurements of photosynthetic performance. The PSII photochemical efficiency will be determined as the maximum quantum yield of PSII (Fv/Fm) using a portable chlorophyll fluorometer (OS1p, Opti-Sciences Inc., Hudson, NH).
- The number of root lesion nematodes in roots and soil and dagger nematodes in soil will be determined one month after treatment and at the end of the season. Root and soil samples will be collected and nematodes extracted as described above.

Data will be analyzed by ANOVA and means separation by Tukey's Adjustment for multiple comparisons in R.

The timeline for the proposed research in 2026 is:
April/May - Identify a field to conduct the research. There are plants at WSU NWREC in Mount Vernon that are inoculated with root lesion nematode that can be used for the trial if needed.
May/June - First nematode collection and application of treatments.
June-Sept - Measure plant response to PEF treatment.
July and Sept - Collect samples for nematode quantification
Dec - Present findings at the Lynden Ag Show

Industry Benefits (150 words max):
Describe the benefits that the industry will receive from the research, including how results will be shared with growers.

This project will provide Washington's red raspberry industry with a practical pathway toward reducing reliance on pre-plant soil fumigation while maintaining effective nematode control. By developing Pulsed Electric Field (PEF) technology as a non-chemical, in-season management tool, growers will gain a new option to manage nematodes in established fields where no currently effective post-plant treatments exist. This added flexibility will help extend the productive lifespan of plantings, improve yield stability, and reduce economic losses associated with nematode damage. This project will deliver science-based guidance needed to move an innovative technology toward field adoption, strengthening the long-term resilience and competitiveness of Washington's raspberry industry.

Budget
Indirect or overhead costs are not allowed unless specifically authorized by the WRRC board.

	Year 1	Year 2	Year 3
Salaries[1]	$5,000		
Time-Slip			
Operations (Goods & Services)	$4,000		
Travel[2]	$2,468		
Meetings			
Other[3]			
Equipment[4]			
Benefits[5]			
Total	$11,468		

The project will be managed by Zasada and Benedetti who will be reponsible for organizing applications, collecting data, and writing reports and presentations. LisiGlobal will be contracted for applications. Moretti and Walters will serve in advisory roles assisting with site selection, data collection and analysis, and application parameters.
Salary - Funds are requested for salary for Zasada for approximately 70 hours of work (FTE 3%). Salary is also requested for Walters to help with monthly plant health assessments (decreases driving time of PIs; FTE 1%)
Operations - Funds are requested fro LisiGlobal to travel to Lynden and make applications.
Travel - Funds are requested for Zasada and Benedetti to travel to Lynden 4 times (~700 miles roundtrip @ $0.50/mile) and for hotel and per diem for Benedetti for 6 nights ($178/day).

1. Specify type of position and FTE.
2. Provide brief justification for travel requested. All travel must directly benefit the project. Travel for professional development should come from other sources. If you request travel to meetings, state how it benefits project.
3. Specify details of other expenditures.
4. Justify equipment funding requests. Indicate what you plan to buy, how the equipment will be used, and how the purchase will benefit the growers. Include attempts to work cooperatively with others on equipment use and purchase.
5. Includes tuition, medical aid, and health insurance for Graduate Research Assistants, as well as regular benefits for salaries and tie-slip employees.

Other Funding Sources:
Include awarding agency name, amount requested/awarded, and any relevant notes.

We recently finished a USDA NIFA Methyl Bromide Alternatives project focused on the application of PEF technology to ornamental perennial crops (2022-2025). This funding was the foundation for defining parameters that can now be applied to raspberry.