

# Oregon Processed Vegetable Commission Proposals 2025 - 2026

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**Proposals**

**Title: Evaluation of entomopathogenic fungi against seed corn maggots in sweet corn**

**Year initiated: 2024** **Current year: 2024-25** **Terminating year: 2025-26**


**Personnel:**

Name: Josephine Antwi
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Phone number: 541-567-6337
Academic rank (Asst., Assoc. or Full Professor): Assistant Professor


**Funding request for 2024-26: $39,419**

**Justification:** Oregon serves as an important region for sweet corn production in the US. As a high-value vegetable crop, damage done by insects on sweet corn can have significant economic implications, including crop yield and marketable quality. Seed corn maggot (*Delia platula*) is an important early season pest of sweet corn, attacking seed germ or underground portions of young seedlings that leads to high yield loses (Gill et al. 2013). Conventional insecticides and insecticidal toxins derived from *Bacillus thuringiensis* (Bt) have been fundamental in managing key sweet corn pests. However, heavy reliance on these control methods have resulted in increased cases of insect resistance, secondary pest outbreaks, and decline in natural enemies (Dara 2019). With the looming threat of losing neoticonitoids as an option to insect management, it is imperative to consider alternative management strategies and tools that could be used to enhance insect management.

Entomopathogenic fungi (EPF) are naturally-occurring fungi that are considered important microbial control agents (MCAs) or biopesticides against insects. *Beauveria bassiana* and *Metarrhizium sp. are* two of the most commonly used EPF, with some strains currently available as commercial formulations. The pathogenicity of various strains of *M. anisopliae* and *B. bassiana* against soil-borne insect pests such as corn rootworm have been promising (Pilz and Keller 2007; Rudeen et al. 2013). The use of EPF to manage seedcorn maggot, on the other hand, remains largely unexplored.

**Hypothesis and Objectives**:
The objectives of the proposed study are to (1) test the efficacy of 4 commercial strains of EPF containing *B. bassiana* and *M. anisopliae* as biopesticides against seedcorn maggot, and (2) to determine if use pattern of these products (i.e., seed treatment, in-furrow, or a combination of both) affects product efficacy. Fungal spores from these products are expected to antagonize seedcorn maggot use of corn seeds. Hence it is hypothesized that product use patterns will protect seeds from seedcorn maggots with objective (2) yielding the highest protection.

**Procedures:**

***Biopesticide delivery methods in the field*:**
Field studies will take place at HAREC. Untreated seeds of Biotech sweet corn will be used in this study. This variety was chosen because resistance or susceptibility to below-ground insect pests such as seedcorn maggot is unknown. However, Biotech is thought to provide protection against

lepidoptera pests (e.g., corn earworm) and herbicides. The experimental set up will comprise plots (treatments) consisting of 6 rows (each 25 ft long) with 4 replicates arranged in a randomized complete block design. Each EPF will be sprayed at recommended label rates (table 1).

Table 1. List of proposed treatments and application rates for seedcorn maggot

| Application type | Product | EPF active ingredient | Rate |
|---|---|---|---|
| Seed treatment | Met Master® | *Metarrhizium anisopliae* | 16 oz/acre |
| | [a]BioCeres WP® | *Beauveria bassiana* | 3Ib/acre |
| | BotaniGard 22WP® | *Beauveria bassiana* | 1 Ib/acre |
| | Fortenza® | *cyantraniliprole* | 0.2 mg/seed |
| In-furrow | | | |
| | Met Master® | | 10Ib/acre |
| | BotaniGard 22WP® | | 40 Ib/acre |
| | Warrior II | lambda-cyhalothrin | 1.6 oz/acre |

[a] the same rate will be used in-furrow

**In-furrow soil** applications will occur prior to planting. Here, an R&D $CO_2$ backpack sprayer (2-liter plastic bottle) containing the product mix will be directly sprayed into prepared furrows. Untreated corn seeds (no pesticide) will then be planted with a hand-held planter immediately following spraying and covered. For **seed treatment**, untreated seed corn will be coated with each EPF product, dried to ensure the products stick to the seeds, then planted as above. For the **combined treatment**, EPF-coated seeds (done in-house) will be planted in furrows previously sprayed with their respective EPF product. Two types of control treatments will be included in this study. First, untreated seed corn (lacking EPF or pesticides) will be directly planted. Secondly, an in-furrow spray treatment with lambda-cyhalothrin (Warrior II, Syngenta) will be applied to the soil prior to planting untreated seeds. Thirdly, seeds pretreated with cyantraniliprole (Fortenza, Syngenta) will be directly planted in untreated soil. Fortenza has been demonstrated to lower seedcorn maggot damage in sweet corn (Rondon and Thompson 2023).

***Evaluating seedcorn maggot damage and yield:*** The degree to which the EPF treatments protect sweet corn from maggot damage will be evaluated by assessing seedling stand, the number of seedcorn maggot larvae, and sweet corn yield. Seedling stand will be determined by counting the number of live plants in each plot at growth stages VE, V1, and V2. Seedlings will be visually inspected at each of these growth stages for poorly developing seedlings. Up to 5 poorly developing seedlings per row per plot will be gently pulled and inspected (within seeds, roots, and stems) to count larvae and damage. At crop maturity, a 3-m row per plot will be harvested and raw sweet corn ears will be weighed to assess yield.

**Anticipated benefits/expected outcomes/information transfer**

In the short term, this project will generate new knowledge about the ability of EPF to control seedcorn maggot in sweet corn in the Columbia Basin of Oregon. In the long term, the project will benefit sweet corn IPM by offering alternative (i.e., MCAs) tools to growers in managing seedcorn maggot. To my knowledge, the proposed study is the first of its kind on sweet corn in the Columbia Basin of Oregon. To disseminate findings, I will present at OPVC meetings as needed and participate in Field Days and workshops that bring Oregon sweet corn growers and stakeholders together. I will also publish peer reviewed articles to reach a wider audience.

**Anticipated project timeline**

| Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |
| --- | --- | --- | --- |
| Field preparation and design. Feb - Mar | Seed treatments and field planting. Seedling stand count. Inspection and counting for maggots. Maintain plots. Late April – May. | Maintain plot | Assess crop yield, compile data, and produce reports. |

**References cited:**


Gill, H.K., Goyal, G. and Gillett-Kaufman, J.L. (2013). Seedcorn maggot, Delia platura (Meigen) (Insecta: Diptera: Anthomyiidae): EENY566/IN1002, 7/2013. *EDIS*, (6).

Dara, S. K. (2019). The new integrated pest management paradigm for the modern age. *Journal of Integrated Pest Management*, *10*(1), 12.

Pilz, C., Wegensteiner, R. and Keller, S. (2007). Selection of entomopathogenic fungi for the control of the western corn rootworm Diabrotica virgifera virgifera. *Journal of Applied Entomology*, *131*(6), pp.426-431.

Rudeen, M.L., Jaronski, S.T., Petzold-Maxwell, J.L. and Gassmann, A.J., 2013. Entomopathogenic fungi in cornfields and their potential to manage larval western corn rootworm Diabrotica virgifera virgifera. *Journal of Invertebrate Pathology*, *114*(3), pp.329-332.

Rondon, S.I. and Thompson, D.I. (2023). Effects of pesticides on seedcorn maggots in sweetcorn. *Arthropod Management Tests*, *48*(1), p.tsad056

***2024-26 Budget***

| | 2024-25 | 2025-26 |
|---|---|---|
| **Salaries:** Faculty | 0 | 0 |
| Undergraduate students[1] | 3,600 | 3,600 |
| Other labor[2] | 8,034 | 8,034 |
| **Employee Benefits (OPE):** Faculty | 0 | 0 |
| Undergraduate student[1] | 360 | 360 |
| Other labor[2] | 1,638 | 1,638 |
| Equipment[3] | 4,262 | 0 |
| Travel: Domestic (in state)[4] | 0 | 1,000 |
| Domestic (out of state) | 0 | 0 |
| Operating Expenses | 0 | 0 |
| Other Expenses[5] | 5,393 | 1,500 |
| **Total** | **23,287** | **16,132** |

[1]Hourly salary for 1 undergraduate student to help collect and prep materials for field studies as well as sort and identify field-collected maggots (10% Fringe Rate)
[2]Salary for 1 hourly time-slip labor for field work ($15/hr, 20hr/wk, 12 wks) and 10% Fringe rate.
[3]R&D $CO_2$ backpack sprayers (2 at $2,131 per unit).
[4]Travel to meetings (fuel University rate $0.625/mile).
[5]Purchase seeds, EPF products, chemical products, reagents, plastics, mesh bags, coolers, forceps.

**TITLE**: Evaluating electric weed control in vegetable production systems of western Oregon

YEAR INITIATED: NA        CURRENT YEAR: 2025-26   TERMINATING YEAR: 2028

PERSONNEL & COOPERATORS:

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Phone: (707) 380-6563; email: a.becerraalvarez@oregonstate.edu

**FUNDING REQUEST FOR 2025-26:** $6,285

**JUSTIFICATION:**

In western Oregon vegetable production, common weeds include broadleaf weeds such as pigweed species (*Amaranthus* spp.), lambsquarters (*Chenopodium album*), henbit (*Lamium amplexicaule*), black and hairy nightshade (*Solanum* spp.), grassy weeds such as annual bluegrass (*Poa annua*), barnyard grass (*Echinochloa crus-galli*), and *Panicum* spp. including witchgrass (*P. capillare*), fall panicum (*P. dichtomiflorum*), and wild proso millet (*P. miliaceum*). Electric weed control (EWC) could help reduce the weed seed bank size and weed populations over time, especially when integrated with other weed control methods such as flaming, cover crops, cultivation, and herbicides. Because EWC can be used pre-plant and between rows it is a good candidate to reduce weeds in vegetable rotations.

Figure 1. *Top left,* the Zasso (EH 30 Thor) currently available at OSU. *Top right*, the nontreated snap beans check 14 days after treatment. *Bottom left*, an electric weed control application within snap beans 14 days after treatment. *Bottom right* shows crop row removed by current equipment.

To the best of the authors' knowledge, the interactions of EWC with interrow cultivators have not been explored. Applying EWC at the third to fourth trifoliate bean leaf stage did promote weed seed germination later in the season in our preliminary demo trial conducted at the Vegetable research farm in Corvallis, OR in 2024 (Figure 1); however, it was not compared to other management. Likely, interrow EWC would be applied more than once or in combination with other treatments like herbicides or cultivation to achieve desired results. Because EWC does not disturb the soil it may reduce the need for interrow tillage. Minimum-till has demonstrated reduced emergence of hairy nightshade, a challenging weed in vegetables (Peachey et al. 2004). Minimum-till systems display clear benefits of soil health improvement, including improved soil resilience to extreme weather events and carbon sequestration (Brainard et al. 2013a). However, minimum-till or no-till systems are atypical in vegetable production; historically, conventional tillage has been the common practice and a useful management strategy for weed control, soil aeration, and seedbed preparation, especially for small-seeded vegetables (Brainard et al. 2013a; Luna et al. 2012). It is hypothesized further that weeds that escape EWC may become more sensitive to cultivation because of the initial damage caused by EWC. Integrating EWC with cultivators and flamers may also slow shifts in the weed community towards tolerant species (Peachey 2019). Interrow EWC applications may give rise to no-till or reduce-till vegetable production (Objective 1).

Current practices are to manually remove weed escapes after herbicide applications or other management before they set seed when hand-weeding labor is available. Finding available labor when needed can be challenging (Jennings and Fennimore 2023). Therefore, another benefit of EWC in vegetables can be reduced costs for hand-weeding. Historically, vegetable production has depended heavily on hand-weeding; however, labor has become more scarce and expensive in recent years (Jennings and Fennimore 2023). Weed control technologies like automated weeding machines and smart cultivators have gained popularity and demonstrate to alleviate the challenges of hand-weeding labor costs in California vegetable production (Jennings and Fennimore 2023). A single tractor operator can reduce weed density early in the season, reduce required time for hand-weeding later in the season, and reduce overall labor costs. However, no previous evaulations of EWC have been documented in the PNW and in the US.

The recent commercialization of EWC units makes adoption of this technology in commercial production feasible (Objective 2). Interrow applicators are available from manufacturers like Zasso (Figure 2). Previous work conducted in the Department of Horticulture at Oregon State University by Dr. Marcelo Moretti, has shown the cost-effectiveness of EWC in perennial crops (Baccin and Moretti 2024). Expanding EWC to annual systems should increase amortization of growers' investment costs. Vegetable producers require effective, economical, National Organic Program-compliant management strategies for weeds. The development of effective management programs is critically important for sector economic sustainability.

Figure 2. Electric weed control (EWC) interrow applicator in sugar beets developed by Zasso. Photo obtained from website.

**HYPOTHESIS & OBJECTIVES:**

Objectives

1. Determine the effectiveness of electric weed control (EWC) alone and integrated with cultivation, flaming, and herbicides for managing weeds in vegetable crops in the Pacific Northwest. (2025-26)
2. Integrating EWC in weed management strategies between the planting rows in grower fields. (2026-27)

**PROCEDURES:**

1. *Determine the effectiveness of electric weed control (EWC) alone and integrated with cultivation, flaming, and herbicides for managing weeds in vegetable crops in the Pacific Northwest. (2025-26)*

EWC passes an electric current through the target species, causing cellular water to expand, resulting in membrane disruption and cell death. The proposed model to describe EWC shows that electric power needed to kill a plant is inversely related to the dielectric resistance of the target plant and the soil as described by the following equation:

$$P = V^2/((Rp/nc) + Rs)$$

where P, which is the power needed to kill a plant, is related to the voltage (V), the plant resistance (Rp), the number of plants in contact with the electrode (nc), and the soil resistance (Rs) (Vigneault and Benoît 2001). Plant size, architecture, and water status affect individual plant resistance. Plants with branched apices may better be controlled by EWC if branching increases contact with the electrode. When multiple plants contact the electrode simultaneously, resistance is distributed across all plants, reducing the current passing through any single specimen. Thus, plant density is inversely related to the speed of operation (capacity) when voltage is kept constant. Edaphic conditions such as soil moisture content can impact EWC performance by increasing or reducing the conductivity of the current through the target plants. Operating speed can also affect EWC efficacy: rapid travel reduces the contact time between weeds and the charged electrodes. The first objective will describe how EWC interacts with cultivation and herbicides to influence weed control between the rows of annual vegetable crops.

<u>Treatment establishment:</u> The trial will be conducted on 3 acres at the Oregon State University Vegetable Research Farm. The field will be tilled with an offset disc and the seedbed prepared with a bed harrow. Snap bean cultivar 'OSU 5630' will be planted at 0.76 m row spacing with a final population of 400,000 to 450,000 plants $ha^{-1}$. The snap bean crop will be managed uniformly until harvest. A total of 30 treatments will be implemented, see table 1 for treatment details. Fomesafen (Reflex) at 0.14 kg ai $ha^{-1}$ plus S-metolachlor (Dual-magnum) at 1.0 kg ai $ha^{-1}$ - both are preemergence herbicides - will be applied after seeding but before crop emergence for the herbicide treatments. Treatment applications later in the season will occur after the beans have developed first to second trifoliate leaves and weeds are up to 8 cm in height. EWC and cultivation treatments will be applied alone and in combination after the preemergence herbicide application and similarly after the beans are at the first to second trifoliate leaf stage. EWC will be applied at five different speeds, 1.0, 2.0, 4.0, 6.0, and 8.0 $km^{-1}$ (0.6, 1.2, 2.5, 3.7, and 5 mph) (Table 1). Electricity will be generated by the commercial unit (EH30 Thor, Zasso, Brazil) which is available to use in the Horticulture Department, OSU. Cultivation with a sweep cultivator and finger weeder will be performed at about 3.0 $km^{-1}$. The flaming will be applied by banding on

the crop row in a stale seed bed method at 47 L/ha (5 gal/A) using propane (Peachey 2019). A hand weeded and nontreated check will be included for comparison. Plot size will be 3-m by 27-m. The study will be repeated in a different area of the field the following year. The results will identify the optimal electric rate to control problematic weed seedlings.

Table 1. The treatment list to evaluate interactions between electric weed control, cultivation, flaming, and herbicides in snap beans.

| EWC speed (km $h^{-1}$) | Treatment list |
|---|---|
| - | Nontreated |
| - | Hand weeded check |
| - | Preemergence herbicide before crop emergence |
| - | Preemergence herbicide, fb cultivation |
| - | Flaming pre crop emergence, fb cultivation |
| 1.0, 2.0, 4.0, 6.0, & 8.0 | EWC pre crop emergence, fb cultivation |
| 1.0, 2.0, 4.0, 6.0, & 8.0 | Preemergence herbicide, fb EWC interrow |
| 1.0, 2.0, 4.0, 6.0, & 8.0 | Flaming pre crop emergence, fb EWC interrow |
| 1.0, 2.0, 4.0, 6.0, & 8.0 | EWC pre crop emergence, fb EWC interrow |
| 1.0, 2.0, 4.0, 6.0, & 8.0 | Flaming pre crop emergence, fb EWC interrow, fb cultivation 7 days after |

EWC, electric weed control; fb, followed by.

*Data collection*: Data describing cover crop biomass, weed density ($m^{-2}$), size, and species composition will be collected before cover crop termination and again 14 and 28 days after termination. After crop planting, weeds will be identified to the species level. Weed control per species will be assessed weekly with visual estimates. Weed cover and weed presence will be recorded at three sampling times, one week after planting, mid-crop cycle, and harvest. A grid with 25 intersecting points will be mounted on 0.25 $m^{-2}$ quadrat and measured four times per plot per sampling time in a regular distribution pattern.

Bean crop germination will be recorded at one and two weeks after planting in two 2 m sections of the plot. The crop will be harvested by hand, and above-ground biomass of snap bean stems and leaves, and bean weights and grade will be recorded.

*Data Analysis:* The study will be organized as a randomized complete block design. Linear regression and non-linear regression analyses will be performed in R. The effect of treatments and their interactions will be compared among the different levels and mean separation when appropriate with Tukey's HSD at $\alpha=0.05$.

2. *Integrating EWC in weed management strategies between the planting rows in grower fields. (2026-27)*

This second objective will be implemented in commercial fields and with the active participation of collaborating growers to validate our initial findings. Results from the studies in objective one will inform specific speed and timing of operations. We have discussed our ideas with growers, and we anticipate that minor adjustments to the experiment may be necessary to accommodate differences in planting spacing, field conditions, and crop-specific timings. Growers are interested in evaluating EWC in areas where troublesome weeds resist control by available methods. We will conduct replicated field studies with the uniform methodology described below.

<u>Treatment establishment</u>: Four field experiments in snap beans and broccoli will be conducted in commercial fields of collaborating growers. We aim for two organic fields and two conventional fields. These crops are often planted at a 50 to 91 cm row spacing. The experiment will include five weed control treatments: 1) nontreated control, 2) grower standard practice, 3) EWC inter-row at 1.5 km $h^{-1}$ performed twice, 4) EWC inter-row at 3 km $h^{-1}$ performed twice. The EWC components of treatments will be reapplied three weeks after the initial application. The standard practice may vary among growers and may consist of herbicide programs with 3 or 4 herbicides applied pre-emergence and post-emergence or tillage. Electricity will be generated by the commercial unit (EH30 Thor, Zasso, Brazil), and a custom-built applicator treating a 60 cm band between the crop rows. The applicator's two 60 cm electrodes will pass one on each side of the planting row. The entire experiment will be hand-weeded at the end of the study, mimicking standard practices. We will record the time required to hand-weed each experimental unit to the nearest second, allowing us to estimate the effect of treatments on labor needs. The on-farm research trials will allow us to provide extension and field days showcasing the new technology. These events will improve grower's knowledge on alternative weed management methods and provide opportunities for discussion with stakeholders.

## ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:

*Short-term outcomes*

This project will enhance our knowledge of electric weed control in vegetable cropping systems and present alternative or additional weed management techniques that can be utilized to improve crop profitability and sustainability. The outcome of this research will result in the proper speed and energy levels to provide adequate weed control alone and in combination with other management, which then will be utilized to implement treatments on commercial grower fields. We will improve knowledge among producers on new weed control technologies through presentations of results, field days, and extension publications.

*Long-term outcomes*

EWC may reduce hand weeding times and reduce labor costs. EWC may be an alternative to soil tillage and herbicides; therefore, enhancing soil health and reducing chemical inputs. EWC machines are commercially available in the US and can be readily purchased by producers. EWC in vegetables has not been extensively studied in the US and this research and extension project can place the Oregon processed vegetable industry as a leading entity and be useful as a marketing technique for the industry.

**PROJECT TIMELINE:**

| | 25 | 25 | 25-26 | 26 | 26-27 |
|---|---|---|---|---|---|
| | W | S/S | F/W | S/S | F/W |
| Objective 1: | | | | | |
| Planning meeting | X | | | | |
| Impose treatment and evaluations | | X | | X | |
| Measurements | | X | X | X | X |
| Report | | | X | | X |
| Objective 2: | | | | | |
| Planning meeting | | | X | | |
| Establish participating growers | | | X | | |
| Impose treatments | | | | X | X |

**LITERATURE REVIEW:**


Baccin L and Moretti M L (2024) Weed Control in Organic Blueberries: How Electricity is Changing the Game. Weeders of the West. Washington State University. Available at https://smallgrains.wsu.edu/weeders-of-the-west/2024/04/05/moretti/

Brainard DC, Haramoto E, Williams MM, Mirsky S (2013a) Towards a no-till no-spray future? Introduction to a symposium on nonchemical weed management for reduced-tillage cropping systems. Weed Technol. 27:190-192

Jennings K, Fennimore S (2023) Practical Vegetable and Specialty Crop Weed Management Systems. Pages 270-285 *in* Korres NE, Travlos IS, Gitsopoulos TK, eds. Ecologically-Based Weed Management: Concepts, Challenges, and Limitations: Wiley

Luna JM, Mitchell JP, Shrestha A (2012) Conservation tillage for organic agriculture: Evolution toward hybrid systems in the western USA. Renew. Agric. Food Syst. 27:21-30

Peachey RE, William RD, Mallory-Smith C (2004) Effect of no-till or conventional planting and cover crops residues on weed emergence in vegetable row crop. Weed Technol. 18:1023-1030

Peachey E (2019) Weed management in conventional and organic snap beans in western Oregon. Oregon State University Extension Communications EM 9025. Accessed on January 9, 2025 from https://extension.oregonstate.edu/catalog/pub/em-9025-weed-management-conventional-organic-snap-beans-western-oregon

Vigneault C, Benoît DL (2001) Electrical weed control: theory and applications. Pages 174-188 *in* Vicent C, Panneton B, Fleurat-Lessard F, eds. Physical control methods in plant protection. New York, NY, USA: Springer-Verlag Berlin Heidelberg

**2025-26 BUDGET:** Please provide the following in a table format as shown, listing only the budget items appropriate for your project.

| | |
|---|---|
| **Salaries** | Y1 |
| Faculty – Aaron Becerra-Alvarez 0.02 FTE | $1,998 |
| Student – undergraduate 0.05 FTE part-time | $911 |
| **Employee Benefits (OPE)** | |
| Faculty | $1,123 |
| Student | $93 |
| **Equipment** | |
| **Travel** | |
| On farm | $67 |
| **Operating Expenses** | |
| Plot fees | $1,593 |
| Materials and supplies | $500 |
| **Other Expenses** | |
| NA | |
| **Total** | **$6,285** |

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable):**

2025-26: $6,285 2026-27: $6,285 2027-28:

**OTHER SUPPORT OF PROJECT:**

This project is part of a proposal submitted to the USDA-NIFA-AFRI CARE program under the title "Crosscutting Weed Management Approaches with Electric Weed Control in Vegetable Farming" requesting a total of $300,000, which is currently under review. By the end of January we should know if this project is accepted for funding. If funded, the federal funds will be used to purchase an inter row applicator for use in the research and extension on EWC in vegetables. If the USDA proposal is not accepted for funding, the objective 1 of this proposal can still be carried out but with a larger electric applicator we have available. The larger applicator is not feasible for commercial vegetable fields but can still provide useful information on control of troublesome weeds in vegetable crops and support preliminary data for a future resubmission of the federal proposal.

**TITLE:** VegNet: Regional Insect Pest Monitoring and Reporting

**YEAR INITIATED:** 1996 **CURRENT YEAR:** 2025-26 **TERMINATING YEAR** on-going

**PERSONNEL & COOPERATORS:**
Processed vegetable growers, TBD
Vegetable processor managers, TBD
OSU Research Farm Manager(s): Ben Lyon, others from the College of Ag Sci. Farm Unit
Kyleah Rabe (student)
Jessica Green (faculty)

**FUNDING REQUEST FOR 2025-26:** $10,456

**JUSTIFICATION:**
Timely assessment of insect pests in vegetable crops is crucial, and during the growing season, pest activity can change rapidly. Without monitoring, pest levels may go unnoticed until a large portion of the crop becomes unmarketable. Depending on pre-harvest intervals, 'rescue' insecticide applications may be available, but a much better approach is to have knowledge of pest activity throughout the season. For instance, soil pests are a big concern during establishment, foliar feeders must be recognized before they become too large to manage, and insects that feed on pollen or contaminate marketable parts of crops affect can harvest or limit load acceptance at the processing plant. VegNet, a long-standing monitoring and reporting system for insect pests, aims to reduce this knowledge gap by providing direct, weekly trap counts as a means to estimate and compare pest levels, both temporally and spatially. If an increase in trap counts is noted, we use degree-day models to predict timing of pest pressure and potential impact.

**HYPOTHESIS & OBJECTIVES:**
This program has been operational long enough to know that pest activity varies widely from year to year, depending on the species. Hypotheses are hard to formulate, but we know that factors such as winter temperatures and drought/rainfall events can affect the abundance of crop pests in the spring and summer.

1. Conduct **weekly pest monitoring** at 8-10 selected locations in Western Oregon. Collected data becomes part of a digital dashboard (the Oregon Pest Monitoring Network, OPMN).
2. Issue **regular reports** that include interpretations about pest activity and predicted impact to growers. These reports will be delivered via email, and will be in addition to weekly blog posts on the OPMN.

**PROCEDURES:**

Monitoring at each selected site will include pheromone traps, sticky traps, and sweep netting. Periodic soil sampling can be requested for certain concerns like rootworms, wireworms, maggots, and symphylans. Monitoring locations will consist of processed (preferred) and fresh market vegetable field sites throughout the north and central Willamette Valley. Data collection will occur weekly from May through September. Moths from pheromone traps will be collected and identified on site. Pheromone lures will be changed every 4 weeks. Unknown and non-target specimens will be preserved and evaluated by the program manager. Trap catch data collected by the field technician automatically uploads to a digital dashboard. The dashboard, Oregon Pest Monitoring Network (OPMN) is publicly available. It displays graphs of pest activity, and users select 'filters' to refine the dataset to what they'd like to see. In addition, the OPMN has an integrated blog site. If abnormally high activity anomalies occur, email reports will be sent to subscribers, advising them to be aware of increased activity and how it might impact production for the next few weeks.

**ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:**

The VegNet program (solely supported by OPVC for decades!) has proven to be a reliable and valued mode of communication between industry staff, Extension personnel, growers, and processors. It has since grown to be of interest to a wider audience including home gardeners, retail nurseries, etc. In some ways, VegNet is the template by which other programs now operate: staff monitor traps and report counts, so that growers and others can increase on-the-ground scouting efforts when and where they're most needed. The new Oregon Pest Monitoring Network, for instance, is based on this process. It hosts data from many different commodities (hazelnut, grass seed and forage, hemp, mint, and vegetables). Staff from the Oregon IPM Center helped to develop the OPMN, and we are earnest in our hope to see it succeed. We are in the process of offering trainings on how to use it, as one of our Center's signature programs for professionals: Pest Monitoring and Prediction.

**PROJECT TIMELINE 2025:**

- Mid-April – Identify field sites and place sentinel traps. These help assess what might already be in the landscape before crops are planted.
- May 10th to Sept 30th – Monitor each field site and issue weekly reports. Concurrent data analysis.
- October – Field day (Vegetable Day on OSU research farm or other OSU Experiment Station event)
- December: Finalize data analysis and prepare final report.

**2025-26 BUDGET:**

| | OPVC |
|---|---|
| **Salaries:** Faculty | 2835<br>(0.05FTE) |
| Other students | 3200<br>($20/hr for 20 weeks) |
| **Employee Benefits (OPE):** Faculty | 1701 (60%) |
| Other students | 320 (10%) |
| Travel: Domestic (in state) | 1750 |
| Operating Expenses [1] | 650 |
| **Total** | **$10,456** |

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable):**
**2026-27:** $14,000 **2027-28:** unknown

**OTHER SUPPORT OF PROJECT / NOTES:**
Program manager's salary (faculty, J.Green) will be supplemented by existing Oregon IPM Center funds, for a total effort of 0.10FTE devoted to pest monitoring and reporting. This is less than the 0.25FTE that has been allocated in years past, but is sufficient due to the reduced workload of reporting, since trap counts are now uploaded automatically onto the Oregon Pest Monitoring Network digital dashboard.

I'd like to thank the commission for stating other insect-related priorities for 2025. I am supportive of my colleagues and their submitted proposals, and will no doubt be helping with those efforts, should they get funded. The reduced financial ask for VegNet this year is meant to help you 'distribute the wealth'. I feel that regional monitoring is a separate project, but equally important to specific pest research trials, and that both will benefit the vegetable industry.

**PROPOSAL**

**TITLE: INVESTIGATING CONTROL OPTIONS FOR SYMPHYLAN MANAGEMENT IN VEGETABLE CROPS IN OREGON**

**YEAR INITIATED:** 2025-26 **CURRENT YEAR:** 2025-26 **TERMINATING YEAR** 2026-27

**PERSONNEL & COOPERATORS:**


**PRINCIPAL INVESTIGATOR**

Navneet Kaur, Assistant Professor, Extension Entomologist, OSU Department of Crop and Soil Science, ALS 3077, OSU Campus Phone: 541-737-5884 Email: Navneet.Kaur@oregonstate.edu

**CO- PRINCIPAL INVESTIGATOR**

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**CO- PRINCIPAL INVESTIGATOR**

Nick Andrews, Organic Vegetable Extension Specialist, OSU Department of Horticulture,

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**COOPERATORS**

Alison Willette, Faculty Research Assistant, Oregon State University, Department of Crop and Soil Science, Phone: 951-764-6724, Email: Alison.willette@oregonstate.edu

Casey Cruse, Research Technician, Dorman Entomology Lab, USDA-ARS, Corvallis, OR


Various grower cooperators and crop consultants throughout the Willamette Valley, including Jon Umble, Fall Creek Farm, and Nurseries, Inc.

**FUNDING REQUEST FOR 2025-26: $17,500**

**JUSTIFICATION**

Through this application, we seek funding to conduct laboratory and greenhouse experiments to understand **symphylan** behavior against glycoalkaloids <u>and identify potential cover crop or rotation options</u> for symphylan suppression. Multiple independent field trials have been undertaken by our program at OSU to evaluate insecticide efficacy against symphylans in diverse cropping systems. Consistently, insecticide products with bifenthrin active ingredient (pyrethroid), such as Capture LFR, were identified as promising options when applied pre-planting, followed by rain or mechanical incorporation for effective symphylan management. We will continue to perform efficacy trials in 2025 and beyond for product registration and provide supporting data as infested sites with reliable pest pressure in vegetable crops is identified. There is also a need to explore <u>non-chemical methods</u> for symphylan management. Over the years, a network of cooperators across multiple specialty crop production systems has been consulted individually or in groups during various grower meetings. Because of increased outreach and project visibility, growers and crop consultants have started to reach out for questions and shared their feedback on non- chemical tactics for symphylan control.

During a workshop at OSU, "Symphylans: In a Class of their Own," held in Corvallis on February 16, 2024, approximately 30 participants were surveyed for their perspectives on the alternative management strategies and weigh-in on priorities for future research and extension efforts. Most of the attendees were farmers and had ongoing infestations on their farms. Most participants (>80%) indicated they had exhausted standard management options such as tillage and were enthusiastic about trying more *creative solutions*. Many farmers shared that they had positive success with using potatoes in rotation with other crops, and the most prominent area of symphylan management interest was on the "**potato effect**," which still has a lot of unknowns.

Research at OSU (Umble and Fisher 2003a, Umble and Fisher 2003b) showed that symphylan populations drop significantly after potato crops. Cultivation of potatoes was found to cause a 2- to 4-fold reduction in pest populations over a broad range of conditions, with populations remaining low into the following cropping cycle. In greenhouse trials, the population decreased in 6 potato varieties with different alkaloid profiles. These plant protection benefits were attributed to the presence of α-chaconine and α-solanine, two major glycoalkaloids in commercial potatoes (Friedman and Dao 1992). In general, potato roots and leaves tend to have much higher concentrations of glycoalkaloids that are toxic to symphylans than tubers. Thus, potatoes can become good rotation crops where symphylan pressure is high. Ideally, late or no- tuber-forming varieties can be a suitable pest management cover crop on farms that aren't interested in growing and selling potatoes. Preliminary discussions with the OSU potato breeder, Dr. Sathuvalli, and Dr. Jim Myers, OSU vegetable breeder, suggested that short-day potatoes or non-tuber forming wild types could avoid the potential side effect of volunteer potatoes becoming weeds. Other Solanaceous crops (litchi tomatoes, ashwagandha, etc.) with high α- chaconine and α-solanine content could also be cover cropping or rotation options. For the cover cropping approach, we also must investigate how long the potatoes or other suppressive crops must be in the field to provide useful symphylan suppression. In this study, we intend to understand symphylans' feeding behavior and response using EthoVision XT when subjected to the laboratory diet (i.e., organic bean sprouts) supplemented with commercially available α- chaconine and α-solanine. We also intend to measure the effect of symphylan survival or populational densities when reared on crops with high α-chaconine and α-solanine content and their potential to serve as a cover crop or rotational option. In this study, we aim to conduct the following:

**HYPOTHESIS & OBJECTIVES:**

**1.** Determine the direct and indirect effects of commercially available glycoalkaloids on symphylan feeding behavior and survival under laboratory conditions

**2.** Investigate the suitability of various solanaceous crops with high glycoalkaloid contents for symphylan survival under greenhouse conditions.

**PROCEDURES:**

1. EthoVision experiments under laboratory conditions. Symphylan behavior will be tracked in a controlled laboratory environment using EthoVision software. Symphylans will be released into 1.5 cm diameter 3D printed arenas containing organic bean sprouts as a food source supplemented with α-chaconine, α-solanine, or water. Arenas will be placed on a platform emitting 930 nm wavelength IR light, and two monochrome GigE cameras (Basler acA1300-60gm) with 4-12 mm lenses (Tamron M12VM412) and IR pass filters will be placed above to record behavior. Clear pieces of plexiglass will be placed over the arenas to prevent symphylan escape and maintain moisture. Eight arenas containing individual symphylans will be recorded simultaneously for four-hour increments. Time spent feeding, time spent within the 2 mm buffer zone around the food, and overall movement will be analyzed.
2. Greenhouse suitability test. Similar approaches to those of Umble and Fisher (2003b) will be used for the greenhouse suitability test. At least ten crop species and varieties will be screened in three to four trials over two years in the greenhouse for activity against symphylans. Crops/varieties will be selected based on observations from growers, researchers, and scientific literature. The suitability of each crop (or variety) for symphylan population development will be evaluated by establishing crops in PVC pots (at least six reps), infesting with 35 adults, and measuring the change in population density after eight weeks. ANOVA will test for differences in symphylan densities among treatments.

**ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:**
Establishing chemical and non-chemical control plans for symphylan control in vegetable crops is urgent. The outcome will be the development of rotational options for insect resistance management, increased industry awareness of existing tools, and label expansion for arthropod pest management in these systems. This project will also propel future work on integrated pest management strategies in other crops where symphylan control is challenging.

**PROJECT TIMELINE:**
**Spring 2025** Laboratory experiments (Obj 1)

**Summer 2025** Greenhouse suitability tests (Obj 2)

**Fall 2025** Data analyses and report submission

**Winter 2026** Grower meeting presentations and publication preparation on symphylans

**LITERATURE REVIEW:**


Friedman, M., & Dao L. (1992). Distribution of Glycoalkaloids in Potato Plants and Commercial Potato Products. *Journal of Agriculture and Food Chemistry, 40: 419-423.*

Umble, J. R., & Fisher, J. R. (2003a). Sampling Considerations for Garden Symphylans (Order: Cephalostigmata) in Western Oregon. In *Sampling and Biostatistics Journal Economic Entomology* (Vol. 96, Issue 3). https://academic.oup.com/jee/article/96/3/969/2217796

Umble, J. R., & Fisher, J. R. (2003b). Suitability of selected crops and soil for garden symphylan populations (Symphyla, Scutigerellidae: *Scutigerella immaculata* Newport). *Applied Soil Ecology*, *24*(2), 151–163. https://doi.org/10.1016/S0929-1393(03)00095-7

**2025-26 BUDGET:** Please provide the following in a table format as shown, listing only the budget items appropriate for your project.

| | |
|---|---|
| **Salaries** | |
| Faculty Research Assistant (Kaur) | $9,000 |
| **Employee Benefits (OPE)** | |
| Faculty Research Assistant (Kaur) | $2,500 |
| **Equipment** | 0 |
| **Travel**: | 0 |
| **Supplies**<br>Petri dishes, potting media, symphylan diet<br>Glycoalkaloids, gibberellic acid, Solanaceous seed source,<br>Plastic pots, paintbrushes, potatoes, collection bins, and plastic containers | $6,000 |
| **Total** | $17,500 |

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable):**
**2026-27: $15,000 2027-28: NA**

**OTHER SUPPORT OF PROJECT:**
Specialty Seed Growers of Western Oregon provided $6,000 funding for this work recently.

**TITLE: Nitrogen fertility requirements of new sweet corn hybrids**
**YEAR INITIATED:** 2023-24 **CURRENT YEAR:** 2025-26 **TERMINATING YEAR** 2025-26.

**PERSONNEL & COOPERATORS:**

| | | | | |
|---|---|---|---|---|
| **PI**: | James R. Myers | **Co-PI**: | Kristine Buckland | |
| **Organization**: | Oregon State University | **Organization**: | Oregon State University | |
| **Telephone**: | 541-737-3083 | **Telephone**: | (503) 506-0955 | |
| **Email**: | james.myers@oregonstate.edu | **Email**: | kristine.buckland@oregonstate.edu | |

**FUNDING REQUEST FOR 2025-26:** $16,501

**JUSTIFICATION:**
Cost of inputs for sweet corn production have risen dramatically in the past few years, making the crop unattractive to growers to produce for processing. One input for which prices have been especially high is nitrogen fertilizer. If nitrogen use could be reduced without loss of yield, then sweet corn contracts for processing would be more attractive. Newer hybrids currently in use by processors have not been evaluated for nitrogen use efficiency. We propose to conduct a trial of contemporary hybrids using different nitrogen fertilizer sidedress treatments to determine if existing recommendations still apply or if these might be adjusted to increase profitability for growers. A comprehensive fertility guide for sweet corn has been recently updated (Sullivan et al., 2020) but nitrogen (N) rate recommendations are based on trials that were performed in the early 2000s with hybrids that are no longer used for processing. As such, there is a need to evaluate new hybrids for N use requirements. If newer hybrids have greater nutrient use efficiencies because of larger root systems, it may be possible to reduce N amounts while maintaining economic yields.

In the first year of this experiment, two linear patterns of response to N were observed. Coronado and Kopa showed increases in yield up to 100 lb/A N and plateaued or even decreased at higher rates of N. Driver, Column, GSS1477, and 007R showed a continuous linear response across treatments, with the highest yields achieved at the higher rates of N. In the second year of this experiment, all hybrids, except 007R, plateaued at 50 or 100 lb/A sidedress N. 007R showed a continuous increase across higher N treatments. These data continue to support the hypothesis that some contemporary supersweet corn hybrids may produce optimum yields at lower sidedress N rates. Due to the variability of the trials, a third year of study in 2025 would help verify these results.

**HYPOTHESIS & OBJECTIVES:**
1. Determine nitrogen (N) requirements for new supersweet corn hybrids grown for processing.

**PROCEDURES:**
The trial will be conducted at the OSU Vegetable Research Farm. The field identified for trial will be subjected to a preplant soil test, which will be used to supply about 40 lb N/A at planting. Pre-plant fertilizer will be broadcast (16-16-16 @ 250 lb/A assuming little or no residual soil N).
Six supersweet hybrids representing those currently being grown in the Willamette Valley and Columbia Basin will be planted in mid-June. These include GSS1477, 007R, 'Driver', 'Kopa', 'Coronado' and 'Column'. These will be over seeded and thinned to 7" within row spacing to achieve 36,000 plants/A based on Peachey & Sullivan (2014). Experiments will be arranged as a split plot with fertilizer treatments as whole plots (strips through the field) and hybrids as subplots. Subplots

will consist of 3 rows on 2.5 ft. centers 30 ft. total plot length and will be replicated 4 times. The trial will have border rows and yield will be taken from the 20 ft. of the center row of each subplot by hand harvest and husking of ears.

Sidedress fertilizer treatments will be applied at the V4 stage as UAN 32 shanked on either side of the data row. Sidedress treatments will consist of 0, 50, 100, 150, and 200 lb N/A.

Seeds will be treated with fungicide/insecticide mix as supplied by the seed company. Weeds will be controlled with 1 pint/A Atrazine 4l mixed with 18 oz/A Outlook and 1qt/A Envy 6 Max.

Data will be collected starting with plant height at V6. Fifty percent silking date will be recorded at tasseling. At harvest, total ear weight, net ear weight, cull ear weight, ear length and diameter, row number, tip fill, and kernel depth will be measured. Hybrids will be harvested 28-32 days after silking with moisture testing (target of 75-77% for supersweet hybrids) used to achieve the optimum harvest time. A soil test of ammonium and nitrate N will be obtained soon after harvest for each hybrid-treatment combination to determine if any plant available N remains.

**References**


Peachey E., & D.M. Sullivan 2014 Effect of pop-up fertilizers and planting density on early season sweet corn growth and ear yield. OPVC report.

Sullivan, D.M., E. Peachey, A. Heinrich and L.J. Brewer. 2020. Nutrient and Soil Health Management for Sweet Corn (Western Oregon) Oregon State University EM 9272.


**ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:**
Based on two years of data, some sweet corn hybrids may achieve high yields using less than recommended rates of sidedress nitrogen. Potentially, a 33% reduction in N may be possible if these results are validated in a third year of trials.

**PROJECT TIMELINE:**

| Spring | Summer | Fall | Winter |
|---|---|---|---|
| • **Soil test**<br>• **Obtain seeds & prep for planting**<br>• **Plant mid-June** | • **Thin plants at V3**<br>• **Apply sidedress treatments @ V4**<br>• **Measure height @ V6**<br>• **Take 50% silking data** | • **Harvest & obtain yield and raw product ratings**<br>• **Post-trial soil test for residual N** | • **Analyze data & write report** |

**2025-26 BUDGET:**

| | |
|---|---|
| **Salaries and benefits** | |
| Faculty Research Assistant | $5,306 |
| OPE @ 74% | 3,927 |
| **Wages and benefits** | |
| Student Wages | 4,030 |
| OPE @10% | 403 |
| **Supplies** | 2,035 |
| **Travel** | 0 |
| **Land rental** | 800 |
| **Total** | $16,501 |

**Budget Justification:** Salary and OPE is requested for a full time faculty research assistant who will commit 10% FTE to the project. OPE is 74%. Undergraduate student wages of $15.50/hr x 20 hr/wk x 26 weeks = $4,030 are requested with 10% OPE. $2,035 is requested for materials and supplies for field work. This includes soil nutritional analyses and moisture testing for harvest. $800 is requested for land use at the Vegetable research farm.

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable):**
No further requests for this project are anticipated unless there is a crop failure.

**OTHER SUPPORT OF PROJECT:**

**Contributions of the OSU breeding program via the Baggett-Frazier Endowment:**

| | |
|---|---|
| **Supplies** | 2,035 |
| **Land rental** | 2,400 |
| **Total** | $4,435 |

An additional $2,035 is required to cover moisture sample processing. The land use rental at OSU Vegetable research farm is $1,600/A and we expect to use a total of 2 A. We would be covering the cost of $2,400 for an additional 1.5 A.

**TITLE: Breeding broccoli for heat tolerance, automated harvest and processing quality**

**YEAR INITIATED:** 1996-97 **CURRENT YEAR:** 2025-26 **TERMINATING YEAR:** indefinite.

**PERSONNEL & COOPERATORS:**


**PI**: James R. Myers
**Organization**: Horticulture, Oregon State University
**Telephone**: 541-737-3083
**Email**: james.myers@oregonstate.edu


**FUNDING REQUEST FOR 2025-26:** $11,483

**JUSTIFICATION:**

Oregon has had a favorable climate for summer production of broccoli with mild temperatures and a long growing season. However, the long-term trends are towards warmer summers with more extremes in weather. For broccoli growers, this presents challenges that affect the cost of production and whether broccoli will remain profitable. For processors, they are facing challenges in finding cultivars with the desired quality and ease of processing characteristics along with productivity. Mechanization has reduced labor costs in many crops, but cole crop harvest is still relatively non-mechanized. Large labor crews are typically needed to harvest broccoli, which comes with a large cost due to wages and can be difficult to obtain due to other crop harvests, such as blueberries, happening at the same time of year. The industry is progressing towards mechanization, but problems remain in developing systems that achieve efficiency in the field and deliver quality product to the processing plant.

There are three components to an efficient automated harvest system: production system that achieves uniformity, efficient harvest equipment, and cultivars with the appropriate traits. The OSU broccoli breeding program has worked for over 30 years to develop cultivars that have architectural traits that make the cultivar more amenable to machine harvest, with improved processing quality.

The two key factors for developing cultivars suitable to machine harvest are uniform heading and appropriate plant architecture. Most commercially available broccoli hybrids are high yielding but have short plants with heavy and poorly exserted heads. Short plants have high fiber in the part of the stem subtending the head that must be used to achieve a normal length cut. The lack of height, as well as the high fiber, makes them a challenge for machine harvest.

In the processing plant, traits that would increase the efficiency of the process include reducing leaves around the head and minimizing large floret size. Historically, leaves around the head have been removed by the human harvester. Leaf removal by machine has proved to be more difficult with the first harvesters that have been developed, but this is a trait that can be manipulated genetically. Florets larger than 2½ inches must be recut, which decreases processing efficiency; plants with small florets would be preferred over those with high yields but large florets. Emphasis for most commercial hybrids has been on large, dense heads on short-stature plants. As a result, these have many large leaves around the head and achieve high head weight by producing larger florets. Quality traits are also amenable to breeding. Our main challenge is still achieving high levels of productivity in this architectural package as hybrids with exserted heads tend to lighter in weight. Other quality traits needed in a processing broccoli include florets and stems that are uniformly dark green in color and shape and beads that are small and kept during the blast freezing process.

Another issue facing broccoli growers in Oregon is that of climate change. Historically, the Willamette Valley of Oregon has been a good environment for broccoli production, with cool days and nights. In recent years, summer temperatures have been warmer but there have been more extreme daytime high temperatures as well. In the past two years, we and others (Nagy et al. 2020) conducted heat tolerance trials of commercial hybrids and a few experimental inbreds to identify materials that showed stable performance across the season. Some commercial hybrids meeting the stability criteria were identified, but none had acceptable harvest and processing characteristics.

**HYPOTHESIS & OBJECTIVES:**

1. Breed broccoli cultivars with excellent processing quality and field productivity.
    a. Incorporate new genetics from non-cytoplasmic male sterile commercial hybrids to broaden the genetic base of the OSU broccoli breeding program.
    b. Identify inbreds with stability for yield and quality across the growing season.
    c. Select for field traits that includes exserted heads, reduced leaves about the head, and lodging resistance. Hybrids should be high yielding, have solid stems, and have large and heavy heads with shallow branches.
    d. Select for processing traits that includes segmented heads that produce uniformly colored florets that are dark green in color with fine beads and short pedicles. Florets should be <2½" in size.
2. Develop seed production systems using cytoplasmic male sterility (CMS) to produce field scale quantities of $F_1$ hybrid seed.

**PROCEDURES:**

We will continue development of a population combining genetics from non-CMS hybrids and OSU inbreds. The goal will be to broaden the genetic base of the OSU breeding program and facilitate breeding higher yielding broccoli hybrids with good head quality in the presence of heat and desired architectural and processing quality traits. The population was initiated and allowed to intercross in 2022, 2023 and again in 2024. In 2024, open-pollinated seed from 58 plants was retained. It will be direct seeded in 2025 in isolation with a May 1 target date to increase the chances of head initiation during a heat event, while still leaving enough time for seed maturation at the end of the season. The experimental design will be 58 half-sib families in plots on 30 inch rows, 10 feet in length replicated three times and randomized. After seedling establishment, plots will be thinned to a 12 inch within row spacing, for a 10 plant plot. Standard cultural practices for fertilizer and weed and pest control will be employed. At heading, families with the best head heat tolerance, size and quality will be identified, then individual plants within the best families will be tagged and all others rogued. The remaining plants will be allowed to flower and intercross. Seeds will be harvested at the end of the growing season as single plants. We may take cuttings from the population if any appear of particular interest for self-pollination to develop inbreds.

In 2024, we planted 64 of our inbreds and segregating breeding lines in a heat trial replicated over time. The trial was planted four times at one-week intervals. The data obtained from this trial was used to evaluate heat tolerance and head quality stability. Eighteen lines that showed significant levels of heat tolerance were kept. Cuttings were taken from these lines to grow in the winter 2024-25 greenhouse for selfing and crossing to produce $F_1$ hybrids for testing. The inbreds and newly developed hybrids will be reevaluated in 2025 using the same method of single reps planted at weekly intervals. Plot size, plant spacing and cultural practices will be as described above. A set of heat tolerant check hybrids (Asteroid, BC1764, Eastern Crown, Emerald Star, Imperial, Kings Crown, Lieutenant, Viper and Wolfman) will be included. Inbreds, lines and hybrids will be evaluated for head size, shape, quality, exsertion, segmentation, floret texture and color, maturity and stability.

At the end of the season, cuttings will be taken from selections and propagated in the greenhouse for self-pollination and crossing. Approximately five or more generations of selfing are needed to develop homozygous inbreds. Backcrossing of selected hybrids to place the nuclear genome in the Ogura cytoplasmic male sterile (CMS) background will continue.

**ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:**

The long-term benefits of the breeding program are hybrids with higher and stable yields, adapted to mechanization, with improved quality traits and abiotic tolerance. In the short term, we would generate new knowledge about the genetic control of yield, quality and abiotic stress traits.

**PROJECT TIMELINE:**

| Spring | Summer | Fall | Winter |
|---|---|---|---|
| • Direct seed general improvement population – target date: May 1.<br>• Start transplants in the greenhouse for heat tolerance trial with 1st planting May 1, followed by weekly intervals. | • Plant inbreds and hybrids in a heat tolerance trial. Anticipated transplanting dates: Jun. 26, Jul. 3, Jul. 10 & Jul. 17.<br>• Maintain plots, evaluate plots & perform quality evaluations | • Harvest seed from general improvement population.<br>• Take cuttings from heat tolerance trial and root in the greenhouse.<br>• Compile data and produce reports. | • Crossing & selfing in the greenhouse<br>• Report to OPVC and growers |

**LITERATURE REVIEW:**

Nagy, Andy, Alex Stone, Jim Myers, & Ed Peachey. 2020. Broccoli Heat Tolerance and Varietal Evaluation in Western Oregon. Oregon Processed Vegetable Commission USDA Specialty Crop Block Grant ODA6022GR: 20491

**2025-26 BUDGET:**

| | |
|---|---|
| **Salaries and benefits** | |
| Faculty Research Assistant, field, 0.08 FTE | $4,245 |
| OPE @ 74% | $3,141 |
| **Wages and benefits** | |
| Student Wages ($15.50/hr, 15 hr/wk, 8 wks | $1,860 |
| OPE @ 10% | $186 |
| Supplies | $300 |
| Land use and greenhouse rental | $1,751 |
| **Total** | **$11,483** |

**Budget Justification:** Salary and OPE is requested for a full-time faculty research assistant who will commit approximately 8% FTE to broccoli breeding. OPE for FRA is 74%. The rest of salary will come from other sources. $1,860 is requested for a summer undergraduate student to assist in plot maintenance and harvest operations and crossing in the greenhouse. Undergraduate student OPE is

10%. Funds for supplies includes $300 for field and greenhouse supplies (fertilizer, pots, labels, stakes, tags, crossing supplies, envelopes, paper bags, etc.). Facilities user charges include land use rental (0.25 acre at $1,600 per acre), and greenhouse rental ($1.93*700 sq. ft.).

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable):**

**OTHER SUPPORT OF PROJECT:**

We have started an industry-funded variety evaluation trials of broccoli and cauliflower that will include processing evaluation and will continue the trial in 2025.

**TITLE: Identifying cauliflower cultivars adapted to a changing climate**

**YEAR INITIATED:** 2025-2026 **CURRENT YEAR:** 2025-2026 **TERMINATING YEAR:** 2025-2026.

**PERSONNEL & COOPERATORS:**


**PI**: James R. Myers
**Organization**: Horticulture, Oregon State University
**Telephone**: 541-737-3083
**Email**: james.myers@oregonstate.edu


**FUNDING REQUEST FOR 2025-26:** $6,189

**JUSTIFICATION:**

Historically, with mild temperatures and a long growing season, western Oregon has had a favorable climate for summer production of cauliflower. In recent years, temperatures have been trending warmer and there have been more extreme high and low temperatures as well. Overall, the long-term trends are towards warmer summers with more extremes in weather variables. This presents challenges for cauliflower production, especially in terms of good head quality. The challenge facing processors is finding cultivars with the desired quality along with productivity, that can grow under these changing weather conditions.

Processors in Oregon have been experiencing difficulties with producing high quality cauliflower heads and are looking for ways to mitigate this. Heads from certain fields lack the compact and tight curds expected for high quality cauliflower. There are two syndromes that are known in cauliflower that reduce quality. One is "riciness" (riceyness) and the other is "bracting" or fuzzy heads.

*Figure 1. Example of a cauliflower head showing riciness. Photo: Bayer Vegetables Australia.*

Riciness is a function of high temperatures followed by low temperatures occurring at the sensitive apex size of 0.35 mm (range 0.2 – 0.5 mm) (Grevsen et al., 2003). It is essentially a vernalization response with floral primordial being converted to inflorescenses. Treatments of 23°C (73.4°F) for 7 d followed by 7 d at 5°C (41°F), 10°C (50°F) or 15°C (59°F) in earliest plantings, resulted in highest levels of riciness (Grevsen et al., 2003). Plants are within the sensitive apex size range about 10 to 25 d after transplanting. Highest percentages are found where warm temperatures are preceeded and followed by periods of cool temperatures. This syndrome is more likely to be observed in early plantings, when a warm spell interrupts the cool spring temperatures.

*Figure 2. Cauliflower head showing bracting (fuzzy head). Photo: Bayer Vegetables Australia.*

Bracting is a function of plant age (measured by curd diameter) and warm temperatures. The "bracts" are actually tiny leaves, and in its most extreme form, bracting leads to leafy heads. The curd takes on a fuzzy appearance as opposed to the inflorescence development seen with riciness. In the cultivar Plana, the curd diameter associated with induction of bracting is 11.5 mm (range 1 – 23 mm) (Grevsen et al., 2003). The average daily base temperature for bracting when the curd is within the sensitive size range is 15°C (59°F), and increases significantly at 18°C (64.4°F). In this study (Grevsen et al., 2003), the sensitive apex size was reached at about 25 d after transplanting, with a two-week window following. The critical stage for induction is later than for riciness and just as the plant is transitioning from a vegetative bud to curd formation. Depending on when cauliflower is planted (or transplanted) both syndromes may be present in commercial cauliflower fields.

Considerable variation for heading response is found in cauliflower, from winter types that require substantial chilling before the vegetative apex converts to reproductive growth, to summer types that require less chilling, to tropical types that lack a chilling requirement.

**HYPOTHESIS & OBJECTIVES:**

Our **hypothesis** is that it is possible to identify cauliflower cultivars that are more resistant to becoming ricy or bracting. Cauliflower cultivars bred for summer production will likely be the best candidates. These will need to be screened to identify cultivars with the best combination of quality traits that processors need.

**Objective:**

1. Identify cauliflower cultivars that show stable head development across the growing season.
2. Evaluate cultivars for production and processing traits to identify those best meeting the needs of growers and processors.

**PROCEDURES:**

A cauliflower cultivar trial with multiple planting dates across the season will be conducted. We will solicit cauliflower hybrids from seed companies with a particular focus on summer types that have desired head characteristics (tight wrapper leaves, holds white head color, uniform maturity, tight heads that do not become loose, no riciness or bracting). We will keep the trial to 10 hybrids, including 'Artica' as a check cultivar. These will be planted five times across the growing season. The first three plantings will be directed-seeded and the last two will be transplanted. Dates for the directed seeded trials will be (weather permitting) April 1, May 1 and June 1. Transplants will be started May 15 and June 15 for late June and late July transplanting, respectively.

Each planting will be replicated four times with plots 30 feet in length on a 30 inch between row spacing. Plant spacing within rows will be 18 inches, expecting 20 plant stand per plot. For direct seeded plantings, the plots will be over seeded and thinned to stand by V3. Transplanted cauliflower will be set at 18 inches. Cauliflower hybrids will be evaluated in the field for head maturity and uniformity, and tightness of wrapper leaves. A subplot of five heads per rep from each planting will be collected at harvest maturity, trimmed and evaluated for curd development, whiteness and quality (total of 100 heads per hybrid across all trials). Heads will be weighted to obtain net weights. Standard cultural practices for fertilizer and weed and pest control will be implemented (Oregon Vegetables, 2010).

**ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:**

Growers and processors will gain a better understanding of the interaction of time and type of planting with choice of cultivar for maximizing head quality for cauliflower planted in western Oregon.

**PROJECT TIMELINE:**

| Spring | Summer | Fall | Winter |
|---|---|---|---|
| • Direct seed trials Apr. 1, May 1 & Jun. 1.<br>• Start transplants in greenhouse May 15. | • Start transplants in greenhouse June 15<br>• Transplant May starts June 25; June starts July 25<br>• Conduct field and grading room evaluations as trials mature | • Compile data and produce reports. | • Report to OPVC, growers |

**LITERATURE REVIEW:**


Bayer Vegetables Australia. 2018. Cauliflower Head Formation. https://www.vegetables.bayer.com/au/en-au/resources/growing-tips/agronomic-spotlights/cauliflower-head-formation.html

Grevsen, K., J. E. Olesen and B. Veierskov. 2003. The effects of temperature and plant developmental stage on the occurrence of the curd quality defects "bracting"' and "'riciness"' in cauliflower. J. Hort. Sci. Biotech. 78:638-646.

Oregon Vegetables. 2010. Cauliflower. https://horticulture.oregonstate.edu/oregon-vegetables/cauliflower-0.

**2025-26 BUDGET:**

| | |
|---|---|
| Salaries and benefits | |
| Faculty Research Assistant, field, 0.05 FTE | $2,653 |
| OPE @ 74% | $1,963 |
| Wages and benefits | |
| Student Wages ($15.50/hr, 5 hr/wk, 12 wks | $930 |
| OPE @ 10% | $93 |
| Supplies | $150 |
| Land use rental | $400 |
| | |
| **Total** | **$6,189** |

**Budget Justification:** Salary and OPE is requested for a full-time faculty research assistant who will commit approximately 5% FTE to the cauliflower trial. OPE for FRA is 74%. The remainder of salary will come from other sources. $930 is requested for a summer undergraduate student to assist in plot maintenance and harvest operations. Undergraduate student OPE is 10%. Funds for supplies includes $150 for greenhouse and field supplies (fertilizer, flats, labels, stakes, tags, paper bags, etc.). Facilities user charges include land use rental (0.25 acre at $1,600 per acre).

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable):**

A second year of trials may be needed if poor quality symptoms do not manifest in 2025.

**OTHER SUPPORT OF PROJECT:**

**N/A**

Title: Corn rootworms in Oregon: how many and where are they

Project Leader(s): Silvia I. Rondon, Professor and Oregon IPM Center Director, 2217 SW Campus Way, Cordley Hall, Office 2217, Corvallis, OR 97330. Email: Silvia.rondon@oregonstate.edu. Phone (541) 737-2469.

Cooperator(s): Kalli Schoelling (MS Candidate), Crop and Soil Sciences; Brittany Barker, Assistant Professor, Oregon IPM Center and Department of Horticulture; Jessica Green, Oregon IPM Center Educator (0.25 FTE) + Pesticide Safety Education Program (0.55 FTE), and Kyleah Rabe, OSU Undergraduate student. Roles: Schoelling and Rabe will collect, summarize, and report the data. Green will help identify collaborators; Barker will help as a consultant for data analysis.

Funding History: N.A. Amount requested: $16,505 (Yr 1)

Abstract: The corn rootworm complex (Coleoptera: Chrysomelidae) includes a group of three insects that can damage corn and other vegetable field crops, such as cucurbits and squash. The western *Diabrotica virgifera virgifera LeConte,* the northern *Diabrotica barberi* Smith and Lawrence, and the southern *Diabrotica undecimpunctata* Barber corn rootworms are among the most challenging pests to control. Some strategies to manage corn rootworms include crop rotation, weed management, scouting and assessing levels of risk, using soil insecticides, and genetically modified crops when available. Corn rootworms were considered a pest in the Midwest; however, since the early 2000s, species like the western corn rootworm (WCR) have steadily become established in Oregon. Likewise with the southern corn rootworm (SCR); no information is available regarding the northern corn rootworm (NCR). Corn rootworms are critical pests affecting corn, and most literature about the biology, ecology, and management comes from these midwestern and eastern U.S. states. This proposal focuses on collecting information about the corn rootworm complex in Oregon by studying the population dynamics and geographical distribution while informing stakeholders about the findings. We hypothesize that this pest complex is widely spread and affects several crops besides corn, and the damage is more significant than expected. As a result of this study, we will update the current distribution and heat maps where the complex most likely will develop.

Key Words: corn rootworm, Chrysomelidae, spotted cucumber beetle, maize, root rating

Objective(s): The main objectives of this proposal are to gain an understanding of (1) population dynamics and geographical distribution and (2) to inform stakeholders about our findings using several outlets.

Justification: Corn rootworms significantly impact agriculture, economic stability, and, therefore, food security. This complex is among the most destructive pests of corn crops worldwide. Investing in corn rootworm research support in Oregon is a proactive pest management approach while developing innovative, environmentally friendly, and cost-effective solutions to ensure agricultural sustainability.

Procedures:
Objective 1A. Population dynamics. Field research will be conducted in 2025 and 2026 on at least five commercial crops: maize, squash, artichoke, and barley or wheat. Densities of corn rootworms will be

monitored with Pherocon AM yellow sticky traps from Great Lakes Integrated Pest Management, Vestaburg, MI (4 per field per ½ acre field). Varieties, planting dates, and agricultural practices will be recorded. Sticky traps will be attached to metal fencing and replaced with new traps every 7 days from early July through late September. Following retrieval, traps will be returned to the laboratory and stored at 6°C until examination. All corn rootworm species will be counted. A general linear model (GLM) procedure will be used to construct analysis of variance (ANOVA) tables for overall corn rootworm densities (per species) as measured with Pherocon AM. A Least Significant Difference test (LSD, $P = 0.05$) will compare adult corn rootworm means per crop by year. The following video https://www.youtube.com/watch?v=EtaaFYVPR_A explains the setup of traps, retrieval, counting, and reporting of this pest.

Objective 1B. Geographical distribution. Data will be collected in 2025 and 2026 by placing two double-sided, yellow sticky cards (Cascade Ag Service, Wenatchee, WA) per maize field around the Willamette Valley. If partners are identified, we will set traps in eastern OR. At least five sites per region will be surveyed. Each card will be secured to a corn stake approximately 1.2 m above the soil surface, as described in our YouTube video. Trapping will begin in early June and continue until September in both years. Sticky cards will be collected and replaced weekly, and corn rootworms will be counted. The minimum distance between sites will be approximately 750 m. Mean corn rootworm counts for each site in the summer and fall of each year will be mapped using GPS coordinates and the GPS Visualizer Utility. Weather data will be collected from AgWeatherNet weather stations close to the trapping sites to determine the phenology of corn rootworms. Data will be entered in USPESt.org.

Objective 2. Sharing information. Sharing timely information is crucial to ensuring alignment and driving action. We will use several outlets to share our findings. A critical needs assessment conducted in 2023 involving producers, researchers, Extension faculty, and support staff identified the need to have a single website serving as a hub for pest activity reports and applied pest forecast services. Thus, we will use the Oregon IPM Center leading site for reporting purposes (https://agsci.oregonstate.edu/oipmc).
Communication outlets:

- Verbal communication: presentations explaining the biology and ecology of this pest complex and recommending adequate control methods if needed. Presentations will take place during the winter and summer field days.
- Newsletter. The results will be disseminated using the IPM, VEGnet, and OPVC mailing lists.
- Social media. We will use LinkedIn and Instagram #IPM accounts to share information.
- Written fact sheets will be published on the OSU Extension Communication site.

Impacts: We expect this project to last at least two years. Our short-term goal is to develop educational programming designed and conducted for various vegetable commodity groups throughout Oregon. Critical needs include corn rootworm identification. Although not part of this proposal, we will create hands-on material to demonstrate looks-alike and showcase the diversity of Chrysomelidae. Training sessions will be in-person, offering live demonstrations using a 'train the trainer' approach. All training materials will be hosted at the Oregon IPM Center website. In addition, all material in English will be made available in Spanish using the language educational model.

Relation to Other Research: This proposal's other objectives were submitted to the Agricultural Research Foundation (ARF) and will be forwarded to the Western Regional IPM Center (WRIPMC). The request for funding to ARF included WCR distribution and host plant selection, which are topics of Ms. K. Schoelling's thesis. The WRIPMC proposal will consist of objectives on phenology models and degree days.

*2025-27 OPVC BUDGET*

| Category | Requested Funding (Yr 1) | Other Funding Requested |
|---|---|---|
| **Salaries** | | |
| Faculty (personal salary) | - | |
| Faculty research assistant | - | |
| Post Doc | - | |
| Graduate student[1] | 4,000 | 20,000 |
| Undergraduate student[2] | 2,550 | |
| Other labor | | |
| OPE for all categories (GS 39% + US 10%) | 1,815 | 7,800 |
| | **8,365** | **27,800** |
| Travel | | |
| Domestic -in state[3] | 3,640 | |
| Domestic-out of state | 1,500 | 5,000 |
| Foreign | - | |
| | **5,140** | **5,000** |
| Services | - | |
| Supplies[4] | 2,000 | 3,000 |
| Equipment | | |
| Other[5] | 1000 | 2,000 |
| | **3,000** | **5,000** |
| Total | **16,505** | **37,800**[6] |

[1] Salary for a Master Student + 39% OPE for 20% of her time.
[2] Salary for an Undergraduate Student + 10% OPE @17$/hour X 150 hours
[3] Costs associated with traveling to and from field sites. $0.66/mile OSU rate X 100 miles X 20 weeks year 1. Same expenses for year 2. Out-of-state funds are requested to partially help students attend a professional meeting.
[4] Funds are requested for the purchase/service of pheromone traps, stakes, and field flags.
[5] Funds are requested for printing and mailing fact sheets, bookmarks, etc.
[4] ARF + WRIPM proposals that will be submitted in 2025.

**Tuition and Fee Coverage Plan (if applicable):** Tuition and fee charges are not allowed as ARF budget items, but if you include a graduate student assistantship in your budget, please indicate how tuition and fees will be paid here.

**TITLE: 'Veg Education' - Increasing exposure and education for processed vegetables through the 4H 'Teens for Teachers' program with experiential learning activities for High School and Elementary School students**

**YEAR INITIATED:** 2025-26 **CURRENT YEAR:** 2025-26 **TERMINATING YEAR** 2025 - 2026.

**PERSONNEL & COOPERATORS:**

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**FUNDING REQUEST FOR 2025-26: $32,260.00**

**JUSTIFICATION:**

According to the Dietary Guidelines for Americans (2020–2025), most consumers fall far short of the recommended intake for fruits and vegetables – with 90% eating too few vegetables, and 80% too few fruits. Despite clinical evidence and effective public health campaigns (e.g. Cox et al., 1998), fruit and vegetable consumption remains below recommended daily-intake (Ragaert et al., 2004). Although individuals ultimately decide what and how much to consume, their personal relationships; the settings in which they live, learn, work, play, and gather; and other contextual factors—including their ability to consistently access healthy and affordable food—strongly influence their choices (Dietary Guidelines for Americans 2020 – 2025). Malnutrition, including both undernutrition and obesity, is a leading contributor to the burden of disease worldwide (Forouzanfar et al., 2015; International Food Policy Research Institute, 2017). Approximately 40% of children and adolescents are overweight or have obesity; the rate of obesity increases throughout childhood and teen years. As a result, 74% of adults are overweight or have obesity (USDA Dietary Guidelines, 2020). Additionally, unsustainable Western food systems are increasingly recognized as a key driver of environmental degradation and climate change (Willett et al., 2019). In response, the United Nations has declared a Decade of Action on Nutrition and expert panels have called for multilevel, multisectoral policy responses to improve food environments (FAO and WHO, 2014). Governments around the world are increasingly implementing food and nutrition policy actions to reduce the impact of health, environmental and economic burden caused by unhealthy diets (Browne et al., 2020).

While it is clear that many factors influence consumers interest in foods, such as taste, convenience, and cost – it is important to acknowledge that exposure and education at an early stage in life can positively affect consumer interest and acceptance of vegetables, especially *processed* vegetables, later in life. According to the International Food Information Council Food & Health Survey (2024), 8 in 10 Americans consider if a food is processed prior to purchasing it, and among those who consider if a food is processed, most say they avoid processed foods at least sometimes. Additionally, survey respondents also expressed confusion about what the term 'processed' means in relation to food production. It is a common misconception that fresh vegetables are always superior in nutritional value to processed vegetables. Several investigations have shown frozen or canned vegetables can actually have higher nutritional value than fresh products. Fresh vegetables are subject to quality and vitamin losses during transportation and storage, whereas processing before these losses occur can yield a nutritionally superior product. Because of the varied growing and harvesting seasons of different vegetables at different locations, the availability of fresh vegetables differs greatly in different parts of the world. Processing can transform vegetables from perishable produce into stable foods with long shelf lives and thereby aid in the global transportation and distribution of many varieties of vegetables (Singh & Jen, 2021).

Much of the market research available focuses on the adult as the main consumer, however, it is important to recognize that educational interventions for young adults can affect their future purchase and dietary decisions. To make a meaningful impact, it is critical to introduce educational and practical activities aimed at teaching the benefits of vegetable processing and increasing awareness and consumption of processed vegetables for students and young adults. (Gilles et al., 2020) highlighted evidence to suggest that comprehensive, multicomponent school-based interventions hold greater potential in promoting and supporting positive health changes in the long-term than single-component nutrition interventions (Assembly of First Nations, 2008; Kulinna, 2016; Naylor et al., 2010). Comprehensive School Health (CSH) is an internationally recognized school-based health promotion approach that integrates multiple aspects of the school environment through four mutually reinforcing components (social and physical environments, teaching and learning, school policy, and partnerships and services) into a single intervention. Evidence from evaluations in non-Indigenous populations have demonstrated that CSH interventions have resulted in increased physical activity, improved dietary habits, and decreased rates of obesity and chronic disease among children (Fung et al., 2012; Stewart-Brown, 2006; Veugelers, 2010; Tran et al., 2014). This holistic approach can be particularly effective in helping students and youth understand more about processed vegetables and encouraging their consumption. By creating a supportive social and physical environment, schools can make processed vegetables more accessible and appealing. Integrating nutrition education into the curriculum through engaging lessons and hands-on activities, such as cooking classes and farm visits, can enhance students' knowledge and interest in processed vegetables. School policies that prioritize healthy eating and partnerships with local farms and food producers can further reinforce these efforts by ensuring a consistent supply of nutritious options and providing real-world learning experiences. Collectively, these components create a comprehensive intervention that promotes lifelong healthy eating habits among students (Action for Healthy Kids, 2023; iCliniq, 2024; CDC, 1996).

Many students and young people show limited interest in consuming vegetables and lack education on vegetable processing. This disinterest can be attributed to various factors, including limited exposure to diverse vegetable options and a lack of understanding of their nutritional benefits (Emm et al., 2019; Merritt et al., 2021). As previously indicated, practical school-based interventions, such as educational presentations, cooking classes, farm visits, and visits to research facilities, can play a crucial role in fostering an interest in vegetables among students. These hands-on experiences not only teach students about the importance of vegetables in their diet but also provide them with the skills to process and cook them, potentially leading to lifelong healthy eating habits (CPSTF, 2017). By integrating these practical interventions, schools can create a more engaging and informative environment that encourages all students to appreciate and consume more vegetables, ultimately supporting their overall health and well-being (Singh & Jen, 2021).

The funding for the creation and implementation of ‘Veg Education’ activities will provide the Food Innovation Center (FIC) faculty and staff with an opportunity to work collaboratively with the Portland 4-H STEM project ‘Teens for Teachers’ and Roosevelt High School to develop and pilot activities and teaching materials focused on increasing awareness and interest in processed vegetables for students. The Portland 4-H STEM program works to provide relevant, engaging, and hands-on learning opportunities to ignite youth spark’s (interests) through the Positive Youth Development lens and the philosophy of Learning by Doing. The mission of the STEM program is to improve youth’s perceptions of themselves as future leaders of STEM and empower youth to reach their full potential by working and learning in partnership with caring adults while fostering their ability to take on challenges of the 21st century. In 4-H, young people prepare themselves for economic and social success while making positive contributions to their communities. This unique opportunity will build on 4H initiatives and involve two student groups. The project team will first conduct educational teaching activities, field trips, and cooking classes to educate Rosevelt High School students about processed vegetables. Then, through the 4H 'Teens for Teachers' Program, the Roosevelt High School students will lead teaching and cooking activities with local elementary school students that highlight Oregon processed vegetables. This approach and collaboration with the 4H 'Teens for Teachers' project will effectively increase the number of students that are able to participate in the project activity and maximize overall impact. 4H programs aim to remove barriers to participation by providing free programs, transportation to field trips, and covering admission costs for youth and families. Incorporating youth voices and ensuring programs are youth driven is a key focus of how they provide their programs. Making sure youth are involved in selecting what they want to learn and spend their time on is important, not only for their belonging, but it also gives them an opportunity to explore their interests with trusted adults who can help connect them with information, resources, and industry professionals. Program staff and partners also work to provide relevant, inclusive, and representative activities, workshops, and career discussions based on participants interests and needs in a space where all feel welcome and respected.

The FIC, in partnership with the Portland 4-H STEM project 'Teens for Teachers' and Roosevelt High School, will build on efforts and previous interest from the 4H program to incorporate experiential educational activities focused on agriculture and food science. There is a clear need to 'pull back the curtain' of vegetable processing and introduce students and youth to processed vegetables in an educational and interactive way. Our collaborative and 'cross curricular' approach with Roosevelt High School will be effective for implementing activities and field trips focused on educating and introducing students to the benefits and culinary applications for processed vegetables. This project also provides an exciting opportunity to support student led teaching efforts and further engage elementary school students in cooking activities focused on processed vegetables through the 4H 'Teens for Teachers' program. We are confident that this approach will excite, inspire, and educate students about the benefits of processed vegetables, and provide culinary knowledge that leads to sustained interest in processed vegetables for years to come.

FIC also works collaboratively with the Oregon Department of Agriculture (ODA) and has experience creating food products for programs working to change the way our children eat in the school lunchroom. Additionally, the FIC has worked with Health Care Without Harm previously to help food entrepreneurs place their value-added food products into the hands of school's lunchrooms and institutional buyers. The FIC facility has a commercial kitchen, research and development lab, analytical lab, and a food processing area located within the building which can be used to host cooking workshops and educational seminars. The FIC also has relevant food processing equipment that allows us to create value added food products that are commercially scalable. Our team is well connected in the food industry with ingredients suppliers and representatives from co-packing facilities. The education, experience, and perspective of the staff at the FIC make us uniquely positioned to deliver on this project. We expect that the outcomes of this project can have far reaching implications for schools throughout the northwest and beyond.

**State how this project relates to other projects in Idaho, Oregon and Washington.**

Oregon is ranked 4th in United States green bean production. In 2020, the state grew 1.3 million tons. That was 8% of the US green beans. All those beans were worth over 20 million dollars to Oregon. There are close to 500 farms that grow green beans on about 13,000 acres (ODA, 2021). Most of the green beans grown in Oregon are for ***processing***, not to sell fresh. The majority are canned or frozen (Perdue, 2017).

Wisconsin produced the most snap beans in the United States in 2021 followed by New York, Michigan, **Oregon** and Florida. Wisconsin produced 669.3 million pounds of snap beans in 2021, accounting for more than 44% of the snap beans produced in the United States.

In terms of production and value, sweet corn is the second largest processing crop, surpassed only by tomatoes. Sweet corn is grown in all 50 states. However, Florida, **Washington**, Georgia, California, New York and **Oregon** are the largest producers of all types of sweet corn. Oregon produces approximately 5.27% of total National production. The production of sweet corn for processing is heavily concentrated in the upper Midwest and the Pacific Northwest with Minnesota, **Washington** and Wisconsin being the leading producers. The total value of the 2021 sweet corn crop was estimated at over $774 million. Of that amount, 75 percent was produced for the fresh market and 25 percent for the processing market. Processing sweet corn production (both frozen and canned) in 2021 had a total crop value of $193 million (NASS, 2022).

Sweet corn was the 19th commodity on Oregon's Top 20 Commodity List in 2020. The monetary value of sweet corn was $41 million. There are two distinct kinds of corn that are grown in Oregon, one of which is used as a grain in animal feed and the other is corn for retail consumption.

These statistics highlight production value of processed vegetables in these states, however, there are educational initiatives and efforts aimed at promoting processed vegetables in this region as well. In Idaho, the Department of Education supports Child Nutrition Programs by providing USDA Foods, including processed vegetables, to schools participating in the National School Lunch Program (NSLP). These efforts include educational initiatives that teach students about the nutritional benefits and culinary uses of processed vegetables (Idaho Department of Education). In Washington, the Farm to Child Nutrition Programs enrich community connections with fresh, healthy food and local food producers by integrating nutrition and agricultural education into school curriculums. This includes hands-on learning opportunities such as gardening, farm visits, and cooking classes that emphasize the use of processed vegetables (Washington State Office of Superintendent of Public Instruction). In Oregon, the Willamette Valley Vegetable Educational Program, supported by Oregon State University and the Oregon Processed Vegetable Commission, offers educational sessions on topics like vegetable processing and cooking techniques. These programs aim to increase students' knowledge and interest in using processed vegetables in their meals (OPVC, 2024). Collectively, these educational efforts in Idaho, Washington, and Oregon are helping to foster healthier eating habits among students by providing them with the knowledge and skills to incorporate processed vegetables into their diets.

**HYPOTHESIS & OBJECTIVES:**

Providing students with educational, fun, and innovative experiential 'cross curricular' learning activities focused on increasing knowledge and awareness of processed vegetables will create revenue for the vegetable industry while contributing to increased vegetable consumption and healthier dietary choices for young adults.

The objectives and activities for this project can be split into three phases 1) Plan, 2) Act, and 3) Share. FIC will work collaboratively with the Portland 4-H STEM project and Roosevelt High School to pilot this experiential 'cross curricular' teaching program focused on educating and introducing students to processed vegetables in new and exciting ways. This project will involve students in two ways; first the project team will organize and host four educational presentations / cooking classes and 3 'field trips' with the Roosevelt High School students. During this phase, the students will also learn about safe food handling and receive mentorship to complete the required testing to obtain food handlers' licenses. This has been a component in previous 4H 'Teens for Teachers' projects and has shown that many students receive their license and then pursue jobs in the food industry. The project team will then work with the Roosevelt High School students to organize a minimum of 2 educational presentations / cooking class activities for local elementary school students. Each class activity, cooking class or field trip will focus on one of the vegetables included in the OPVC (snap beans, beets, broccoli, cauliflower, carrots, and sweet corn) with the end goal that all vegetables listed above have been included in the project activities. Class teaching activities are defined as 'educational presentations' that highlight vegetables and vegetable processing methods; cooking class activities are defined as hands-on cooking and food preparation classes that have students working with processed vegetables; and 'field trips' are defined as off-site visits to farms, processor facilities, or other relevant locations. This project will integrate into the Roosevelt School academic calendar – teacher, student, and class availability will determine the schedule, however, estimated timelines for project activities is included below.

| Phase 1 – Plan: Establish a system for collaborative planning and teaching curriculum development. | | | | |
|---|---|---|---|---|
| Objectives and Activities | Partners | Performance Measure | Target | Timeline |
| Obj. 1) Work collaboratively with project partners to plan 'cross curricular' teaching activities<br><br>Activity 1: Organize project kick-off meeting to provide high level overview and outline project goals<br><br>Activity 2: Develop a project schedule & timeline suitable for all partners<br><br>Activity 3: Identify and prioritize teaching activities<br><br>Activity 4: Identify off-site 'field trips' (i.e. farm visits, processing facility visits, etc.)<br><br>Activity 5: Identify cohorts of elementary students for the ''Teens for Teachers'' activities | OPVC producers, 4H STEM program 'Teens for Teachers' project, Roosevelt High School | • # of partners<br>• Confirmed project schedule<br>• # of teaching activities planned<br>• # of field trips planned<br>• # of processed vegetables included in teaching activities<br>• # of vegetables included in field trips<br>• # of elementary students included in 'Teens for Teachers' activities | • 8 partners (incl. producers)<br>• Confirmed project schedule (1yr completion)<br>• 4 teaching activities / cooking classes planned for High School Students<br>• 2 teaching activities / cooking classes planned for elementary school<br>• 4 field trips planned<br>• 6 different processed vegetables included in teaching activities | Feb-Mar |

| Phase 2 – Act: Implement teaching plan and 'cross curricular' activities at partner school | | | | |
|---|---|---|---|---|
| Objectives and Activities | Partners | Performance Measure | Target | Timeline |
| Obj. 2) Implement 'cross curricular' teaching plan that includes educational presentations, hands-on cooking classes, and off-site 'field trips'<br><br>Activity 1: Conduct educational presentations to introduce students to vegetables, vegetable processing methods, and safe food handling<br><br>Activity 2: Conduct hands-on cooking classes with students<br><br>Activity 3: Conduct 'field trips' to visit farms and vegetable processors with students<br><br>Activity 4: Assist students with obtaining food handlers' license<br><br>Activity 5: Provide mentorship for the students as they conduct 4H 'Teens for Teachers' Program and teach local elementary students about processed vegetables | OPVC producers, 4H STEM program 'Teens for Teachers' project, Roosevelt High School | • # of teaching activities executed<br>• # of cooking classes executed<br>• # of farms or veg processors engaged<br>• # of field trips completed<br>• # of student participants<br>• # of processed vegetables highlighted<br>• # of 4H 'Teens for Teachers' student-led activities that incorporate processed veg<br>• # of Teens that obtain food handlers license | • 4 teaching activities<br>• 4 cooking classes<br>• 3 farms or veg processors visited during field trips<br>• 80 students from Roosevelt High School participating<br>• 140 students from local elementary schools participating<br>• 6 different processed vegetables included in teaching activities and cooking classes<br>• 2 student-led teaching sessions<br>• Estimated 40 Roosevelt High School students that obtain food handlers' license | March - May |

| Phase 3 – Share: Reporting of results in the form of a teaching framework and public showcase forum | | | | |
|---|---|---|---|---|
| Objectives and Activities | Partners | Performance Measure | Target | Timeline |
| Obj. 3) Document project activities and compile teaching materials into a framework that can be used by other schools and share project results in a public forum.<br><br>Activity 1: Compile educational lectures, class activities, and cooking class materials into an open-source easy-to-use guide<br><br>Activity 2: Share and disseminate the project results with OPVC and other stakeholders in a public forum that highlights the achieved results of project | OPVC producers, 4H STEM program 'Teens for Teachers' project, Roosevelt High School | • # of lecture materials / presentations created<br><br>• # of cooking class activities created<br><br>• # of stakeholders project is disseminated to in public forum | • 4 presentations created<br><br>• 4 class activities / cooking classes with High School Students created<br><br>• 2 class activities with Elementary School Students created<br><br>• 1 final project report<br><br>• Minimum 20 stakeholders at public forum | June - Oct |

**PROCEDURES:**

FIC will assume project management responsibilities for the project. As listed above, the project will be split into three phases for year 1 and the objectives and activities organized within each phase. Phase 1 is the 'plan' stage for the project and is intended to organize and schedule project tasks with partners – key activities include the following: Organize project kick-off meeting to provide high level overview and outline project goals; Develop a project schedule & timeline suitable for all partners; Identify and prioritize teaching activities; Identify off-site 'field trips' (i.e. farm visits, processing facility visits, etc.). Phase 2 is the 'act' stage of the project, and encompasses the teaching activities / cooking classes and off-site field trips – key activities include the following: Conduct educational presentations to introduce Roosevelt High School students to vegetables and vegetable processing methods; Conduct hands-on cooking classes with Roosevelt High School students; Conduct 'field trips' to visit farms, vegetable processors, and/or other relevant locations with students. As previously mentioned, Roosevelt High School students will learn about safe food handling and take an online test to receive their food handler's permit. In this phase (with mentorship from project leaders), students will also conduct educational cooking classes with students from local elementary schools to share knowledge that they have gained and to teach the younger students how to cook with processed vegetables. Project partners will provide mentorship, and the 4H 'Teens for Teachers' students will lead the sessions. These activities will be documented and the work will be presented in phase 3 of the project. Phase 3 is the 'share' stage of the project, and has a main focus to compile the project activities into a final report, and include a framework that can be easily adapted and implemented by other interested school districts – key activities include the following: Compile educational lectures, class activities, and cooking class materials into an easy-to-use guide; Share and disseminate the project results with OPVC and other stakeholders in a public forum. FIC will also schedule meetings with Oregon Processed Vegetable Commission members as needed so that OPVC is informed of the projects progress and status at each stage.

**ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:**

Educational activities such as teaching lessons, cooking classes, farm visits, and processing facility tours that incorporate processed vegetables can significantly benefit both the processed vegetable industry and students that participate in these activities. Working collaboratively with the 4H 'Teens for Teachers' program and Roosevelt High School will allow the project team to work with and inspire a diverse group of students. The most recent full year data for Roosevelt HS includes the 2021-2022 school year. Roosevelt HS served 1,281 9th- 12th grade students and the demographic breakdown of the students includes 38% Hispanic/Latino, 32% White, 14% Black/African American, 10% multiracial, 3% Asian, 2% Native Hawaiian/Pacific Islander, and 1% American Indian/Alaska Native (3). Current 4-H programming at Roosevelt reaches 88 teens with demographic information as follows: 33 Hispanic/Latino, 24 White, 23 Black/African American, 4 multiracial, 2 Asian, 2 Native Hawaiian/Pacific Islander.

For the industry, these activities serve as a powerful marketing tool, showcasing the versatility and convenience of processed vegetables, thereby increasing awareness and demand. They also help demystify the processing methods, building consumer trust and appreciation for the quality and safety of processed products. For students, these hands-on experiences provide valuable knowledge about the journey of vegetables from farm to table, fostering a deeper understanding of food processing. The inclusion of safe food handling education and the project goal for students to obtain their food handlers' license will lower barriers for them to pursue entry level jobs in food handling and processing. Last year, 92 out of 104 Roosevelt High School students received their food handlers' license, and 14 students got a job in the food industry as a result of participation in the 4H 'Teens for Teachers' program. We expect that this project will achieve similar results this year. Furthermore, by engaging with processed vegetables in a practical and enjoyable way, we expect that students are more likely to develop an interest in cooking and consuming these products, promoting healthier eating habits and lifelong culinary skills. This dual benefit creates a win-win situation, enhancing industry growth while informing and inspiring the next generation of consumers.

## PROJECT TIMELINE:

| Year 1 | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|
| **Project Timeline** | | | | |
| Kick-off meeting with project partners | | | | |
| Confirmation of scheduled activities at schools | | | | |
| Confirmation of scheduled 'field trips' | | | | |
| Execute teaching and cooking activities | | | | |
| Execute 'field trips' | | | | |
| High School Student led project work with Elementary students | | | | |
| Project reporting | | | | |
| Stakeholder meeting results presentation and public forum | | | | |

*Tthis project timeline is based on a schedule previously used between 4H 'Teens for Teachers' and Roosevelt High School, but there is flexibility for a project start date in the fall if OPVC feels that may be more suitable.*

## LITERATURE REVIEW:

Previous research has indicated that efforts to include children and young adults in hands-on food preparation activities can increase interest and acceptance of vegetables and other healthy eating habits. Chu et al. (2012), observed that a higher degree of involvement in food-related activity may be instrumental in the development and maintenance of healthy eating behaviors in children. Encouraging the development of food preparation skills could be a viable approach in health promotion programs, where a hands-on approach can be seen as a way to enhance the effectiveness of nutrition education. Teaching children how to prepare simple, cost-effective and healthful meals can help in the development of a life skill that could be maintained through adulthood. Similarly, Cunningham-Sabo & Lohse (2013) conducted a study that included an experiential school-based food education program (Cooking with Kids), CWK) and reported that fruit and, especially, vegetable preferences are positively influenced by an intervention that provides opportunities for all students, regardless of previous cooking status, to directly experience these foods through tasting or cooking activities. Maiz et al. (2021), conducted research to determine if involving children in the different steps of meal preparation (choosing a recipe, purchasing the ingredients, and cooking) effectively reduces food neophobia in the short-term and medium-term, comparing it to a standard nutritional education (NE) program. The variables studied were: food neophobia, choice, and intake, willingness to try new foods, vegetable preferences, diet quality, and cooking attitude and self-efficacy. The study results identified a reduction in food neophobia, which suggests that those HO [hands-on], participatory, and positive experiences, and the resulting exposure increment, might be useful for improving children's diet quality by increasing their willingness to try new foods, fruit and vegetable preference, and consequently their consumption.

Additionally, the FIC currently has or has previously had funding through several programs for similar types of food focused development programs involving schools or institutions:

1. Farm to Institution Collaborative for the United States Department of Agriculture USDA-AMS- TM-RFSP-G-22-0009
2. Plant Forward Future; Partners Ecotrust, HCWH, ODA, WSDA, OSU/FIC
3. Institutional Purchasing Pathways: Partners Ecotrust, HCWH, Mudbone, Grown/Feed'em

Freedom, Prosper Portland, OSU/FIC

4. Oregon Farm to School Program; Partners ODA, ODE, Ecotrust, OFSSGN, Food Corps, OSU/FIC
5. Oregon Farm to Institution Collaborative; Partners 16 local and Statewide partners
6. Lake County Development Corporation; State of Montana technical assistance for CN foods

Previously, the FIC has completed formulation and sensory research for the following projects:

**Helping Schools, Hospitals and State Prison Systems prepare, purchase, and communicate with the food industry produce reduced sodium foods – one kitchen at a time**

**ISSUE:**
Excess sodium increases blood pressure because it holds excess fluid in the body, and that creates an added burden on the heart. Too much sodium will increase your risk of stroke, heart failure, osteoporosis, stomach cancer and kidney disease. ... Even foods such as breads and cereals can have high amounts of salt. https://www.livescience.com/36256-salt-bad-health.html

Daily, the National School Lunch Program serves over 30 million children, the School Breakfast Program serves over 14.7 million children and the Child and Adult Care Food Program serves over 6.1 million children.

Schools are an important player in overall national efforts to reduce the amount of salt that people eat. As such, schools participating in the National School Lunch and School Breakfast Programs will continue to reduce the amount of salt in meals by choosing lower sodium versions of foods and flavoring foods with spices and herbs.

Rules apply to USDA-regulated processors that provide foods to the school child nutrition (CN) programs. There are large gaps in knowledge about how to implement the reduction in sodium to the CN specific food systems. The food industry needs to work side by side with research laboratories to confirm that their products are providing reduced sodium for their product, and to further reduce sodium in the foods that they prepare on site for all three food service applications; schools, hospitals and prisons, to reduce the risk of heart disease from diets too high in sodium.

**ACTIONS:**

For this project we are working with the Department of Justice, Oregon Health Authority, Oregon Department of Education, food entrepreneurs and processors on a wide variety of foods, including tortillas, sliced bread, hamburger buns, and noodles. Our process is largely the same for each of the different participants from vendor to purchaser:

• We consult with grant participant to clearly understand their product and process, the sodium content of their food product, and target sodium reduction.

- We conduct a kitchen laboratory study to determine whether the process will achieve the targeted sodium reduction and see if people still find the food product acceptable.
- When kitchen laboratory procedures succeed, we may verify the process on site, because there are many variables, we can't mimic in the kitchen lab.
- We generate a report the participant uses in their sodium reduction work, and standard operating procedures are modified to meet the sodium reduction.
- Implementing the changes and connecting the buyer and vendor confirm our success.

**OUTCOMES:**

Reduction of sodium in tortillas manufactured by the kitchens at the Coffee Creek Detention Facility has been successfully implemented. A study of the reduction of sodium in sandwich bread and buns used in schools has been studied through on site sensory and consumer research, with some implementation by Franz Bread. A meeting of buyers and vendors has been held to connect them and created unique buying opportunities. Training sessions have been held around Oregon in kitchens where cooking is being done locally and recipes could be modified to reduce sodium. Training and advising has been done with a variety of processors to help them connect with the Oregon Farm to School food programs, with many new foods entering the school food systems.

**PNW Proteins Study:**

A consumer sensory evaluation study of grass-fed beef crumble made up of nearly 70% vegetables and sustainably sourced fish jerky was conducted in Portland OR using students at three different schools (one high school and two middle schools) in April 2022. This study was a collaboration with EcoTrust, a non- profit organization based in Portland, OR. The beef crumble was prepared by the Oregon State University (OSU) Food Innovation Center's Product Development team. The fish jerky was purchased from a local snack company. A total of 79 full responses were collected for the fish jerky sample and 91 full responses were collected for the beef crumble sample. The purpose of the study was to measure the students overall liking and attitudes toward healthy Pacific Northwest local proteins and the possibility of introducing them to the school lunch menu. The students were asked to rate the appearance, aroma, overall liking, salt level, aftertaste level, and provide comments on each sample. The data was collected using the Compusense Data Acquisition System.

**OSU Food Innovation Center has supported the research for use of waste stream and pomace grade materials in food products and has included sensory and consumer research to illustrate the possible impacts of the development of new uses of waste stream and pomace grade materials from manufacturing of agricultural products in our region. The FIC has also worked extensively with Farm to School and Health Care Without Harm-Procureworks teams to incorporate our research into everyday meal patterns in school and institutional meal plans. Below please find a list of literature supporting our work.**


- Concha-Meyer, A. A., Durham, C. A., Colonna, A. E., Hasenbeck, A., Saez, B., & Adams, M. R. (2019). Consumer Response to Tomato Pomace Powder as an Ingredient in Bread: Impact of Sensory Liking and Benefit Information on Purchase Intent. *JOURNAL of FOOD SCIENCE*. Published. https://doi.org/10.1111/1750-3...

- Davis, L., Jung, J., Colonna, A. E., Hasenbeck, A., Gouw, V., & Zhao, Y. (2018). Quality and Consumer Acceptance of Berry Fruit Pomace-Fortified Specialty Mustard. *JOURNAL of FOOD SCIENCE, 83*(7), 1921–1932. https://doi.org/10.1111/1750-3...

- La Croix, Kimberly W., Fiala, S. C., Colonna, A. E., Durham, C. A., Morrissey, M. T., Drum, D. K., & Kohn, M. A. (2015). Consumer detection and acceptability of reduced-sodium bread. *PUBLIC HEALTH NUTRITION*, *18*(8), 1412–1418. https://doi.org/10.1017/S13689...

- Gwin, L., Durham, C. A., Miller, J. D., & Colonna, A. E. (2012). Understanding Markets for Grass- Fed Beef: Consumer Taste, Price, and Purchase Preferences. *Journal of Food Distribution Research*, *43*(2), 91–111. http://purl.umn.edu/145331....

- Gwin, L., Durham, C. A., Miller, J., & Colonna, A. E. (2012). Understanding Markets for Grass- Fed Beef: Consumer Taste, Price, and Purchase Preferences. *Journal of Food Distribution Research*, *43*(2).

- Centers for Disease Control, Prevention Strategies & Guidelines, Guide to Strategies to Increase the Consumption of Fruits and Vegetables


**What does a healthy food system look like?**

A healthy food system is comprised of a diverse network of local food systems that are transparent, health- and wealth-promoting, resilient, sustainable, fair, and economically just. The primary role of this food system is to conserve, protect, and regenerate the human and ecological systems that enable food production to support the needs of all eaters now and in future generations. This restorative food system must ensure equitable access to affordable, health-promoting food.

For a more detailed discussion of healthy and sustainable food systems we recommend the following resources:

- Environmental Nutrition: Redefining Healthy Food in the Health Care Sector - Health Care Without Harm
- Food Systems Primer - Johns Hopkins, Center for a Livable Future
- Toward a Healthy Sustainable Food System - American Public Health Association [www.foodcommunitybenfit.noharm.org](www.foodcommunitybenfit.noharm.org)

**REFERENCES:**

Action for Healthy Kids. (2023). Why Schools Need Comprehensive Health Education. Retrieved from actionforhealthykids.org

Assembly of First Nations. An environmental scan of nutrition programs and policies in First Nations schools. Ottawa: Assembly of First Nations; 2008.

Browne J, Lock M, Walker T, et al. Effects of food policy actions on Indigenous Peoples' nutrition-related outcomes: a systematic review. BMJ Global Health 2020;5:e002442. https://doi.org/10.1136/bmjgh-2020-002442

Centers for Disease Control and Prevention. Guidelines for school health pro-grams to promote lifelong healthy eating. MMWR 1996;45(No. RR-9) cdc.gov

Chu, Y. L., Farmer, A., Fung, C., Kuhle, S., Storey, K. E., & Veugelers, P. J. (2013). Involvement in home meal preparation is associated with food preference and self-efficacy among Canadian children. *Public Health Nutrition*, *16*(1), 108–112. https://doi.org/10.1017/S1368980012001218

Cox, D. N., Anderson, A. S., Reynolds, J., Mc Kellar, S., Lean, M. E. J., & Mela, D. J. (1998). Take Five, a nutrition education intervention to increase fruit and vegetable intakes: impact on consumer choice and nutrient intakes. British Journal of Nutrition, 80(2), 123–131.

The Community Preventive Services Task Force (CPSTF). (2017). Nutrition: Gardening Interventions to Increase Vegetable Consumption Among Children. Healthy People 2030. https://odphp.health.gov/

The Community Preventive Services Task Force (CPSTF). (2017). Nutrition: Gardening Interventions. The Community Guide. https://thecommunityguide.org

Cunningham-Sabo, L., & Lohse, B. (2013). Cooking with Kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Childhood Obesity*, *9*(6), 549–556. https://doi.org/10.1089/chi.2013.0076

Emm, S., Harris, J., Halterman, J., Chvilicek, S., & Bishop, C. (2019). Increasing Fruit and Vegetable Intake with Reservation and Off-reservation Kindergarten Students in

Nevada. *Journal of Agriculture, Food Systems, and Community Development*, 9(B), 1-10. University of Nevada, Reno

Food and Agricultural Organization of the United Nations, World Health Organization. Second International Conference on nutrition, conference outcome document: framework for action. Rome: FAO and WHO, 2014.

Forouzanfar MH, Afshin A, Alexander LT, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the global burden of disease study 2015. Lancet 2016;388:1659–724.

Fung C, Kuhle S, Lu C, Purcell M, Schwartz M, Storey K, et al. From "best practice" to "next practice": the effectiveness of school-based health promotion in improving healthy eating and physical activity and preventing childhood obesity. Int J Behav Nutr Phys Act. 2012;9:27.

Gillies, C., Blanchet, R., Gokiert, R. *et al.* School-based nutrition interventions for Indigenous children in Canada: a scoping review. *BMC Public Health* **20**, 11 (2020). https://doi.org/10.1186/s12889-019-8120-3

iCliniq. (2024). What Is the Importance of School Health Programs? icliniq.com

Idaho Department of Education. (n.d.). USDA Foods & Processing / Child Nutrition Programs. *Idaho Department of Education*. sde.idaho.gov

International Food Information Council. 2024 Food & Health Survey. June 20, 2024. Available at: https://foodinsight.org/2024-food-health-survey/

International Food Policy Research Institute. Global nutrition report. Washington DC: International Food Policy Research Institute, 2017.

Kulinna PH. School staff perceptions of factors influencing participation in a Whole-of-School initiative in an Indigenous community. Health Educ J. 2016;75(7):869–81.

Maiz, E., Urkia-Susin, I., Urdaneta, E., & Allirot, X. (2021). Child Involvement in Choosing a Recipe, Purchasing Ingredients, and Cooking at School Increases Willingness to Try New Foods and Reduces Food Neophobia. Journal of Nutrition Education and Behavior, 53(4), 279–289. https://doi.org/10.1016/j.jneb.2020.12.015

Merritt, E., Peterson, A., Evans, S., Marston, S. A., & Zuiker, S. (2021). Learning About Culture and Sustainable Harvesting of Native Plants. *NSTA Science and Children*, 58(4). NSTA

National Agricultural Statistics Service (NASS), 2022. https://www.agmrc.org/commodities-products/vegetables/sweet-corn

Naylor PJ, Scott J, Drummond J, Bridgewater L, McKay HA, Panagiotopoulos C. Implementing a whole school physical activity and healthy eating model in rural and remote First Nations schools: a process evaluation of Action Schools! BC. Rural Remote Health. 2010;10(2):1296

Oregon Department of Agriculture. "Oregon Agricultural Statistics." October 2021. https://www.oregon.gov/ODA/shared/Documents/Publications/Administration/ORAgFactsFigures.pdf.

Office of Superintendent of Public Instruction. (n.d.). Farm to Child Nutrition Programs. *Washington State Office of Superintendent of Public Instruction*. ospi.k12.wa.us

Oregon Processed Vegetable Commission. (2024). Willamette Valley Vegetable Educational Program. *Oregon Processed Vegetable Commission*. opvc.org

Perdue, Sonny and Hubert Hamer. "Census of Agriculture." United States Department of Agriculture, 2017. nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf.

Ragaert, P., Verbeke, W., Devlieghere, F., & Debevere, J. (2004). Consumer perception and choice of minimally processed vegetables and packaged fruits. *Food Quality and Preference*, *15*(3), 259–270. https://doi.org/10.1016/S0950-3293(03)00066-1

Jen, Joseph J. and Singh, R. Paul. "vegetable processing". *Encyclopedia Britannica*, 13 May. 2021, https://www.britannica.com/technology/vegetable-processing  Accessed 4 January 2025.

Stewart-Brown S. What is the evidence on school health promotion in improving health or preventing disease and, specifically, what is the effectiveness of the health promoting schools approach? Copenhagen: WHO Regional Office for Europe (Health Evidence Network report); 2006. http://www.euro.who.int/document/e88185.pdf. Accessed January 3, 2025.

Tran BX, Ohinmaa A, Kuhle S, Johnson JA, Veugelers PJ. Life course impact of school-based promotion of healthy eating and active living to prevent childhood obesity. PLoS One. 2014;9(7):e102242.

U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020-2025. 9th Edition. December 2020. Available at DietaryGuidelines.gov.

Veugelers PJ, Schwartz ME. Comprehensive school health in Canada. Can J Public Heal. 2010;101(Suppl 2):S5–8.

Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. Lancet 2019;393:447–92.

**2025-26 BUDGET:** Please provide the following in a table format as shown, listing only the budget items appropriate for your project.

| | OPVC<br><br>_____ |
|---|---|
| **Salaries:** Faculty | $ 12,303.45 |
| Graduate student | |
| Other students | |
| Other labor | |
| **Employee Benefits (OPE):** Faculty | $ 7,856.55 |
| Graduate student | |
| Other students | |
| Other labor | |
| Equipment | |
| Travel: Domestic (in state) | $ 500.00 |
| Domestic (out of state) | |
| Foreign (conferences, etc.) | |
| Operating Expenses [1] | $ 3,600.00 |
| Other Expenses [2] | $ 8,000.00 |
| **Total** | $32,260.00 |

[1] Otherwise known as "Goods and Services" or "Supplies and Materials."
[2] Capital outlays, or other needs. Please detail in footnote.
[2] *Capital outlay – stipend for High School students time for teaching elementary school students ($100 per student, 80 students).*

Please note that no indirect cost or graduate student tuition is allowed.

**ANTICIPATED REQUESTS IN COMING YEARS (if applicable): 2025-26: 2026-27: 2027-28:**

**OTHER SUPPORT OF PROJECT:**

| **Contributor** | **Type of Support** | **Amount ($)** |
|---|---|---|
| Food Innovation Center | In-kind support facility use fee | $ 3,000.00 |
| 4H Program | Bus transportation fees for students | $ 1,000.00 |
| 4H Program | Fee for students to obtain food handlers' license; $20 / student | $ 800.00 |
| TOTAL | | $ 4,800.00 |