2021—2022
Proposals



Oregon
Processed Vegetable
Commission



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Proposals

TITLE: Monitoring Soil Moisture and Temperature Impacts on Soilborne Fusarium Diseases in Processing Vegetable Cropping Systems

YEAR INITIATED: 2019-20 **CURRENT YEAR:** 2021-22 **TERMINATING YEAR** 2021-22

PERSONNEL & COOPERATORS:

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Two OPVC-member farms in the Willamette Valley

FUNDING REQUEST FOR 2020-21: $35,000

JUSTIFICATION: Sweet corn and snap bean production, amongst other vegetable crops grown in the Willamette Valley of Oregon, are impacted by soilborne diseases caused by *Fusarium* species. The decline in sweet corn yields due to Fusarium crown and stalk node rot as well as root rot in snap bean and sweet corn are well documented in the valley. The widespread presence and increasing disease pressure from *Fusarium* in the soils of western Oregon compels growers to define optimum management practices in order to minimize the impact from *Fusarium* diseases.

Soilborne diseases caused by fungi like *Fusarium* species are increasingly important. Although breeding for plant resistance to *Fusarium* species is valuable, it is not the end-all in disease management because *Fusarium* is capable of genetic adaptation for quickly overcoming plant resistance genes. Soilborne *Fusarium* propagules that survive between crops are unreachable by most chemical applications. Fungicide seed treatments provide only short periods of efficacy and cannot protect throughout the growing season for vegetable crops like sweet corn and snap bean. Soil fumigants and other soil treatments are costly, destroy beneficial soil microorganisms, and do not control *Fusarium* existing in plant debris.

Plant pathologists have informally and formally discussed the increased presence of pathogenic *Fusarium* species. The factors behind the greater yield impacts from *Fusarium* are complex and potentially have synergistic interactions. In western Oregon soils, soil temperature and moisture levels during the growing season as well as during the non-cropping months greatly affect disease pressure. It is likely that conditions occurring during winter and early spring months promote the survival and/or propagule increases of *Fusarium* species. It could be a direct effect such as periods of warmer winter temperatures that promote both weed growth and *Fusarium* reproduction on weedy hosts, or indirectly by the modulation of the breakdown of crop plant residues after harvest as well as the variation of other soilborne microflora (bacteria, actinomycetes, other fungi) that are antagonistic to pathogenic *Fusarium* species.

Little has been done in investigations on soil water and temperature effects on these Fusarium diseases in processing vegetables in western Oregon. Peachey (2005) showed that an irrigation regime that imparted drier soil conditions was associated with lower levels of root rot in sweet corn. However, Fusarium crown and stalk node rot disease severity may increase or have earlier onset in sweet corn fields under drier, hotter soil conditions. For long term success in managing fields to suppress *Fusarium*, we need to have enhanced information on how soil temperature and moisture are related to the population of *Fusarium* in the soil as well as their effect on subsequent disease levels.

During the first year (2019-2020) of research on this project, we found that the number of *Fusarium* colony forming units per gram of oven-dried soil were very high overall in the two sweet corn and one snap bean field monitored, especially in the sweet corn field on one farm where *Fusarium* levels in the soil ranged well above 100,000 CFU/g soil. This would explain the overall severe crown root that was found early in sweet corn plants. Root rot was severe in snap beans while root rot was minimal on the adventitious roots of sweet corn. Rotation crops of wheat and grass for seed that were planted in two of the fields we monitored during 2020-2021 funding cycle also exhibited significant *Fusarium* infection of the mesocotyl and roots, respectively. *Fusarium* species were isolated from 88 and 100% of the grass and wheat plants sampled on the 24^{th} of June in 2020.

This project is a continuation of the OPVC-funded project in 2019-2020, and follows on the backside of the current ODA Specialty Crop Block Grant funding period that was awarded in fall of 2020 to the OPVC for this set of research activities. The ODA grant currently funds this project only until October of 2021, and we are requesting partial-year funding to continue the project until Spring 2022, as detailed below.

HYPOTHESIS & OBJECTIVES: We hypothesize that the incidence of *Fusarium* diseases can be predicted by soil temperature and moisture levels. It may be possible to reduce *Fusarium* diseases and their associated losses in sweet corn and snap bean fields by connecting the interaction of *Fusarium* and soil environment with the physical properties of soils and cropping practices such as irrigation and residue management or choice of rotational crops. The proposed investigations would aid in improving the sustainability of processing vegetable production in Oregon.

The objectives of this project are:

1. Evaluate soil conditions (temperature and moisture) as predictors of *Fusarium* levels in the soil.
2. Evaluate *Fusarium* disease incidence and severity of crops in monitored sweet corn and snap bean fields.
3. Evaluate *Fusarium* disease incidence and severity on crop plants in bioassays of field soils.

PROCEDURES:
Objective 1: Evaluate soil conditions as predictors of *Fusarium* levels in the soil.

We will continually monitor soil temperature and soil moisture through the growing season and overwinter. Each field will have two TDR-315 sensors installed in the top 6-inches of soil and two sensors at 12-inches. TDR probes will be connected to data loggers (equipment owned by Buckland's program) that will be located at recording stations within the field. Data will be downloaded at regular intervals and used to describe overall field conditions throughout the season. We anticipate being able to identify temperatures as well as duration of conditions, such as excessively dry and hot summer conditions or winter low temperatures, which may discourage the growth of *Fusarium* or promote propagule die-out. In 2020-21, we anticipate beginning to overlay crop lifecycles with disease incidence to begin to develop predictive modeling. We will also complete a basic soil health assessment including soil physical, chemical and biological properties as a reference for soil moisture and temperature data.

Fusarium population levels in fields will be determined in representative soil samples collected immediately prior to sowing the crop, every two to three weeks until harvest, and then, monthly during the fall/winter until sowing the following spring. Twelve-inch soil cores will be collected in a systematic manner across each of four blocks in each commercial field site. Soil cores will be combined within each block and three subsamples for each block will be evaluated for *Fusarium* colony forming units by soil plating onto a *Fusarium*-selective medium.

Objective 2: Evaluate *Fusarium* disease incidence and severity of crop plants in monitored sweet corn and snap bean fields.

For the crops rotated into the three monitored fields, rot of belowground portions as well as any crown tissues will be evaluated every two to three weeks beginning in June. Plants will be evaluated by digging up 10 plants from each block (40 plants per field), washing soil from the root balls of each plant, and rating for the disease incidence and severity. A sub-sample of plants will be plated onto a *Fusarium*-selective medium to confirm the presence of *Fusarium* spp.

Objective 3: Evaluate *Fusarium* disease incidence and severity on crop plants in bioassays of field soils.

Soil will be collected during early summer to be used to conduct plant bioassays (Darby et al. 2006; Wen et at. 2017) in the greenhouse to determine the soilborne pathogen potential. Ray Leach "Cone-tainer"™ system (Stuewe and Sons, Tangent, OR) will be filled three-quarters of the way in each cone-tainer with a commercial growing medium (Sun Gro Horticulture, Agawam, MA). Air-dried field soil will be used to fill the remaining upper quarter of each cone-tainer. Individual non-treated seeds will be sown in each cone-tainer and 20 cone-tainers per field will be used for each plant species tested. We propose to include a variety of sweet corn and snap bean as well as two other crops, and request that the OPVC advise us on the varieties of sweet corn, snap bean, and the other two crops that would be used in the bioassays. Three to four weeks after sowing, stand counts will be recorded and then plants will be removed from cone-tainers, roots will be washed free of soil, and disease incidence and severity ratings will be made for any rot present on roots or stem tissues. A subsample of affected tissues will be plated out onto a *Fusarium*-selective medium to confirm *Fusarium* spp.

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:
We anticipate that the data from continual soil monitoring will be the start of a database that will identify conditions under which Fusarium diseases will pose an increased likelihood of crop loss. We anticipate the need to continue soil and plant health monitoring over three seasons to gather data under a wide variety of environmental conditions. With these results, growers and field agronomists can adapt crop rotation, irrigation scheduling and crop disease scouting intervals as needed to minimize crop losses.

PROJECT TIMELINE:
Temperature and moisture data will be recorded continually throughout the year. Soil will be sampled in late spring and at planting for full chemical, biological and physical analysis. Soil pathogen sampling and crop sampling will begin in June, after which samples will be collected every 2-3 weeks throughout the growing season.

Activities	Year 2			
	2021-2022			
	Spring	Summer	Fall	Winter
Soil monitoring				
Soil samples				
Soil pathogen sampling				
Plant bioassays				
Sampling of plants in the fields				

LITERATURE REVIEW: *Fusarium* species are common soil inhabitants that can infect most crop species and cause a range of symptoms and types of diseases. Fusarium wilts, root rots, and seed/seedling diseases occur world-wide, causing economically important disease outbreaks (Summerell et al., 2010). Many of the disease symptoms in important annual crops caused by *Fusarium* species lead to lodging, stunting, or death of the plants, and can also result in the accumulation of harmful mycotoxins. In this proposal, we focus on sweet corn and snap bean because of the agronomic importance of these crop species in the processing vegetable systems and the plethora of associated *Fusarium* diseases (Table 1). Many *Fusarium* species are associated with rot of corn roots, stalks, and ears. Root rot of corn has been studied in the Midwestern US for decades. A new *Fusarium* disease that became yield limiting in sweet corn, was observed on *Zea mays* in western Oregon during the 1990s (Fig. 1; (Miller and Ocamb, 2009)). This disease is incited by *F. oxysporum* var. *redolens*, which can cause Fusarium crown and stalk node rot in sweet corn, dent and silage corn (Ocamb, *unpublished*). *Fusarium solani* f. sp. *phaseoli* causes root rot in snap bean (Fig. 1; (Silbernagel and Mills, 1990)). *Fusarium* diseases are common on sweet corn and snap bean in western Oregon processing fields. Ocamb previously investigated sweet corn root rot and Fusarium crown and stalk node in western Oregon (OPVC reports 2002 through 2013) as well as Fusarium root rot of snap bean (OPVC reports 2010 and 2011).

Managing irrigation rates to change the soil moisture content has been shown to impact yield loss due to Fusarium root rot in beans (Miller and Burke, 1998). Clearly, soil moisture content is also affected by air temperatures and precipitation events. Investigations into soil moisture and temperature effects have also been linked with incidence and intensity of *Fusarium* and other soilborne pathogens in other crops (Smiley, 2009). Modeling tools currently exist for crops such as wheat to predict *Fusarium* pressure based on climatic events (http://www.wheatscab.psu.edu). Our proposed work involves different disease and crops, yet promises to provide the basis for future decision making tools.

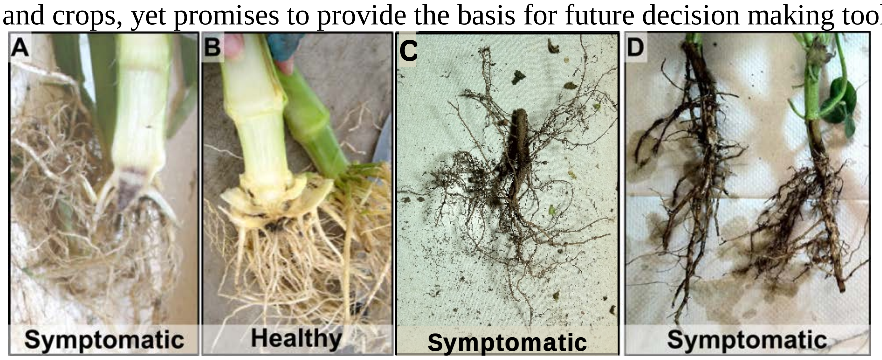

Figure 1. Crown and stalk node rot of sweet corn, 'Jubilee' and root rot of snap bean. (A) Sweet corn plant exhibiting crown and stalk node rot. (B) Crown of corn plant unaffected by Fusarium crown and stalk node rot. Initially, corn leaves turn brown starting at the base of the plant as *Fusarium* grows up the stem and to the roots; infection of the brace root occurs as the pathogen(s) spreads from infected crowns. Rot of stalk nodes and crown tissues interfere with transport through the vascular system and negatively affects yield. This disease is widespread across the Pacific Northwest and occurs on both sweet corn and Round-up Ready dent corn lines. Plants with similar

symptoms have been found in sweet corn produced in Midwestern US, Europe, and South America. (C & D) Snap bean plants grown in western Oregon exhibiting root rot due to soilborne *Fusarium*.

Table 1. ***Fusarium* species reported for corn and snap bean in the USA**

Crop	*Fusarium* species reported*	Diseases incited
Corn (*Zea mays*)	*F. acuminatum, F. avenaceum, F. culmorum, F. episphaeria, F. equiseti, F. graminearum, F. merismoides, F. oxysporum, F. poae, F. proliferatum, F. rimosum, F. sambucinum, F. scirpi, F. semitectum, F. solani, F. sporotrichioides, F. subglutinans, F. temperatum, F. tricinctum, and F. verticillioides*	Crown rot; crown and stalk node rot; damping-off; ear rot; root rot; seed rot; seedling blight; and stalk rot.
Snap bean (*Phaseolus vulgaris*)	*Fusarium oxysporum* f. sp. *phaseoli,* and *Fusarium solani* f. sp. *phaseoli*	Root rot; and wilt.

Literature Cited:

Darby, HM, Dick, RP, and Stone, AG. 2006. Compost and manure mediated impacts on soilborne pathogens and soil quality. Soil Science Society of America Journal 70(2):347-358.

Miller, D, Burke, D (1986) Reduction of Fusarium root rot and Sclerotinia wilt in beans with irrigation, tillage, and bean genotype. *Plant Disease* 70:163-166.

Miller N, Ocamb CM (2009) Relationships between yield and crown disease of sweet corn grown in the Willamette Valley of Oregon. *Plant Health Progress* doi:10.1094/PHP-2009-0831-01-RS.

Silbernagel MJ, Mills LJ (1990) Genetic and cultural control of Fusarium root rot in bush snap beans. *Plant disease* 74:61-66.

Smiley, RW (2009) Water and temperature parameters associated with winter wheat diseases caused by soilborne pathogens. *Plant Disease* 93:73-80.

Summerell BA, Laurence MH, Liew E, Leslie JF (2010) Biogeography and phylogeography of *Fusarium*: a review. *Fungal Diversity* 44:3-13.

Wen, L, Lee-Marzano, S, Ortiz-Ribbing, LM, Gruver, J, Hartman, GL, and Eastburn, DM. 2017. Suppression of soilborne diseases of soybean with cover crops. Plant Disease 101:1918-1928.

2021-22 BUDGET:

	OPVC
Salaries: Faculty Research Assistant (0.10 FTE)	$5,600
Other students	$3,250
Employee Benefits (OPE): Faculty	$3,740
Travel: Domestic (in state)	$1,000
Operating Expenses[1]	$2,500
Total	$16,090

[1] Laboratory and field soil and plant sampling supplies.

ANTICIPATED REQUESTS IN COMING YEARS (if applicable):
We anticipate continuing the study as described thru the winter of 2021-2022. We need to continue the data collection at current rates through the winter and into the following spring of 2022 to observe the over-wintering soil conditions and the resulting early season impacts on the crop in spring of 2022. Additionally, the greenhouse soil bioassay testing will provide a replicated impact of soil disease on emerging crops. At that point, we anticipate to have adequate data amassed to be competitive at outside grant opportunities on a national scale.

OTHER SUPPORT OF PROJECT:
Faculty time, laboratory and field lab space as well as existing equipment from both Buckland and Ocamb is available and will ensure the project is adequately supported; the value of the faculty time (not including Facility Research Assistant time) during 2019-2020 and again 2020-2021 was estimated at $24,926 for Ocamb's effort and $11,612 For Buckland's effort in each year.

PROPOSAL TO THE OREGON PROCESSED VEGETABLE COMMISSION (2021)

1. OPVC PROPOSAL COVER PAGE (1 page)

PROJECT TITLE: Broccoli Breeding and Evaluation

PROPOSED PROJECT DURATION: 1 year (renewed yearly)

Personnel & Cooperators:

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BUDGET TOTALS
TOTAL BUDGET REQUEST (all years):
Year 1: **$8,315 (breeding)**
$5,696 (processing)
$14,012 (total)

2. PROPOSAL NARRATIVE (maximum 5 pages)

JUSTIFICATION and LITERATURE REVIEW

Oregon has had a favorable climate for summer production of broccoli with mild temperatures and a long growing season. The challenges facing broccoli growers are the cost of production and buffering against recent climate perturbations. The challenges facing processors are 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 remains relatively non-mechanized. Large labor crews are typically needed to harvest broccoli and cost and access to labor are the two main problems for broccoli harvest – cost in terms of wages to workers and access in that other crops such as blueberries need labor for harvest at the same time as broccoli. 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. One aspect of mechanical harvest in particular appears to be the removal of leaves from around the head.

The three pillars that are needed to achieve efficient mechanization are the production system, the harvest equipment, and the plant genetics. Our program focuses on the plant genetics. The OSU broccoli breeding program has worked for over 20 years to develop cultivars that have architectural traits that make the cultivar more amenable to machine harvest.

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 portion 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 harvester when harvested by hand. Leaf removal by machine has proved more difficult with the result that heads coming into the plant carry too much vegetative matter, resulting in the rejection of lots. Florets larger than 2½ inches have to 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. These are traits that are amenable to breeding and our exserted head materials already have fewer leaves and smaller florets with the main challenge with these hybrids being achieving high levels of productivity in this architectural package. 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 retained 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 conducted heat tolerance trials of commercial hybrids and a few experimental inbreds to identify materials that showed stable performance across the season. This evaluation needs to be extended to the experimental material in the OSU breeding program to identify those with better buffering to abiotic stresses. We had planned to do this in 2020, but the pandemic prevented us from conducting this aspect of the breeding program.

Disease resistances that are desirable include bacterial head rot, downy mildew, and club root resistances. Inbred lines from the Oregon State University breeding program have the genetic potential to create hybrids with greatly improved head exsertion and segmentation, better color, and low fiber. The OSU hybrids are suitable for machine harvest, and some inbreds possess some of the already discussed disease resistance characteristics. Traits that need improvement in OSU materials are elimination of hollow stems and heavier heads with shallow branching without increasing floret size.

Many OSU hybrids are high quality and have shown stable, high yields over several years, but to bring these into commercial production, cytoplasmic male sterility needs to be backcrossed into inbreds used as the female in crosses. There is also a need to derive new inbreds with improved disease resistance.

OBJECTIVES

1. Breed broccoli cultivars with excellent processing quality and field productivity.
    a. Field traits include exserted heads with reduced leaves about the head on lodging resistant plants. Hybrids should be high yielding, have solid stems with large and heavy heads with shallow branches.
    b. Processing traits include 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. Screen OSU inbreds and hybrids for heat tolerance and stability.
3. Develop seed production systems using cytoplasmic male sterility (CMS) to produce field scale quantities of F_1 hybrid seed.

PROCEDURES

We will continue to derive new inbreds and use these on a small scale to produce F_1 hybrid seed for replicated yield trials. Inbreds lines saved from the 2020 fall trials will be grown from cuttings in the greenhouse. During the winter of 2021, these will be bud-pollinated to perpetuate the line, and crossed to other inbred lines to evaluate combining ability for F_1 hybrid production. Crossing efforts will focus on obtaining enough seed for replicated field trials of new hybrid combinations. Our breeding cycle is set up for fall production in the field, but where sufficient seed is available, we will trial hybrids in the spring as well. New inbreds will be obtained from selections of a random-mated mass selected population originally developed under organic production systems, where cuttings will be brought into the greenhouse for self-pollination. Approximately five or more generations of selfing are required to develop homozygous inbreds.

Inbreds and experimental hybrids and commercial hybrids will be grown in the 2021 main fall planting in the field in a single replicate observation trial, and hybrids alone in a replicated yield and quality evaluation trial. Plots will be evaluated for head size, shape, and exsertion, segmentation, floret texture and color, maturity and disease resistance.

A replicated yield trial will be conducted in the fall. Up to 10 of the most promising OSU experimental hybrids and two to four check varieties will be planted. The other will consist of commercial hybrids selected chosen because of reported heat tolerance and/or have desirable mechanical harvest traits. Hybrids will be transplanted in one row plots 30 feet in length and replicated four times. In addition to observation data, yield data will be obtained. Entries in the yield trials will be taken to the OSU pilot processing plant for blanching and freezing. Frozen material will be evaluated at the OSU winter cutting and will be displayed at the PNVA meetings in Kennewick, WA in November.

Abiotic (heat) stress tolerance will be evaluated by planting sequential replicates at one week intervals across the growing season, with planting timed to span the period of greatest heat during the summer. OSU inbreds and hybrids with sufficient seed will be grown along with a selection of commercial cultivars that performed well in heat trials in 2019 and 2020. Plots will consist of 10 plants per line per planting date and plants will be evaluated at harvest maturity for head quality.

Backcrossing of selected hybrids to place the nuclear genome in the Ogura cytoplasmic male sterile (CMS) background will continue. We will continue developing CMS forms of S454, S462, S463, S471, S473 and S475. Seed production of selected hybrid combinations using a fertile inbred as a male and a CMS inbred as a female will be evaluated in the field using isolation plots.

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:

Quarter 1	Quarter 2	Quarter 3	Quarter 4
Crossing & selfing in the greenhouse,	Packet & prepare for 2021 field season; start transplants for a late June planting.	Maintain plots, conduct evaluations & harvest yield trials and perform quality evaluations; samples taken to Pilot plant for processing and freezing.	Take cuttings from field and root in the greenhouse; compile data and produce reports; conduct sample display of frozen materials.

Requested Budget

1) Breeding (Myers)

Salaries and benefits	
Faculty Research Assistant, field, 0.06 FTE	$2,619
OPE @ 75.4%	$1,966
Wages and benefits	
Student Wages ($12.50/hr, 15 hr/wk, 8 wks	$1,500
OPE @ 10%	$150
Supplies	$300
Land use and greenhouse rental	$1,780
Total	$8,315

2) Processing (Wiegand)

Salaries and benefits	
Faculty Research Assistant	$3,242
OPE @ 61.59%	$1,997
Wages and benefits	
Student Wages	$246
OPE @ 10%	$25
Supplies	$187
Total	$5,696
Grand Total	$14,012

BUDGET NARRATIVE

Salary and OPE is requested for a full time faculty research assistant who will commit approximately 6% FTE to broccoli breeding OPE for FRA is 75.4%. The remainder of salary will come from other sources. For the Food Science & Technology faculty research assistant, approximately 5% FTE will be required to process broccoli samples; the remainder of salary to come from other sources. $1,500 is requested for a summer undergraduate student to assist in plot maintenance and harvest operations. The FST FRA will also supervise an undergraduate student in broccoli processing. Undergraduate student OPE is 10%. Funds for services and 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 (0.5 acre at $1,390 per acre = $695), and greenhouse rental ($1.55*500 sq. ft. = $775).

PROPOSAL TO THE OREGON PROCESSED VEGETABLE COMMISSION (2021)

1. OPVC PROPOSAL COVER PAGE (1 page)

PROJECT TITLE: Green Bean Breeding and Evaluation

PROPOSED PROJECT DURATION: 1 year (renewed yearly)

Personnel & Cooperators:

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CoPI: Zak Wiegand
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Funding request for 2021-2022

Year 1: $31,070 breeding
$8,515 processing
$39,584 total

Contributions from the OSU breeding program

Year 1: **$20,163**

2. PROPOSAL NARRATIVE (maximum 5 pages)

JUSTIFICATION and LITERATURE REVIEW

Green beans grown for processing in the Willamette Valley contribute significantly to the Oregon state economy each year ($26.2 million in 2019). The industry produces a high quality product with the unique flavor, color, and appearance based on the Bush Blue Lake (BBL) class of green beans. Based on genetic studies we have conducted, Blue Lake green beans form a distinct gene pool compared to other snap beans. Furthermore, the growing environment in Western Oregon is unlike any other green bean production area in the United States, and the OSU BBL cultivars have been bred for this environment for more than half a century. Developing productive varieties that are adapted to Western Oregon requires a dedicated breeding effort. BBL green beans have higher yield potential than those bred for the Midwestern U.S. A factor contributing to BBL pod quality is that these types typically have very low fiber pods. A tradeoff of the higher yields is that BBL beans allocate fewer resources to vegetative growth, which can compromise plant architecture and lead to lodging when pod loads are heavy. Lodging and low fiber content contributes to susceptibility to white and gray mold by BBL types.

White mold disease caused by *Sclerotinia sclerotiorum* is a pathogen of more than 400 species of plants including snap bean. Not only does it have the potential to cause heavy yield loss, but it can adversely affect pod quality and cause rejection of whole lots at the processing plant if moldy pods in the lot exceeds 3%. The growing environment in western Oregon is favorable to disease development, especially during cooler and moist conditions that may occur anytime during the growing season. The disease is mainly controlled by fungicide application, which requires precise timing and can be expensive especially if two sprays are used. Biological control also has potential but is expensive has not been implemented on a wide scale.

If genetic variation exists, resistance is usually the most efficient means of achieving control of any disease, as the costs associated with control of that disease are internalized in the cost of the seed. White mold disease resistance is no exception to this principle.

While partial resistance is known, there are challenges to successful deployment. First, the genetic factors conditioning resistance generally have small individual effect and are strongly influenced by the environment (in this respect, white mold resistance shows many similarities to the genetic control of yield). A number of resistance factors are known but these are in different varieties, many of which are not snap beans. Our work supported by the USDA National Sclerotinia Initiative involving meta-QTL analysis revealed that there are 17 factors contributing to resistance distributed throughout the bean genome. More recently, we conducted a genome wide association study (GWAS) and identified 39 regions of the bean genome that harbor resistance. These resistance factors can be combined in the same variety which is best facilitated by the use of molecular markers for selection. In addition to physiological resistance, avoidance traits such as maturity, growth habit, lodging, flower number and retention, and canopy porosity influence the overall level of resistance. This requires an approach to plant breeding that emphasizes field scale breeding using replicated plots with marker assisted selection. Recently, we have screened additional snap bean lines and have discovered several which have useful levels of resistance. We are only beginning to understand what resistance factors they possess, and have begun crossing to these to introgress from these resistance sources. We are using these newly identified resistance sources in our breeding program. We also have about 150 advanced lines ready for screening for disease resistance.

While the main focus of the program is on improving white mold resistance of the BBL types, other traits including yield, maturity, growth habit, pod size, shape and color, and processing characteristics need to be maintained or improved.

OBJECTIVES

1. Breed improved Bush Blue Lake green bean varieties with:
    a. White mold resistance
    b. Improved plant architecture
    c. High economic yield
    d. Improved pod quality (including straightness, color, smoothness, texture, flavor and quality retention, and delayed seed size development)
    e. Tolerance to abiotic stresses

PROCEDURES

Breeding for White Mold Resistance: Because of the overriding need for white mold resistant snap bean cultivars, breeding for white mold resistance continues to be the primary objective of the breeding program.

The focus in 2021 is to evaluate over 150 advanced lines that are potentially resistant to white mold for field performance and processing quality. In 2020, conditions were unfavorable for disease development and we were unable to conduct field screening of our lines.

We were able to evaluate 29 lines in a replicated yield and quality trial and most performed very well, with 11 out-yielding the OSU5630 check cultivar. These lines were originally selected as having relatively high levels of white mold resistance, but they need to be re-evaluated. We will place the majority of these lines in trial along with as many of the remainder of advanced lines as we handle to again evaluate yield quality and disease resistance. Preliminary trials of approximately 75 entries each with two reps and appropriate BBL checks will be grown as described below. In addition to yield and quality trials, these will be screened in our white mold disease trial.

Varietal Development: A long term strategy of the program is to create a MAGIC (Multiparent advanced generation intercross) population to develop a breeding population with high levels of white mold resistance. The parents were identified by our evaluations of the 376 accession Snap Bean Association Panel (SnAP). The population is based on combining eight white mold resistant parents by making four two-way crosses, following with two four-way crosses, and finally a single eight-way cross. At each step the number of individuals crossed increases with the goal of obtaining around 1,000 unique lines by the third round of crossing. These lines are selfed for another three generations to develop homozygous inbred lines. These can be genotyped with molecular markers and phenotyped for disease resistance for molecular mapping studies. The population can also be used to extract elite white mold resistant snap bean lines.

We will also continue our traditional program with crosses among elite lines and the best white mold resistant lines. Pedigree and single seed descent breeding methods will be used to advance and select early generation materials. While the emphasis will be on breeding for white mold resistance, we also need to continue to incorporate improved plant architecture and conduct yield and processing trials of the best lines. Preliminary yield trials will be planted between May 10 and July 5. Plots will consist of a single 20-foot row from which 5-foot sections will be harvested for graded yield and raw product evaluation. Lines will be evaluated for growth habit, yield and graded samples will be evaluated for pod smoothness, straightness, seed to pod ratio, and color. Those that meet expectations in the raw product evaluation will be frozen for evaluation of the processed product. User panels will evaluate quality of samples. Frozen material will be evaluated at the OSU winter cutting and will be displayed at the PNVA meetings in Kennewick, WA in November. Where the opportunity presents in the preliminary yield trials, we will evaluate for white mold resistance and/or heat tolerance.

Advanced Lines: Seed increase, roguing, and sub-line maintenance of the historical releases will continue. Seed quality of OSU advanced lines will be quantified using germination damage tests that are standard in the industry. In short, seeds are dropped onto a steel plate, and then subjected to cold (10°C) germination tests.

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:
The long term benefits of the breeding program are cultivars with higher and stable yields, improved quality and durable disease resistance. In the short term, we would generate new knowledge about the genetics of disease resistance and other snap bean traits.

PROJECT TIMELINE:

Quarter 1	Quarter 2	Quarter 3	Quarter 4
Crossing in the greenhouse; finish cleaning seed & packet & prepare for 2021 field season.	Plant bean trials and nurseries beginning May 1 – July 1. Maintain plots.	Maintain plots, conduct evaluations & harvest yield trials and perform quality evaluations. Samples taken to Pilot plant for processing and freezing.	Harvest dry seed, dry and thresh. Compile data and produce reports. Conduct sample display of frozen materials.

Requested Budget	
1) Breeding (Myers)	
Salaries and benefits	
Faculty Research Assistant	$17,462
OPE @ 75.4%	$13,107
Wages and benefits	
Student Wages	$0
OPE @10%	$0
Supplies	$500
Travel	$0
Land and greenhouse rental	$0
Total	$31,070
2) Processing Evaluation (Wiegand)	
Salaries and benefits	
Faculty Research Assistant	$3,242
OPE @ 61.59%	$1,997
Wages and benefits	
Student wages	$1,780
OPE @ 10%	$196
Supplies	$1,300
Total	$8,515
Grand Total	**$39,584**

Contributions of the OSU breeding program	
Student Wages	$9,500
OPE @ 10%	$950
Supplies	$500
Travel	$93
Land and greenhouse rental	$9,120
Total	$20,163

BUDGET NARRATIVE

Request to OPVC:
Salary and OPE is requested for a full time faculty research assistant who will commit 40% FTE to green bean breeding. OPE is 75.4%. A Food Science and Technology faculty research assistant will commit approximately 0.05 FTE to processing of entries from green bean trials; the remainder of salary to come from other sources. Undergraduate student wages of $1,780 are requested for the processing program with 10% OPE. $500 is requested for materials and supplies for field work (includes stakes, tags, envelopes, paper bags, etc.)

Contributions of the Vegetable Breeding Program:
Undergraduate student wages of $9,500 are estimated for the breeding program with 10% OPE. An additional $500 is required to cover greenhouse materials and supplies expenses (fertilizer, pots, labels, stakes, tags, crossing supplies). To cover transport of samples from the farm to campus for processing, $93 is estimated. Land use rental at the OSU Vegetable Research Farm consists of five acres at $1,390 per acre and greenhouse rental of 1,400 ft2 at $1.55 per square foot.

RESEARCH PROPOSAL TO THE AGRICULTURAL RESEARCH FOUNDATION FOR THE OREGON PROCESSED VEGETABLE COMMISSION

TITLE: Seed corn maggot control in snap beans and sweet corn without chlorpyrifos (Lorsban)

YEAR INITIATED: 2021-22 **CURRENT YEAR:** 2021-22 **TERMINATING YEAR** 2021-22

PERSONNEL & COOPERATORS:

Ed Peachey, OSU Vegetable Extension, Weed Science, Horticulture Department, ALS 4045, Oregon State University, Ed.Peachey@oregonstate.edu, 541-740-6712

FUNDING REQUEST 2021-22: $8,917

JUSTIFICATION:

The days for chlorpyrifos (Lorsban) as a seed treatment are numbered. Even though EPA recently reviewed the toxicology of this insecticide and posted a review that would allow a few uses to remain (Dec 2020), it is likely that all tolerances for this insecticide will be revoked by the end of 2023. Coupled with the fact that the EU has no currently established tolerances for chlorpyrifos, and that export markets are very important to many commodities produced in the US, we must find new methods of control for many pests that have been controlled at a very low cost by chlorpyrifos. Seed treatment with chlorpyrifos will be permitted in OR under new administrative rules, however, as long as FIFRA tolerances remain intact.

Snap beans are a very important crop for many farms in the Willamette Valley. One pest that can be extremely damaging to snap beans is seed corn maggot. As we relearned this year, if snap bean seed void of chlorpyrifos is planted, it is possible to lose 50 % or more of the crop. In 2020, the seed of Pierroton snap beans (Syngenta) was treated with thiamethoxam (a neonic insecticide) rather than chlorpyrifos. Nearly 300 acres of snap beans were severely damaged. Organic growers are well familiar with the seed corn maggot and the damage it can cause, and they go to great lengths to avoid damage from this pest, and still may suffer nearly 100 percent stand loss. The damage from seed corn maggot in 2020 took conventional producers by surprise given the seed was treated with thiamethoxam.

How are producers going to adapt to this new reality? If chlorpyrifos is not available, what are the options? Certainly, growers can give more attention to crop rotations, condition of organic amendments or manures that are incorporated or applied, and appropriate seasons for planting. But experience tells us that these tactics will only slightly reduce the chance of loss to seed corn maggot when cannery schedules dictate planting dates through the thick and thin of spring weather. Thus the challenge of finding replacements for a very trustworthy insecticide that costs about $7.5 per acre (snap bean seed treatment) is daunting.

The primary replacement insecticide of interest is spinosad. The toxicologic profile of this insecticide is very favorable and spinosad provides protection to snap beans similar to chlorpyrifos, at least in NY tests (Nault 2007). Efficacy has yet to be demonstrated in Oregon and around the country. Spinosad is also approved for organic use in some crops, and in the case of organically grown snap beans, the benefit would be immense. The downside of Spinosad is cost: approximately $33/A based on a seed population of 150,000/a and a rate of 0.5 mg ai/seed; $56/A for the 0.75 mg ai/seed rate (the rate probably needed to protect snap beans, based on past research at Cornell). It is hard to imagine how this increase in seed cost will be absorbed by an already troubled processing industry.

Another possibility to control seed corn maggot is a t-band of bifenthrin over the seed row, which will likely provide good protection at roughly $15/a but with the inconvenience and cost of equipping planters with a secondary fertilizer delivery system (bifenthrin would likely be applied with a starter fertilizer).

Probably the most practical option would be to consider combinations of insecticides that can be applied to seed. A priority would be to use moderate and complimentary rates of thiamethoxam and spinosad to improve maggot efficacy without substantially increasing cost. Whether these insecticides are compatible for this use, or the concept has merit, is unclear.

Seed corn maggot damage is not confined to snap beans. Sweet corn is also impacted under severe maggot pressure. Spinosad also has the potential to improve seed protection in sweet corn. Chlorpyrifos is not currently in broad use for seed protection on sweet corn seed, but the loss of chlorpyrifos will leave a gapping hole in current strategies to manage cucumber beetle larvae, cutworms, and seed corn maggot. Banding chlorpyrifos over the seed corn row has been effective for managing damage of the two later pests, particularly in reduced tillage situations. Cucumber beetle damage to sweet corn is known to increase lodging in the fall when weather turns wet and windy, in addition to loss of stand that is often associated with untreated sweet corn seed.

HYPOTHESIS & OBJECTIVES:

1. Are there any emerging or underused insecticides that could be harnessed to prevent seed corn maggot damage to snap beans and sweet corn?
2. Are there synergistic insecticide combinations with spinosad that could be applied to seed to increase efficacy but keep costs in check?

PROCEDURES:

Funding for this project will expand an IR-4 study that is focused on spinosad as a control for seed corn maggot so that we can compare spinosad efficacy and cost to other less costly treatments. For snap beans, the emphasis will be on the on-farm efficacy of bifenthrin (Capture LFR) as a t-band to protect seeds such as Pierroton, a very small seeded variety that was severely damaged by seed corn maggot in 2020. Insecticide treatments will also include low and high rates of spinosad and ultra-low rates of spinosad in combination with seed already treated with thiamethoxam (See Table 1 below). Similar treatments will be included at the sweet corn site. All seeds planted will have traditional fungicide seed treatments to protect seeds from disease.

Sites will be selected with cooperators that have early planting dates. If possible, manure will be spread and worked into the area immediately before planting. Capture LFR will be applied in a 6 inch band over the seed row at 8.5 oz/A, after the openers but before the press wheels. Untreated seed will be sent to Dr Taylor at Cornell for application of spinosad. Application rates for the insecticides are listed in Table 1. Each treatment will be replicated 3 times at the three on-farm sites.

After planting, a strip of bone and meat meal will be placed over the furrow to attract seed corn maggot flies. Emerged and damaged seedlings will be counted when crops have 2 true leaves.

Seeds that have not emerged will be excavated and examined to determine if damage was associated with seed corn maggot feeding. Snap beans and corn will be harvested to determine treatment effects on final yield.

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:

- Alternative strategies to reduce the effect of seed corn maggot on snap bean and sweet corn seedling emergence.
- Efficacy and usefulness of spinosad as a seed treatment
- Efficacy of bifenthrin when applied as a t-band over seed already treated with a neonicitinoid insecticide.

PROJECT TIMELINE:

Field studies will commence along with first plantings of snap beans and sweet corn in the spring of 2021. Crops will be harvested in July through August.

Table 1. Treatments that will be applied at two on-farm snap bean and one sweet corn site.

1	Spinosad	0.2	mg/seed	seed treatment applied at Cornell
2	Spinosad	0.5	mg/seed	"
3	Spinosad	0.8	mg/seed	"
4	Capture LFR	4.25	oz/A	6 inch t-band
5	Capture LFR	8.5	oz/A	6 inch t-band
6	Capture Cruiser (thiamethoxam)	4.25 -	oz/A -	Augment commercial rate of thiamethoxam on seed
7	Cruiser (thiamethoxam)	-	-	Standard seed treatment
8	Spinosad Cruiser (thiamethoxam)	0.2 -	mg/seed -	Augment commercial rate of thiamethoxam
9	No seed treatment	-	-	Fungicides only

2021-22 BUDGET:

Salaries (RA 0.1 FTE)	4162
Benefits	2955
Wages	
Harvest labor	450
Equipment rental	0
Supplies	300
Travel	200
Crop loss reimbursement	850
Other	0
Total	8917

ANTICIPATED REQUESTS IN COMING YEARS $0

OTHER SUPPORT OF PROJECT: Main project is supported by IR-4. These requested funds will allow us to expand the number of tested treatments to on-farm sites.

RESEARCH PROPOSAL TO THE AGRICULTURAL RESEARCH FOUNDATION
FOR THE OREGON PROCESSED VEGETABLE COMMISSION

TITLE: **Monitoring and Reporting Insect Pests in Cole Crops and Sweet Corn (VegNet)**

YEAR INITIATED: 1996 CURRENT YEAR: 2021-22 TERMINATING YEAR: ongoing

PERSONNEL & COOPERATORS:

RESEARCH LEADER/PI: Ed Peachey
ORGANIZATION: OSU
PHONE NUMBER: 541-740-6712
E-MAIL ADDRESS: ed.peachey@oregonstate.edu

CO-PI: Jessica Green
ORGANIZATION: OSU
PHONE NUMBER: 541-737-5456
EMAIL: jessica.green@oregonstate.edu

FUNDING REQUEST FOR 2021-22: $14,910

JUSTIFICATION

VegNet is the only insect monitoring and reporting program for processed vegetable growers in the region. It is widely used by OSU Extension personnel as well as regional private sector agrochemical and seed company representatives. Pest monitoring is a critical piece of integrated pest management (IPM). Rather than adhering to a calendar schedule, pest monitoring helps growers make informed spray decisions by using insect counts as part of a decision-making process. VegNet program is a stable and widely -used IPM resource.

As the future changes for all of us, it seems apparent that research budgets need to adjust. Continuation of this important crop pest monitoring program provides obvious benefits to OPVC growers and stakeholders. Yet, many of the pests we monitor have wide host ranges that overlap commodity interests. It is our hope that lessening the financial strain on the commission by 30% will allow for the program to continue in spite of current challenges. We are grateful for any support possible and would be happy to adjust priorities based on specific commodity needs or budget (e.g. more focused scouting on corn vs. beans or broccoli, for instance).

OBJECTIVES

Continue operation of a regional pest monitoring and reporting network for damaging crop pests including armyworm, black cutworm, variegated cutworm, diamondback moth, cabbage looper, 12-spot beetle, and aphids.

PROCEDURES

Sampling tactics 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 vegetable field sites throughout the north and central Willamette Valley. Data collection will occur weekly from mid-April to September. Moths from wire mesh traps will be collected and identified on site. Unknown and non-target specimens will be saved for further analysis and preservation. Pheromone lures will be changed every 4 weeks. Sticky traps will be checked and replaced at each sampling event (weekly). Trap catch data will be tallied, analyzed, and reported by the program manager. Weekly reports will be issued via an email marketing system that currently has over 400 subscribers. Web traffic metrics (email opens, links clicked, etc.) of reports will be monitored at the end of the season to measure the impact of program content.

ANTICIPATED BENEFITS, EXPECTED OUTCOMES, AND INFORMATION TRANSFER:
VegNet has become a relied-upon resource for many people. The short-term benefit is provision of advanced warnings of pest problems so that producers can make informed IPM decisions. Long-term benefits include: adding to a substantial dataset of research-based findings that can be used by other agencies to confirm crop pest models; and highlighting support of IPM in Oregon agriculture. Information transfer with this project is concurrent - data and analyses are presented each week through an email subscription platform and a companion research blog (https://beav.es/ZwK).

PROJECT TIMELINE:

- April – Identify field sites and place traps. Monitoring of nearby landscape is possible while we wait for crops to be planted
- May to Sept – Monitor each site and issue weekly reports
- Early Oct – Field day

BUDGET

	OPVC
Salaries: Faculty	$7829
Graduate student	----
Other students	----
Other labor	----
Employee Benefits (OPE): Faculty	$4854
Graduate student	----
Other students	----
Other labor	----
Equipment	----
Travel: Domestic (in state)	$1311
Domestic (out of state)	----
Foreign (conferences, etc.)	----
Operating Expenses	$916
Other Expenses	----
Total	**$14,910**

ANTICIPATED REQUESTS IN COMING YEARS Unknown

OTHER FINANCIAL SUPPORT
We will be partnering with the Oregon IPM Center as they pursue a federal Extension Implementation Program Area (EIP) grant for FY22. The purpose of the EIP is to "increase IPM implementation among the clientele served by an eligible institution". This collaboration is exciting, and could lead to secure funding for VegNet in the future. However, for this upcoming cycle, our involvement with OIPMC is limited to exploring past datasets as a means of refining and developing regional degree-day models for certain species.

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PROPOSAL FORMAT

Project numbers (if any):

TITLE: Creating an Oregon Green Bean awareness campaign

YEAR INITIATED: n/a **CURRENT YEAR:** 2021-22 **TERMINATING YEAR** 2022-23.

PERSONNEL & COOPERATORS:

Lane Selman, Oregon State University, 6454 NE 7th Avenue, Portland, OR 97211. 503-528-6631. lane.selman@oregonstate.edu

Cooperators:
Jim Myers, Oregon State University, 4017 ALS, Corvallis, OR 97331. 541-737-3083. james.myers@oregonstate.edu

Zak Wiegand, Oregon State University, 3051 SW Campus Way
Corvallis, OR 97331. 541-737-8481. zak.wiegand@oregonstate.edu

Alex Stone, Oregon State University, 4017 ALS, Corvallis, OR 97331. 541-602-4676. alex.stone@oregonstate.edu

FUNDING REQUEST FOR 2021-22: $26,795

JUSTIFICATION:

Millennials and Gen Zs are eating more vegetables, leading to a predicted 10 percent increase in fresh vegetable consumption over the next few years. Frozen vegetable consumption has been in decline, but because Millennials and Gen Zs are also eating more frozen vegetables, consumption of frozen vegetables is forecast to increase by 3 percent in the next few years (NPD Group). The interest by young consumers in vegetables, as well as their interest in eating foods that are both healthy and come with a story, are drivers of this project.

Oregon green beans are nutritious, delicious and have a great story, especially for young regional eaters. The Oregon processing industry has built its reputation on the blue lake green bean. First brought to the Willamette Valley as a pole bean more than a century ago, it was soon established as the major processing bean. Many an Oregonian as high schoolers have spent their summers picking pole beans in the first half of the 20th century. The pole bean was replaced by the bush blue lake green bean through the breeding efforts of Tex Frazier in the 1950s to early 70s, and remains the primary type with the cultivar OSU5630 now grown on the majority of acreage in the valley.

Relative to other types of green beans, blue lake types are higher yielding, have excellent culinary quality and processing characteristics, and retain quality after processing. They have among the lowest fiber pods of any type of green bean and have a highly preferred flavor profile that it shares with many of the old-time pole beans such as ‘McCaslan’ or ‘Kentucky Wonder’. The pods will retain texture and color even when left for hours under the heat lamp of a buffet line. They are flavorful and versatile, easy to prepare and flexible in accommodating different cuisines. As new users search for frozen vegetables to eat, it is time to tell the story of the blue lake green bean and promote its use and consumption to ensure that it is part of the increase in frozen food consumption.

HYPOTHESIS & OBJECTIVES:

Overall objective: to educate regional consumers, culinary professionals, retailers and distributors about the history and sensory quality of Oregon green beans and their value and use as a local frozen vegetable. In other words "Make Oregon green beans hip!"

Objective 1: Describe the story, history and culinary value of Oregon green beans
Objective 2: Describe the best-tasting and culinarily useful frozen green bean types
Objective 3: Develop cooking tips and recipes for several types of frozen green beans
Objective 4: Create an Oregon Green Bean campaign to engage consumers, culinary professionals, retailers and distributors with green bean history, types, recipes and cooking tips through various communication channels

PROCEDURES:

In 2011, Selman created the Culinary Breeding Network (CBN) with a mission to build communities of plant breeders, seed growers, farmers, produce buyers, chefs and other stakeholders to improve quality in vegetables, fruits and grains. Some CBN activities include 1) working with culinary professionals to identify best quality varieties, their usage and recipe development; 2) developing marketing campaigns, i.e. website creation, content development, branding, artwork/design, photography and video production (see www.eatwintervegetables.com); 3) organizing public outreach events, both in-person and virtual, i.e. Sagra and Variety Showcase; 4) marketing through social media, i.e. CBN Instagram with >21,000 followers.

In a November 2020 survey sent to 75 direct-market farmers working with CBN, 45% of respondents identified CBN's most valuable impact in the food system as creating a "buzz" in the community around specific vegetables and/or varieties. Additionally, 82% have started growing a variety due to CBN promotion, showing a strong track-record of effective stakeholder engagement and success in responding to their needs. When asked where CBN should expand or increase efforts for the future, farmers responded with 56% marketing and promotion of specific varieties.

<u>Objective 1: Describe the story, history and culinary value of Oregon green beans</u>

The historical story of green beans as Oregon's state vegetable will be written into a promotion and marketing piece. A basis for this story will be Dr. Jim Baggett's History of the Blue Lake Bean Industry. This 1500-word story will be developed by author and journalist Margarett Waterbury who has experience writing articles and essays on Oregon agriculture, e.g. Fibrevolution: Bringing flax back to Oregon. This piece will be published to Medium, sent to journalists (i.e. Capital Press, Portland Monthly) and food-focused podcasts, as well as shared with businesses that may be interested in also sharing this story (i.e. Burgerville, Food Co-ops).

<u>Objective 2: Describe best-tasting and culinarily useful frozen green bean types</u>

Building off of Myers' previous work, superior tasting varieties will be selected to develop flavor/culinary descriptions by CBN collaborating chef Tim Wastell. Myers has identified best tasting varieties in four different green bean types including Romano, Blue Lake, Midwest and Extra Fines. Myers will identify three varieties in each of the four types to grow, harvest and freeze in the 2021 growing season. These 12 varieties will be provided to chef Tim Wastell to use for creating a culinary description for each of the four types, including notes on flavor, texture and best culinary usage.

Objective 3: Develop cooking tips and recipes for several types of frozen green beans
CBN collaborating chef Tim Wastell of Antica Terra; culinary educator Katherine Deumling of Cook What What You Have; and cooking advocate Jim Dixon of Real Good Food will create cooking tips and recipes. Eight recipes will be developed, including two recipes of each of the four types. Professional photographer Shawn Linehan will take photos of four (one recipe per green bean type) of the executed dishes and create double sided recipe cards with tips on one side and a recipe on the other, incorporating bean and dish photos. Examples of these recipe cards and photos are here.

Objective 4: Create an Oregon Green Bean campaign to engage consumers, culinary professionals, retailers and distributors with green bean history, types, recipes and cooking tips through various communication channels

Poster: A poster created to create an identify for and celebrate the Oregon Green Bean awareness campaign designed by Victory Gardens of Tomorrow. Printed posters will be distributed at in-person events and shared on CBN social media.

Social Media: The Oregon Green Bean story, types, recipes and cooking tips will be shared through the CBN instagram account (>21k) and distributed in a CBN newsletter (>2k). A social media campaign will be created to highlight Oregon chefs posting videos of themselves using frozen green beans in home-cooked meals. We will create and promote a #hashtag to facilitate promotion and make the campaign searchable.

Sagra: A week-long virtual Oregon Green Bean Sagra will be presented through the CBN YouTube site. In Italy, a Sagra is a festival to increase awareness of locally grown foods and create excitement and interest around regionally-grown vegetables. Selman and Stone have successfully been introducing these festivals here in Oregon. In 2019, the Winter Vegetables Sagra (SCBP funded) occurred in partnership with the Friends of Family Farmers annual Fill Your Pantry sale. The event attracted over 1,000 attendees and included 31 farmer vendors. In 2020, due to Covid restrictions, Selman and Stone organized an online Sagra which took the form of nine weeks of virtual programming starting in December 2020 which will run through March 2021. The Sagra features TED-style talks, interactive Q&A sessions, cooking demos, and virtual field tours with content focused on nine winter vegetables: Celeriac, Radicchio, Brussels Sprouts, Cabbage, Cauliflower, Collards, Winter Squash, Garlic and Purple Sprouting Broccoli. Presentations explore plant histories, origins and domestication; medicinal, nutritional and culinary elements of species; farm visits; cooking demonstrations; art and folklore. This virtual event had 850 pre-registrations. Presentations which are watched, recorded and archived on the new (created in November 2020 for this purpose) Culinary Breeding Network YouTube channel with 778 subscribers and have had over 11,800 views. The Sagra was featured in Capital Press. Viewers have been a mixture of farmers, consumers and chefs and many have requested continuing this virtual content even after Covid restrictions.

Green Bean Zine. A zine will be published and aimed at consumers to share the Oregon Green Bean story, flavor descriptions of types, recipes and cooking tips. Custom illustrations will be created for the zine and can be used in other marketing materials as well. Selman and Stone have experience in creating zines and found them to be popular with consumers. Example: Garlic Types and Market Niches (https://www.eatwintervegetables.com/garlic-zine).

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:
Increased interest in home cooking with frozen green beans.
Increased knowledge on how to use frozen green beans.
Increased awareness of the history and culinary value of green beans in Oregon.

PROJECT TIMELINE:
Timeline: May 1, 2021-April 30, 2022

May 2021 - Myers plants selected high-quality 12 green bean varieties (four types) at OSU
June 2021 - Poster design created
June 2021 - Waterbury begins research on Oregon green bean history and conducts interviews
June 2021 - Zine planning begins in order to determine illustrations needed
July 2021 - Myers plants harvests / Wiegand freezes them
August 2021 - Wastell receives frozen beans for creating flavor/culinary descriptions
Aug-Sept 2021 - Wastell, Dixon and Duemling develop recipes and cooking tips
Sept-Oct 2021 - Linehan photographs recipes and creates recipe cards
Dec 2021 - Zine completion and week-long Sagra
Jan - Feb 2022 - Social media campaign with chef videos

LITERATURE REVIEW:
Myers and colleagues (Wallace et al., 2018) conducted a diversity study of snap beans using a panel of 200 snap and dry bean cultivars, heirlooms and landraces. They found that snap beans could be arranged into eight distinct groups that parallel dry bean centers of domestication and races. Of these eight groups, four are known mainly as older heirloom beans and are rarely grown commercially today. The other four groups include the blue lake green beans and other heirloom pole beans, the Midwestern green beans typified by 'Tendercrop', the flat podded Romano beans and the extra fine European types. Each has their own set of culinary characteristics.

A graduate student of Myers, Lyle Wallace, (2018) examined flavor volatiles in green beans. He found that three compounds are the primary determinants of flavor in green beans. These are 1-octen-3-ol, 3-hexen-1-ol and linalool. The two former compounds contribute the "beany" flavor while the latter produces a floral aroma. Blue lake and European extra fine types tend to be high in 1-octen-3-ol and 3-hexen-1-ol, but low in linalool. Midwestern green beans have just the opposite volatile profile whereas Romano beans tend to be high in all three compounds. Additional volatiles may influence flavor as well, but their effects do not seem to be as important as the octen-hexen-linalool trio. Different flavors, combined with differences in pod color, texture and fiber may make certain types of snap beans better suited to certain dishes, and understanding these specificities will help in promoting the blue lake type.

REFERENCES:
Baggett, James R. and William Lucas. 2005. A story of the Blue Lake pole bean industry in Western Oregon. Oregon State University Valley Library Special Collections and Archives, History of the Pacific Northwest Collection (HD9235.B42 U63 2005).

Drucker, A et al, 2020. Garlic Types and Market Niches. Available at https://www.eatwintervegetables.com/garlic-zine).

NPD Group. Guess who is eating their vegetables now? Younger consumers drive growth of fresh and frozen vegetable consumption. Available at https://www.npd.com/wps/portal/npd/us/news/press-releases/2016/guess-whos-eating-their-vegetables-now-younger-consumers-drive-growth-of-fresh-and-frozen-vegetable-consumption-boomers-not-so-much/

Wallace, L., H. Arkwazee, K. Vining and J.R. Myers. 2018. Genetic diversity within snap beans and their relation to dry beans. Genes 9(587); doi:10.3390/genes9120587. http://www.mdpi.com/2073-4425/9/12/587/htm.

Wallace, Lyle T. 2018. Sensory Analysis and Genetic Mapping of Green Bean Flavor. Ph.D. dissertation, Oregon State University.

2021-22 BUDGET: $26,795

	OPVC
Salaries: Faculty	$7,351
Graduate student	
Other students	
Other labor	
Employee Benefits (OPE): Faculty	$4,294
Graduate student	
Other students	
Other labor	
Equipment	
Travel: Domestic (in state)	
Domestic (out of state)	
Foreign (conferences, etc.)	
Operating Expenses [1]	$15,150
Other Expenses [2]	
Total	

[1] Otherwise known as "Goods and Services" or "Supplies and Materials."
[2] Capital outlays, or other needs. Please detail in footnote.

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

BUDGET JUSTIFICATION:
Lane Selman, Professor of Practice: The equivalent of 0.10 FTE (base salary is $73,512) = **$7,351**. OPE benefits calculated at 58.42%. Total OPE=**$4,294**

Written story of Oregon Green Bean. Contractor Margarett Waterbury. 1500 words. **$1500**

Culinary descriptions. Contractor chef Tim Wastell. $250/description x 4 types = **$1000**

Recipe creation. Contractors chef Tim Wastell and culinary educator/advocates Katherine Deumling and Jim Dixon. $450/recipe x 8 recipes = **$3600**

Recipe cards w/photos. Contractor Shawn Linehan. One day of shooting and one day of editing to create 4 recipe cards and 20-25 bean and dish photos = **$2000**. Cost for chef = $850 for the day of shooting = **$850**

Sagra. $250 stipend/speaker x 5 speakers = **$1000**

Social Media campaign. $250 video/chef x 6 chefs = **$1500**

Campaign Poster. Contractor Victory Gardens of Tomorrow (creation) = **$1000**. Printing 100 prints x $3/print = **$300**

Green Bean Zine. Contractor Shawn Linehan (layout/design) = **$1000** and Contractor Fiona Murray (illustrations) = **$1000**. Printing 100 zines x $4/zine = **$400**

ANTICIPATED REQUESTS IN COMING YEARS (if applicable): n/a

OTHER SUPPORT OF PROJECT: n/a