2018 - 2019

Research Proposals

for

Oregon Processed Vegetable Commission

Prepared by
Agricultural Research Foundation
January 2018

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Processed Vegetable

PROPOSAL TO THE OREGON PROCESSED VEGETABLE COMMISSION (2018)

1. OPVC PROPOSAL COVER PAGE (1 page)

PROJECT TITLE: Broccoli Breeding and Evaluation

PROPOSED PROJECT DURATION: 1 year (renewed yearly)

BUDGET TOTALS
TOTAL BUDGET REQUEST (all years):
Year 1: **$7,308 (breeding)**
$4,648 (processing)
$11,956 (total)

PI: James R. Myers
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Cooperators: Brent Radke, Food Science and Technology, OSU

2. PROPOSAL NARRATIVE (maximum 5 pages)

JUSTIFICATION and LITERATURE REVIEW

Mechanization has reduced labor costs in many crops, but broccoli and cauliflower remain relatively unmechanized. Large labor crews are typically needed to harvest the crops. 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. Some progress has been made towards mechanizing the process both in Europe and the U.S., but problems remain in creating a cost competitive approach.

The three parts to the equation for efficient mechanization are the production system, the harvest equipment, and plant genetics. Our program focuses on the genetics aspect of this equation. 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. More recently, the OPVC was awarded a two year USDA Specialty Crop Block Grant in 2016 to automate broccoli harvest through the addition of a robotics approach attached to existing prototype harvesters. In fall of 2017, we also applied for a Western SARE grant to examine production questions related to developing the machine harvest package, and will know whether this was funded sometime during summer of 2018.

Most broccoli cultivars are not well suited for mechanical harvest. The two key factors in developing cultivars that are suitable 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 addition to direct harvest characteristics, processors need broccoli that makes a high quality pack. Most commercial hybrids are bred for fresh market production and lack the traits that processors need. Florets and stems need to be dark green in color and should be uniform in color and shape; beads should be small, and retained during the blast freezing process. An added benefit to dark green color that we recently discovered is that darker color is associated with higher carotenoid (compounds such as pro-vitamin A) levels. Heat tolerance, and resistance to bacterial head rot, downy mildew, and club root are all desirable. 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.

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. Develop broccoli varieties adapted to western Oregon with suitable quality, high yields, and disease resistance including concentrated and uniform yield potential, large heads that are well exserted and have minimal leaf development on stems, firm, uniform florets of dark green color, and fine beads with short pedicels, which are retained after freezing.

2. Develop seed production systems using cytoplasmic male sterility (CMS) or self-incompatibility (SI) to produce field scale quantities of F_1 hybrid seed.

3. Scale up seed production to facilitate wider testing of OSU hybrids.

METHODS

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 2017 growing season will be grown from cuttings in the greenhouse. During the winter of 2018, 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 we will attempt to produce enough seed that we can conduct replicated yield trials in fall and spring. Selections from a random-mated mass selected population will be treated in a similar manner, 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 2018 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.

Provided enough seed is available, two replicated trials will be conducted. One would be a fall trial in 2018 as we have traditionally done, and the other would be a spring trial planted in 2019 from the same seed source. In these trials, up to 10 of the most promising OSU experimental hybrids and two to four check varieties will be planted. Because of the increase of new commercial hybrids with exserted habit, we will be including these in our evaluation trials. 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 trial 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.

Backcrossing of selected hybrids to place the nuclear genome in the Ogura cytoplasmic male sterile (CMS) background will continue. We have in hand a stable CMS form of the inbred S446 and have until recently focused on developing CMS forms of S454, S462, S463 and S465. New inbreds that appear to be very promising in cross combinations to produce productive hybrids include S471, S473 and S475, and these will be added to the list for backcrossing in CMS. 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 and cages with honey bees. We will continue to pursue arrangements with seed companies to use the OSU inbreds to produce commercial hybrids intended for the processing market in the Willamette Valley.

PITFALLS

If inbreds share the same self-incompatibility allele, it may not be possible to produce that combination commercially even if one parent is CMS. For that reason, we generally try to choose inbreds that are self-fertile for introgression of CMS.

3. BUDGET DETAILS (maximum 2 pages)

Requested Budget	
1) Breeding (Myers)	
Salaries and benefits	
Faculty Research Assistant (Hort)	$2,526
OPE @ 66%	$1,659
Wages and benefits	
Student Wages	$1,290
OPE @ 10%	$129
Supplies	$300
Land use and greenhouse rental	$1,405
Total	$7,308
2) Processing (Radke)	
Salaries and benefits	
Faculty Research Assistant (FST)	$2,563
OPE @ 63%	$1,614
Wages and benefits	
Student Wages	$258
OPE @ 10%	$26
Supplies	$187
Total	$4,648
Grand Total	$11,956

BUDGET NARRATIVE

Salary and OPE is requested for a full time faculty research assistant in Horticulture who will commit approximately 6% FTE to broccoli breeding. The remainder of salary will come from other sources. For the faculty research assistant in FST, approximately 5% FTE will be required to process broccoli samples; the remainder of salary to come from other sources. $1,140 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 $1,259 per acre = $630), and greenhouse rental ($1.55*500 sq. ft. = $775).

PROPOSAL TO THE OREGON PROCESSED VEGETABLE COMMISSION (2018)

1. OPVC PROPOSAL COVER PAGE (1 page)

PROJECT TITLE: Green Bean Breeding and Evaluation

PROPOSED PROJECT DURATION: 1 year (renewed yearly)

BUDGET TOTALS
TOTAL BUDGET REQUEST (all years):

Year 1:	$27,004 breeding
	$7,846 processing
	$34,850 total

Contributions from the OSU breeding program

Year 1:	**$19,158**

PI: James R. Myers
Organization: Horticulture, Oregon State University
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Cooperators: Brent Radke, Food Science and Technology, OSU

2. PROPOSAL NARRATIVE (maximum 5 pages)

JUSTIFICATION and LITERATURE REVIEW

Green beans grown for freezing in the Willamette Valley contribute significantly to the Oregon state economy each year ($17.1 million in 2016). 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. The growing environment in Western Oregon is different from any other green bean production area in the United States. Developing productive varieties that are adapted to this area requires the attention of a substantial breeding effort in Western Oregon. BBL green beans have higher yield potential than those typically bred for the Midwestern U.S. A factor contributing to BBL pod quality is that these types typically have the lowest fiber pods (equivalent to Romano beans and much less than most Midwest and fresh market types). 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 the fall when cooler and moister conditions persist. The disease is mainly controlled by fungicide application, which requires precise timing and can be expensive especially if two sprays are required. 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.

Our program has focused on using several resistance sources. These can be placed into two groups: resistance factors derived from common bean and resistance factors from the related species, scarlet runner bean. Of the common bean germplasm sources, NY 6020 is a snap bean developed by the snap bean breeding program at Cornell University. It has been well characterized genetically and we know that it has two relatively large resistance factors that have molecular markers for selection. This has been the primary focus of our white mold breeding program. 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.

From the scarlet runner derived materials we have several snap bean germplasm lines that have significant levels of resistance. WMG904-20-3 resistance was recently characterized in a recombinant inbred population where we found a major factor for resistance residing on common bean linkage group 8.

The NY 6020 derived lines are most advanced in the program and selections have been narrowed to four lines. With this particular form of resistance we have observed a negative correlation between disease resistance and yield. Lines with good white mold resistance generally yield 75 – 85% of susceptible check cultivars and we may ultimately determine that none of this material merits release. Our attention is turning now to some of the newly identified resistance sources. In particular, we have a number of crosses to the wax bean 'Unidor' which has shown good white mold resistance. These need to be evaluated for resistance, increased, and placed into replicated yield trials. Additional crosses are in earlier generations, and need to be moved along the pipeline.

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 and gray mold resistance
    b. Root rot resistance
    c. Improved plant architecture
    d. High economic yield
    e. Improved pod quality (including straightness, color, smoothness, texture, flavor and quality retention, and delayed seed size development)
    f. Tolerance to abiotic stresses

METHODS

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

Most NY 6020 derived lines have been evaluated for three or more years and we have winnowed the group down to 4 lines with the best combination of disease resistance, yield and pod quality. These lines need to be reevaluated since performance can vary from year to year, and we are seeking varieties that are stable over environments as well possessing disease resistance. These lines will be trialed again in 2018 along with new entries in the pipeline. A preliminary trial of approximately 50 entries with three 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. We will also evaluate new materials for root rot resistance.

Varietal Development: The program will continue 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. A replicated preliminary yield trial 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 one time, two – three days apart. Lines will be evaluated for growth habit, yield and $/acre. Graded samples will be evaluated for pod smoothness, straightness, seed to pod ratio, and color. These samples will be canned and frozen for evaluation of the processed product. Industry panels will evaluate quality of canned and frozen samples. Where the opportunity presents, we will evaluate disease resistance. Most of the entries in this the preliminary trial are larger sieve size materials, but we have a set of extra fine to 3 sieve experimental lines that were tested in 2017. From the 15 lines trialed in 2017, 5 will be advanced for testing in 2018.

Advanced Lines: Seed increase, roguing, and sub-line maintenance of the most promising lines 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.

The most promising lines near release will be provided to seed companies for evaluation and increase. As these lines are increased, they will be tested in small-scale on-farm acreages.

PITFALLS

White mold disease can vary from year to year. However, we have managed to achieve consistent results by using fields with a high sclerotia load and managing them for enhanced infection at bloom.

3. BUDGET DETAILS (maximum 2 pages)

1) Breeding (Myers)	
Salaries and benefits	
Faculty Research Assistant (Hort)	$15,997
OPE @ 66%	$10,507
Wages and benefits	
Student Wages	$0
OPE @10%	$0
Supplies	$500
Travel	$0
Land and greenhouse rental	$0
Total	**$27,004**
2) Processing Evaluation (Radke)	
Salaries and benefits	
Faculty Research Assistant (FST)	$3,000
OPE @ 63%	$1,890
Wages and benefits	
Student wages	$1,505
OPE (@ 10%	$151
Supplies	$1,300
Total	**$7,846**
Grand Total	**$34,850**
Contributions of the OSU breeding program	
Student Wages	$8,170
OPE @ 10%	$817
Supplies	$500
Travel	$86
Land and greenhouse rental	$9,586
Total	**$19,158**

BUDGET NARRATIVE

Request to OPVC: Salary and OPE is requested for a full time faculty research assistant in Horticulture who will commit 38% FTE to green bean breeding. A faculty research assistant in Food Science & Technology 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 $1,505 are requested for the processing program with 10% OPE. OPE for the FRA is 66% and that of the SFRA is 63%. $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 $8,170 are estimated for the breeding program with 10% OPE. An additional $500 is required to cover field and greenhouse materials and supplies expenses (fertilizer, pots, labels, stakes, tags, crossing supplies). To cover transport of samples from the farm to campus for processing, $86 is estimated. Land use rental at the OSU Vegetable Research Farm consists of five acres at $1,259 per acre and greenhouse rental of 2,123 ft^2 at $1.55 per square foot.

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

TITLE: Weed Control in Snap Beans: Tolerance to Flame Weeding and Lambsquarters Biology

YEAR INITIATED: 2017-18 **CURRENT YEAR:** 2018-19 **TERMINATING YEAR** 2018-19

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 FOR 2018-19: $5,562

JUSTIFICATION:

Nonchemical weed control strategies are in short supply in dicotyledonous crops such as snap beans, particularly strategies that target weeds within the seed row. One option is the use of flame weeding in stale seedbeds, a common practice in low input and organic systems. Seedbeds are prepared but weeds encouraged to emerge before the crop is planted, then removed with flame before the crop emerges. Flame weeding is routinely used in corn, but the window of opportunity is less in snap beans because of potential damage to the hypocotyl and growing point in young bean seedlings. Monocot crops such as corn are very tolerant to flame weeding because the growing point remains protected beneath the soil for the early part of the growing season.

Stale seedbeds are very useful in slow emerging crops such as carrots and beets. Summer annual weeds tend to emerge within days after tillage, compared to carrots and beets that often take weeks to emerge. Snap beans often emerge in 7 to 10 days, and sometimes as quickly as 5 days, depending on soil temperature of course. To make stale seedbeds practical in snap beans, the soil should be worked 10 to 14 days prior to planting so that weeds emerge before the snap beans and controls can be applied.

Flaming and contact herbicides are typically used to control the weeds that emerge before the bean seedlings. There is a small amount of selectivity even as snap beans begin to emerge, particularly at the soil cracking stage because the hypocotyl and leaves are partially protected. Snap bean tolerance to flaming has not been adequately determined, particularly after soil cracking.

Suppress herbicide (capric + caprylic acid) is a new product that is OMRI listed and that may be a reasonable alternative to flame weeding. It certainly would be easier to use and less dangerous. We only have one year of data on the relative tolerance of snap beans to this herbicide compared to flame weeding.

Reflex was recently labeled in snap beans, but lambsquarters control has been unpredictable. Effective preemergence herbicides with herbicides such as Reflex that control lambsquarters are essential to the long-term sustainability of weed control programs in conventional snap beans. Some also have reported that Basagran no longer controls lambsquarters as well as in the past, the first sign that a population may be developing resistance. This is a critical issue, because Basagran must be tankmixed with Raptor to provide adequate crop safety, yet over-use of Raptor and Basagran may be impeding lambsquarters control. Basagran kills lambsquarters when tankmixed with Raptor, but declining efficacy must be addressed with other control strategies.

HYPOTHESIS & OBJECTIVES:

1. Measure the effect of snap bean emergence and flame timing on yield reduction.
2. Assess tolerance of lambsquarters populations to Basagran.

PROCEDURES:

Objective 1. Final tillage will be applied 7-10 days before planting snap beans. Plots will be 40 ft long by 10 feet wide. Snap beans will be planted on 30 inch rows. Flame treatments will be applied at approximately 5, 10, 15 and 25% emergence with a strip flamer designed to improve efficiency. A portion of each plot will be designated as weed free and weeds removed with cultivation and hand hoeing to eliminate competition with the crop and provide an estimate of the weed control treatment effect on crop yield. Each treatment will be replicated 4 times. Plant stand and weed seedling survival will be recorded in all plots 2 WAP, and snap bean pods picked and graded. Comparison treatments will include Suppress and Avenger Opti applied at 40 GPA, lactofen+S-metolachlor PRE, and untreated plots with and without tillage.

Objective 2. Lambsquarters seed will be collected from fields where lambsquarters has become prolific and is suspected of resistance to Basagran, and from fields at the Vegetable Research Farm where Basagran has not been used more than once in the last 20 years. Seeds will be planted in small pots in the greenhouse in late summer and Basagran applied when the plants have 6 to 8 true leaves. Basagran rates will be 0.125, 0.25, 0.5 and 1 lb ai (1qt)/A. Injury on seedlings will be recorded at 7, 14 and 28 DAT.

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:

- Better understanding of tolerance of snap beans to flame weeding and organic herbicides when applied to emerging snap beans.
- Practicality, weed control benefit, and comparative costs of stale seedbed systems when using flame weeders or organic and conventional herbicides.
- Lambsquarters tolerance to Basagran and potential that current practices are selecting for resistant biotypes.

PROJECT TIMELINE:

- Flaming study will commence in late May with harvest in August.
- Lambsquarters seed will be collected from fields in the summer and tested in the greenhouse in late summer early fall.

2018-19 BUDGET:

Salaries:	FTE	
Faculty	0.02	1596
Graduate student	0.00	0
Other students	0.04	923
Other labor (temporary for harvest)	6 person days	768
Employee Benefits (OPE):		
Faculty		670
Graduate student		0
Other students		74
Other labor		0
Other expenses		
Equipment		0
Travel: Domestic (in state)		200
Land rental	0.5 A	625
Greenhouse rent	3 months	256
Operating Expenses: Stakes, flages, pesticides		450
Total		$ 5,562

ANTICIPATED REQUESTS IN COMING YEARS None
OTHER SUPPORT OF PROJECT: none

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

TITLE: Effect of herbicide, variety, and seed size on broccoli yield and uniformity when transplanted with a tape system.

YEAR INITIATED: 2018-19 **CURRENT YEAR:** 2018-19 **TERMINATING YEAR** 2018-19

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 FOR 2018-19: $4,305

JUSTIFICATION

The fate of broccoli production in the Willamette Valley hinges on whether the current production system can be retooled to facilitate mechanical planting and harvesting. These phases of current production are labor intensive, and given projected market trends, labor will become less available and costs will continue to rise. The tradeoff between direct-seeding and transplanting is labor upfront in transplanting costs or labor costs later for thinning and hoeing. Weed control in direct-seed brassicas is also less reliable with currently labeled herbicides.

The OPVC is currently supporting projects that are developing image-sensing software and exserted head varieties that will improve the potential to move to mechanical harvest. Another piece to the puzzle would be improvement of planting systems that reduce not only the labor required, but facilitate head uniformity and lessen the troubles associated with weed control in direct-seed systems.

Emerging technologies in vegetables include tape transplanting systems that have the potential to greatly reduce labor costs. It is unclear how the exserted heard varieties developed by the OSU vegetable breeding program of OSU will perform in tape transplanting systems. Also unknown is whether Goal herbicide is suited for tape transplanting of brassicas and whether this system will allow other herbicide such as Prowl (pendimethalin) to be applied before transplanting. We tested Prowl herbicide in cooperation with the IR-4 program and demonstrated good crop safety with Pre-transplant applications, yet when the label was issued, the use pattern was confined to Post-directed sprays (avoiding the growing point of the plant) to mitigate potential crop injury. There may be potential to use Prowl with the tape-transplanting system because like most transplant machines the soil is moved aside. But with the tape transplanting system, a membrane is also positioned between the transplant and the treated soil, potentially improving crop safety. If so, a combination of low rates of Prowl and Goal (lower rates that currently used) would greatly improve the spectrum and longevity of control in brassica crops.

HYPOTHESIS & OBJECTIVES:

1. Measure the effect of variety and herbicide when broccoli is transplanted with a tape system.
2. Determine the rate that Prowl herbicide moves across the paper of the tape system relative to bare soil, and whether additional protection is afforded to the transplant.

PROCEDURES:

A trial will be set at the Vegetable Research farm to examine factors that may improve yield, head uniformity, and weed control in transplanted broccoli. Factors examined in the trial will include variety (exserted head vs. the industry standard), transplanting system (tube vs tape), seed size and uniformity (sorted for size vs mixed), and pre-transplant herbicide (Prowl vs Goal).

Two brassica varieties will be seeded into plugs or tape transplant cells in the greenhouse in March. The seed source will include seeds that are sorted or unsorted by wt. When transplants are adequate size and hardened off, field plots will be prepared and starter fertilizer applied to three rows 26 in. wide in beds 78 in. wide with our Gaspardo precision seeder. Herbicides will be broadcast before transplanting at the following rates: Goal Tender at 1 and 2 pts/A; and Prowl H20 at 1.5 to 3 pts/A. One treatment will include the low rates of both.

A hand-pull tape transplanter will be used to deliver one plant per 12 inches in designated plots. A hole punch will be used to insert transplants into the soil in standard plots. After initial weed evaluations, the plots will be hand-weeded to reduce the impact on broccoli yield. Broccoli heads will be harvested from 20 ft of row one time and head size and wt measured.

In a separate pot study, broccoli tape transplants and standard plugs will be transplanted into soil that has been treated with 8 pts of Prowl/A. Care will be taken to ensure that treated soil does not contaminated the transplant zone when the plugs and tape transplants are positioned in the soil. Injury to leaves and roots will be assesses at approx. 6 weeks after transplanting.

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:

- Evaluation of tape transplanting system and relevance to broccoli production in the Willamette valley.
- Transplant safety to pre-transplant herbicides

PROJECT TIMELINE:

- March set seeds
- May prepare plots and transplant
- June-July evaluate and harvest

2018-19 BUDGET:

Salaries:	**FTE**	
Faculty	0.00	0
Graduate student	0.04	769
Other students	0.06	1385
Other labor (temporary for harvest)		0
Employee Benefits (OPE):		
Faculty		0
Graduate student		115
Other students		111
Other labor		0
Other expenses		
Equipment	Tape transplanter and plugs	850
Travel: Domestic (in state)		0
Land rental	0.5 A	625
Operating Expenses: Stakes, flages, pesticides		450
Total		$ 4,305

ANTICIPATED REQUESTS IN COMING YEARS None
OTHER SUPPORT OF PROJECT: none

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

TITLE: Evaluating Tolpyralate Herbicide and Rotational Strategies to Economize Sweet Corn Production

YEAR INITIATED: 2018-19 CURRENT YEAR: 2018-19

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 FOR 2018-19: $17,636

JUSTIFICATION

This project will continue to develop and evaluate strategies to improve profitability in sweet corn. Tolpyralate herbicide (Shieldex) will be available for the first time in 2018, and promises to bring some improved efficacy for weed control in sweet corn. Efficacy in trials to date has been as good or better than Impact and Laudis and may provide a window of opportunity in some situations to exclude atrazine as a tank mix.

In 2016, tall fescue was interseeded into sweet corn (var. GH 6462, SU) at V6 and produced a reasonable stand of tall fescue. In 2017, tall fescue was again interseeded into sweet corn (var. GH 4927, SU), but the tall fescue did not establish well for unknown reasons. Research is needed to determine what factors influenced these outcome. If this system of interseeding tall fescue into sweet corn was reliably predictable, one full year could be shaved from the sweet corn-fescue rotation, while reducing tillage costs in the spring and improving weed control during the establishment phase of tall fescue. Interseeded fescue seed yield the following summer would likely not match the yield possible in the 2nd year after spring-seeding fescue, but this drawback may be more than compensated for by the reduction in establishment costs.

The HPPD herbicides Laudis and Impact have moderately short rotation intervals, but with exceptions. Laudis carryover often injures red clover when these crops are interseeded into corn. Carryover potential on all these herbicides is particularly important given the tight rotations in vegetable systems, particularly for products that could influence survival of interseeded or fall planted cover crops.

HYPOTHESIS & OBJECTIVES:

1. Measure efficacy of topyralate in sweet corn and compare with other HPPD inhibitors such as tembotrione (Laudis) and topramezone (Impact) with and without atrazine and other tankmixes to improve efficacy.
2. Determine the effect of tall fescue planting time, corn growth stage, crop competition, and weed control program on potential of relay-planted tall fescue to establish as a marketable seed crop.
3. Assess potential carryover of tolpyralate and other PRE and POST herbicides on establishment of interseeded fescue and other cover crops.

PROCEDURES:

1. *Measure efficacy of topyralate in sweet corn and compare with other HPPD inhibitors such as tembotrione (Laudis) and topramezone (Impact) with and without atrazine and other tankmixes to improve efficacy.*

Two demonstration and research trials will be located on farms in the Willamette Valery that will compare Laudis, Impact, and Shieldex herbicides for postemergent control in sweet corn. Particular attention will be given to residual control potential with these products. Sites that include a good population of wild proso millet and other broadleaved weeds will be located, with treatments applied in Mid-June. Factors evaluated will include: timing of POST herbicide application (V2 vs V4), and tankmix partner (Atrazine 1 pt, Basagran 1 qt/A, or Outlook 16 oz/A). Each treatment will be replicated 4 times. Evaluations will include phytotoxicity 3 and 7 and 21 days after treatment (DAT), corn heights at 800 growing degree days (GDD), and yield. Corn ears will be harvested from 20 ft of row in each plot.

One of the trials will also be inter-seeded with tall fescue one day after the V4 application to determine tolerance of fescue to the herbicides that were applied, and to better understand those factors regulating fescue survival and growth. Fescue stand establishment will be measured by counting fescue plants in 3 ft of seed row 4 WAP. Biomass will be clipped from plots after corn harvest. Tall fescue biomass will be measured again in December and again in April if the plot is allowed to survive. Nitrogen uptake will be determined in the fall.

2. *Determine the effect of tall fescue planting time, corn growth stage, crop competition, and weed control program on potential of relay-planted tall fescue to establish as a marketable seed crop.*

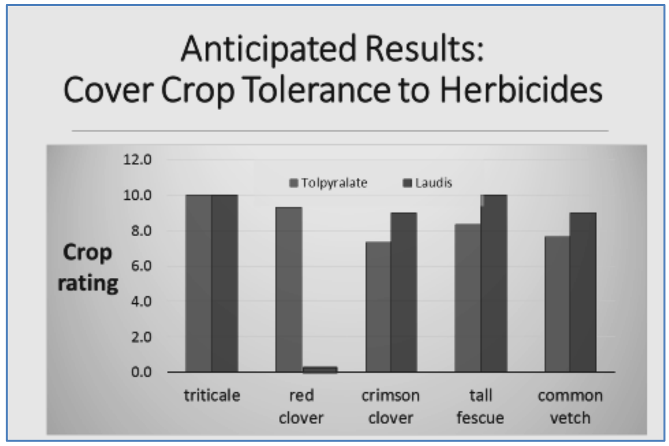
Several experiments will be placed at the Veg Research Farm near Corvallis to determine optimum strategies to interseed tall fescue into sweet corn. Variables will include timing (early vs late corn), sweet corn variety (competitive vs less competitive, eg. Coho vs 4927), and crop stage at seeding (v2, v4, and v6). Cover crop emergence and establishment will be measured at silking, and cover crop and weed biomass samples will be harvested from all plots after corn harvest and again in December and April. The nitrogen content of the last cover crop sample in all plots will be analyzed in the spring. Corn will be harvested by hand from all plots to assess impacts on yield. Following hand harvest, the entire plot will be machine harvested to remove all remaining ears.

3. *Assess potential carryover of tolpyralate and other PRE and POST herbicides on establishment of interseeded fescue and other potential interseeding crops.*

A trial will be located at the Research Farm in Corvallis that will compare carryover potential of Outlook, Dual Magnum (PRE), Atrazine (PRE), and Laudis, Impact, and tolpyralate (Shieldex) POST as measured by cover crop tolerance. Cover crops chosen will represent a wide array of plant families as listed below. PRE herbicides will be applied 14 and 7 days before cover crops are planted; POST herbicides will be applied one day after the cover crops are seeded in strips perpendicular to the cover crop rows. Emergence counts will be taken at 2 weeks after planting along with an overall growth and survival rating.

Crops to be Tested in 2018

Rye	Red clover	Annual ryegrass
Triticale	Crimson clover	Perennial rye
Forage oat	Common vetch	Tall Fescue
Spring barley	Berseem clover	Buckwheat
Spring wheat		Phacelia



ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:

This project is continuing to explore strategies to reduce the cost of production of sweet corn. New herbicide options will be demonstrated so that producers can choose the best management practices to maximize returns on investment and time. Interseeding of tall fescue into corn will become more reliable with data from this study that will find the best timing and weed control practices.

2018-19 BUDGET:

Salaries:	**FTE**	
Faculty	0.04	3077
Graduate student	0.10	4038
Other students	0.15	3692
Other labor		
Employee Benefits (OPE):		
Faculty		1292
Graduate student		606
Other students		295
Other labor		0
Other expenses		
Equipment		0
Travel: Domestic (in state)		408
Land rental	3 ac	3777
Operating Expenses: Stakes, flages, pesticides		450
Total		17636

OTHER SUPPORT OF PROJECT:

The Ag Res Foundation, WSARE, and Meyer Memorial Trust have all contributed to initiate the cover crop project. ISK contributed support from 2011 to 2015 to determine crop safety of tolpyralate across sweet corn varieties.

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

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

YEAR INITIATED: 1996 CURRENT YEAR: 2018-19 TERMINATING YEAR: ongoing

PERSONNEL & COOPERATORS:

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FUNDING REQUEST FOR 2018-19: $20,392

JUSTIFICATION

For more than a decade, the OPVC has funded an integrated pest management (IPM) program called VegNet. Historically managed by OSU Extension, this program has been a valuable resource for vegetable growers and processing entities throughout the region. VegNet provides activity data for a variety of crop pests that affect snap bean, cabbage, cauliflower, broccoli, and sweet corn production. For each species of insect, current trends are compared to archived data of the most recent year prior as well as the 10-year average. The strength of this program lies in its regional nature. That is, sampling insects from throughout the central Willamette Valley can reveal landscape-scale trends that would not be evident to individual landowners.

The utility of having a regional monitoring network applies to a wide range of Ag professionals. Weekly reports are published to provide growers and crop consultants a basis to maintain or intensify field scouting efforts and make informed spray decisions. Processing plants utilize the information as well, and in years past, have collaborated with VegNet to make direct comparisons between trap count numbers seen in the field and actual pest loads received. VegNet data are easily accessible online and viewed by more than 100 people each week, some of which are located in the eastern United States.

Historical patterns of crop pest cycles can vary widely between years, and are dependent on, among other things, environmental parameters. Unless there is a record of previous year's pest activity, it can be difficult to discern what is 'normal'. In 1995, an unprecedented loss of brassica produce (rejected by the cannery) was attributed to cabbage looper worm contamination. Sweet corn growers in 1998 were caught off guard by the amount of black cutworm damage, because, again, there was no estimation of what constituted normal population levels. Comparing year-to-year patterns is useful, but designing a better forecasting system would be ideal.

Growing degree-days are one example of an environmental variable that affects insect growth and development. Many of the pests monitored by VegNet have extensive literature about thresholds and growth rates in response to temperature. Some of the models we use are decades old, but they provide at least some basis to estimate pest patterns. In recent years, however, we have had significant outbreaks of certain species (TBL 1.), with no seeming association to degree-days. Odd as it may sound, low- and high-pressure jetstream systems can establish the airflow necessary for moths to migrate over long distances. This was first studied in the late 1980's for black cutworm (Showers 1989), and is now well-known for diamondback moths, armyworms, and corn earworm as well. Methods exist to predict butterfly migrations, for instance, and we have made contact with OSU researchers who may be interested in collaborating on a pest forecasting project. This might allow us to better predict when adult moths might arrive in the region, rather than detecting them in pheromone traps as they do. Over time, growers could gain advantage by estimating risk of a certain species and how that might influence early planting decisions, etc.

Table 1. Key crop pests of Willamette Valley vegetable crops and migration patterns that could be influencing recent population dynamics.

Pest	Vegetable crops affected	Notable activity patterns over past 3 years	Migratory tendency[a]
12-spot beetle (*Diabrotica undecimpunctata*)	snap beans, sweet corn, squash, cucumbers	Above average in 2014, especially late in the season, led to huge boom early 2015. Consistently 2-3X above historical norms	OVR
Loopers (*Autographa californica; Trichoplusia ni*))	brassicas, snap beans, spinach	2017 worst outbreak since 2008. Multiple generations and probable overwintering in fall-seeded brassicas	BOTH
Armyworms (*Mamestra configurata; Mythimna unipuncta; Spodoptera praefica*)	brassicas, bell peppers, tomatoes	Sudden and severe outbreak in 2017. This group known to have higher activity after years with wet winters	LRM
Cabbage white butterfly (*Pieris rapae*)	brassicas	Unremarkable in recent history, except for peak late Sept 2017. Often tracked by hobbyists so good model. 2004 outbreak in WV	LRM
Cabbage maggot (*Delia radicum*)	brassicas	Traditionally a concern year to year. Pan trapping can help validate models of spring and fall peak flights	OVR
Corn earworm (*Helicoverpa zea*)	sweet corn	2014 very early arrival, 2015 and 17' peak larger than normal and 2 weeks earlier	LRM
Cutworms (*Agrotis ipsilon; Peridroma saucia*)	sweet corn, snap beans	Some species overwinter, black cutworm possible. 2017 and 1997 very similar trends, 4X above historical norms	BOTH
Western corn rootworm **(***Diabrotica virgifera)*	sweet corn	newly monitored because of westward expansion from E. Oregon/Washington	unknown
Diamondback moth (*Plutella xylostella*)	brassicas	activity has been unpredictable, but was significantly above average is 2017, 2015, 2009, and 2005	BOTH
Aphids (*Brevicoryne brassicae*, others)	brassicas	not monitored recently	LRM

[a.] Pests are either suspected of overwintering in the Willamette Valley (OVR), or known to exhibit long-range migrations (LRM). Some species may overwinter and re-invade each year from southern latitudes (as different generations, e.g. cabbage looper) (BOTH).

RELATION TO OTHER PROJECTS IN IDAHO, OREGON, AND WASHINGTON: VegNet is the only monitoring and reporting program for vegetable growers in the region. The irrigated agriculture program at Hermiston Agricultural Research and Extension Center (HAREC, OSU) runs a pest tracking and reporting service in eastern Oregon for potato growers. It is modeled closely after VegNet, and recently has incorporated interactive maps as a reporting tool. The maps are developed and maintained by Anderson Graphics, and an example can be seen here. Washington State Extension runs a similar program for potato pests, and issues weekly alerts via email. Idaho has pheromone monitoring programs for forest pests (gypsy moth and tussock moth), and Japanese beetle, and there are a few organizations (Idaho-Oregon Fruit and Vegetable Association, Food

Producers, etc.) that may have interest in VegNet, but are probably more closely aligned with the priorities of OSU-HAREC and WSU Extension.

HYPOTHESIS & OBJECTIVES

1. Continue operation of a regional pest monitoring and reporting network for damaging crop pests including black cutworm, variegated cutworm, diamondback moth, cabbage looper, 12-spot beetle and others.
2. Improve interpretation of long-term historical data for analysis, and work with cooperating researchers to better forecast pest outbreaks based on weather patterns, annual rainfall, and other macro-environmental factors.
3. Manage an electronic agronomic platform as a visualization and reporting tool, and share with OPVC growers to gain access to trap count information and maps.

PROCEDURES

Field sites will be selected from Mt. Angel to Junction City to give an accurate assessment of pest trends throughout the central Willamette Valley. Wire mesh traps and paper sticky traps will be set and baited with pheromone lures. A trained research technician will collect insects from the traps report to the program manager, and perform necessary maintenance. Insects in wire mesh traps will be killed to prevent re-capture of previously trapped specimens. Lures will be changed every 4 weeks. Trap catch data will be analyzed and summarized by the program manager, and reports will be emailed to program subscribers each week (from May-Sept.). Additionally, the OSU research blog will continue to be updated with pest profiles and other relevant information. Data will be entered into an agronomic software program, which will allow direct communication with OPVC growers as necessary (e.g. site-specific reports and maps).

ANTICIPATED BENEFITS & EXPECTED OUTCOMES: VegNet has become a relied-upon resource for many people. Benefits include advance warning of pest problems so that producers can make informed IPM decisions, and research-based data that can be used by other agencies to confirm crop pest models.

INFORMATION TRANSFER: One of the unique characteristics of the VegNet program is that data is disseminated very quickly; usually within 3 days of when it was collected. The program operates on an email subscription platform, where participants receive update summaries of regional patterns direct to their inbox every Friday (between May-Sept). A blog site also exists, and new content is uploaded at least once a month.

PROJECT TIMELINE: Each year, we try to deploy at least two monitoring stations early in the spring (mid-April) to estimate background levels of pests. However, the most accurate data comes from traps that are located next to production fields. Usually, field sites are identified by May 1st, traps are placed, and they remain there for the duration of the season, or until crops are harvested. Data collection will occur over 23 weeks. In addition to weekly data reports, a field day will be scheduled for vegetable growers and field reps to review seasonal trends and potential implications for the following year.

Table 2.		2018-19 BUDGET	
SALARIES	Faculty	$9,273	Sr. FRA I, 0.20 FTE
	Other labor	$2,640	Technician, 1.5 months @ $11/hr
EMPLOYEE BENEFITS (OPE)			
	Faculty	$5,842	63% OPE
	Other labor	$211	8% OPE
EQUIPMENT		n/a	
TRAVEL			
	In-state	$1,590	Trap route, 23 weeks
	Regional	$315	Attendance at PNVA conference
OPERATING EXPENSES		$1,135	Research supplies & software
Total request to OPVC		**$20,392**	

ANTICIPATED REQUESTS IN COMING YEARS $22, 000/year.

LITERATURE REVIEW

- Chapman, J.W. et *al*. 2002. High-altitude migration of the diamondback moth, *Plutella xylostella*, to the UK: A study using radar, aerial netting and ground trapping. *Ecological Entomology*, 27:641-650.
- Showers, William B., et *al*. 1989. Direct evidence for meteorologically driven long-range dispersal of an economically important moth." *Ecology*, 70: 987-992.

Oregon Processed Vegetable Commission

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