OPVC CONTINUING PROJECT REPORT: 2016 **PROJECT YEAR**: 1 of 1

1. OPVC REPORT COVER PAGE (maximum 2 pages)

OPVC Project Number: Mechanical Broccoli Harvester Prototype Development

Project Title: **Enhancing Oregon broccoli and cauliflower competitiveness by improving harvest efficiency**

PI: Peter J. Mes
Organization: P&R Seeds LLC
Telephone: (208) 961-0848
Email: info@prseeds.com
Address: 2397 NW Kings Blvd, #247
City/State/Zip: Corvallis, OR 97330

Cooperators: Crescent Valley High School FIRST Robotics Team 955, GK Machine

Total Project Request (all years):
Year 1: $10,000 **Year 2:** **Year 3:**

Other funding sources: none
Amt. awarded: $10,000

2. EXECUTIVE SUMMARY (ABSTRACT):

Oregon vegetable processors are in need of improvements to the cost of harvesting broccoli and cauliflower, along with improvements to the quality of the vegetables being processed. The objective of this research project is to develop autonomous, mechanical harvesting solutions for the broccoli and cauliflower producer. This work is complementary to Oregon State University development of a new broccoli hybrid developed specifically for automated mechanical harvest.

Current harvest methods rely on manual field labor, with minimal automation and mechanization. P&R Seeds, working in conjunction with Oregon State University and the FIRST Robotics team 955, from Crescent Valley High School, has worked to implement new camera-controlled computer 'vision' technology for use in the vegetable harvesting process. The robotics team, working with P&R Seeds, has worked to develop a prototype system which can be used for facilitating automation of harvest for broccoli and cauliflower. Two different prototypes were tested in the lab, and one was field tested at the year's end to demonstrate the viability of the technology in mechanizing vegetable harvest. These prototypes will be used to facilitate development of a full-scale commercially viable field harvester in the coming years.

3. **FULL REPORT (no maximum)**

3.a. BACKGROUND

By utilizing the diverse experiences of the parties involved in this project, it became clear in January of 2016 that the time had come to pioneer an improvement to the vegetable processing industry. Breeding work at Oregon State University is close to producing commercially available broccoli that is suited to mechanical harvest. But no "good" mechanical harvesting solution exists in Oregon. P&R Seeds and Crescent Valley High School Team 955 agreed to work together with OSU to develop such a solution.

3.b OBJECTIVES

The primary goal of this year was to develop a prototype 'vision system' capable of identifying broccoli in field conditions. Identification parameters include position in the field with 3-dimensional position information (x,y, and z coordinates) so that a mechanical harvester may be directed to the exact location of the broccoli to harvest it without any human interaction. A secondary goal was set to build a prototype capable of moving into position to simulate cutting the broccoli at the desired point of the broccoli stalk. The third goal was to take the prototype hardware and adapt it to an available old cauliflower harvester.

3.c. SIGNIFICANT FINDINGS

With new donated camera technology from Intel, the robotics team developed a successful prototype capable of identifying broccoli in field conditions, both in full sun and rainy skies. The prototype robot was able to successfully utilize this positional information to simulate harvesting the broccoli in the field. This demonstrates that the vision system can successfully be used to automate broccoli harvest.

3.d. METHODS

Using broccoli from the Oregon State University breeding program of Jim Myers, a computer-controlled camera vision system was developed and tested to identify broccoli. Lighting types, light-exclusion areas, and light saturation methods were all tested as variables in perfecting the camera system. A computer program was written by programmers in the high school robotics team to identify the broccoli. Robotics students also developed a hardware and software system capable of using the information from the computer program to adjust a 'harvester arm' capable of cutting broccoli at target position on the broccoli stalk.

3.e. RESULTS & DISCUSSION

The primary and secondary goals of this project were successfully met. Due to limitations in time, the third goal of adapting the technology to a field harvester was not accomplished before the fall rains arrived. This goal should be completed in the 2017 year, given the continued support of the industry, such that producers will be able to judge whether the technology can be scaled up and adapted to commercial applications.

Electronic Filing: When sending your report to OPVC, name your file using 1) principal investigator last name, 2) keyword and 3) final report. For example: if Jane Doe was submitting a final report for her N fertility project it would be named DoeNFertilityFinal.doc.

4. BUDGET DETAILS

Budget

Item	Year 1	Year 2	Year 3
Salaries	$,4900		
Benefits			
Wages			
Benefits			
Equipment			
Supplies	$5,000		
Travel	$100		
Plot Fees			
Other			
Total	$10,000		

Please submit proposal electronically in PDF format to opvc@westernadvocates.com. See the OPVC grant program page (http://horticulture.oregonstate.edu/content/opvc-competitive-grant-program) for the submission deadline date.