

V(A). Planned Program (Summary)

Program # 14

1. Name of the Planned Program

Global Food Security and Hunger: Sugar Beets & Minor Crops

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	15%		10%	
111	Conservation and Efficient Use of Water	10%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	5%		9%	
202	Plant Genetic Resources	10%		9%	
205	Plant Management Systems	15%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		10%	
212	Diseases and Nematodes Affecting Plants	10%		10%	
213	Weeds Affecting Plants	10%		10%	
215	Biological Control of Pests Affecting Plants	5%		9%	
216	Integrated Pest Management Systems	10%		9%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		2%	
511	New and Improved Non-Food Products and Processes	0%		2%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	4.2	0.0	6.5	0.0
Actual Paid	3.0	0.0	10.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
108955	0	465396	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
108955	0	465396	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
118431	0	4878573	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

SBMC Team members reported 5,309 direct educational contacts through Extension and 114,925 indirect contacts. Team members published two articles in refereed journals, three peer reviewed multi-state Extension publications (PNW), and participated in projects funded by \$382,155 in grants.

The sugar beet and minor crops team integrated field research, demonstration, and outreach education primarily related to crop pests, diseases, and weeds, and to irrigation systems and soil moisture relationships. Studies exploring relationships between irrigation, soil moisture, and soil-borne pathogens such as rhizomania and rhizoctonia are continuing in multiple settings. Field studies and tours were conducted in collaboration with growers and in UI Agricultural Experiment Station fields to study onions, sugar beets, dry beans, and sweet corn, to evaluate green manures and compost manure applications, and to test sugar beet varieties under a range of conditions. In northern Idaho, variety tests were established for 18 varieties of pea, 15 chickpea, and 15 winter pea varieties. Winter legume trials were also established to study cover crop attributes.

Pest diagnostic services and treatment recommendations are provided for growers. Pest monitoring and pest survey activities are conducted and coordinated by UI Extension faculty. Economically important pests studied and reported include onion thrip, Rhizoctonia, Aphanomyces, leaf minor and curly top.

Significant efforts were devoted to weed management, pesticide registration, development and extension of knowledge about IPM tools, and soil moisture/irrigation protocols influencing pests and diseases. New and practical information was shared through 54 Extension workshops, at commodity schools, and through presentations at grower and industry meetings and conferences. Faculty participated in a dozen regional conferences and commodity schools. PNW pest management handbooks were updated and IR-4 pesticides were evaluated as part of the regional project. Faculty prepared a host of Extension publications (for example the 2013 Small Grain and Grain Legume report) and research publications explaining their findings to end users and to other scientists.

2. Brief description of the target audience

Growers of minor crops in Idaho and western U.S., EPA, USDA, ISDA and other western departments of agriculture, regional land grant institutions, public interest groups, crop advisers and farm workers throughout Idaho are a targeted audience of this program. Other targeted audiences include sugar beet growers, growers of minor crops, and those who advise growers (i.e. sugar company fieldmen and agronomists, chemical companies, seed companies and consultants).

3. How was eXtension used?

use of eXtension was not reported in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5077	114925	232	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2014

Actual: 1

Patents listed

201400386, White Gold (Mustard, white)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	5	18	23

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Extension workshops, schools and conferences.

Year	Actual
2014	15

Output #2

Output Measure

- Field tours and demonstration projects.

Year	Actual
2014	11

Output #3

Output Measure

- Applied and basic laboratory and field research experiments

Year	Actual
2014	51

Output #4

Output Measure

- Professional invited presentations.

Year	Actual
2014	8

Output #5

Output Measure

- Presentations at Extension Workshops, schools, and conferences

Year	Actual
2014	40

Output #6

Output Measure

- Sugarbeet costs and returns estimates

Year	Actual
2014	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	O: growers use best practices in the production of sugar beets and minor crops. I: Number of Idaho growers indicating adoption of recommended practices (follow-up survey data).
2	O: Development of new research information. I: Research publications (peer reviewed).
3	Growers use best practices in regard to irrigation management and nutrient use efficiency in the production of sugar beet and minor crops. Indicator: Number of Idaho growers indicating adoption of recommended practices (follow-up survey data).
4	Producers have increased knowledge of pest management and water / nutrient management practices that affect the environmental and economic sustainability of sugar beet and other minor crop production. Indicator: Number of participants who demonstrate increased knowledge following Extension education programs.
5	Improving the economics of biofuel production, biopesticide development will promote and enhance organic and low input fruit and vegetable production. Indicator: Producers will increase oilseed crop acreage.

Outcome #1

1. Outcome Measures

O: growers use best practices in the production of sugar beets and minor crops. I: Number of Idaho growers indicating adoption of recommended practices (follow-up survey data).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	388

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

O: Development of new research information. I: Research publications (peer reviewed).

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Growers use best practices in regard to irrigation management and nutrient use efficiency in the production of sugar beet and minor crops. Indicator: Number of Idaho growers indicating adoption of recommended practices (follow-up survey data).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Excess N fertilizer applied to sugar beets may cause several problems; it decreases sugar beet quality, it can negatively impact surface and groundwater, it negatively impacts sugar beet economics. Overwatering sugar beets also has negative impacts; it can cause diseases and leach nutrients out of the root zone.

What has been done

In conjunction with AMSCO field consultants, soils tests were taken prior to the sugar beet growing season and soil moisture monitoring equipment was installed in growers' sugar beet fields in order to increase nutrient and water use efficiency.

Results

Cooperating sugar beet growers used data from the soil moisture monitoring equipment to help them schedule irrigation. Consequently, they used less water than they normally use and the incidence of disease was reduced.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water

Outcome #4

1. Outcome Measures

Producers have increased knowledge of pest management and water / nutrient management practices that affect the environmental and economic sustainability of sugar beet and other minor crop production. Indicator: Number of participants who demonstrate increased knowledge following Extension education programs.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	301

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Pest management and crop protection issues are extremely important from economic, environmental and human health perspectives. Based on University of Idaho Crop Enterprise Budgets, pesticide expenses range from 18% to 39% of the operating costs of the high valued crops; alfalfa seed, onions, potatoes, and sugar beets. Using an IPM based decision making process for pesticide applications may help reduce overall costs to the producer and pesticide impacts to workers and the environment. Water and energy use in sugar beet irrigation can be reduced by proper irrigation scheduling and by proper irrigation equipment maintenance. Over-irrigation can increase disease pressure while minor under-irrigation will reduce sugar yield only slightly.

What has been done

Educational programming was included in the December 2013 UI Snake River Sugar Beet Conference and at the August 2014 Amalgamated Sugar Company Ag Symposium. Field tours and surveys were conducted in more than 20 fields in order to evaluate and detect irrigation, nutrient & pest issues. We educated growers on diseases, soil crusting, frost damage, nutrient balances, over-watering and a need for best management practices. Two studies evaluating the effect of irrigation level on sugar yield were conducted at the Kimberly R&E Center. One study also looked at irrigation interaction with tillage system, weed and insect populations, and the other with disease and insect population. PNWPestAlert.net was used to quickly disseminate research based pest control information relevant to immediate threats to Treasure Valley crops. Articles were written and published in the trade magazine Sugar Producer in 2014.

Results

Participants at the conferences strongly indicated the value of new information that they received. Producers accessing PNW PestAlert.net not only received new knowledge, but also increased their use of IPM strategies to control pests, such as using beneficial insects, installing pheromone traps, rotating chemistries, etc., by 25% (2013 data).

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water

202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #5

1. Outcome Measures

Improving the economics of biofuel production, biopesticide development will promote and enhance organic and low input fruit and vegetable production. Indicator: Producers will increase oilseed crop acreage.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Brassicaceae oilseed crops including rapeseed (*Brassica napus*), mustard (*Brassica juncea* and *Sinapis alba*), and camelina (*Camelina sativa*) exhibit rotational and environmental quality benefits making them excellent choices as rotational crops for the production of advanced liquid biofuel feedstocks. Substituting a mustard crop for a pulse crop can significantly reduce the amount of herbicide used in the cropping system. Brassicaceae crops are extremely competitive with most common annual weed species, reducing the need for chemical weed control in the crop. Natural chemicals produced by Brassicaceae plant tissues also appear to provide pest control benefits that exceed those expected from an average break crop. Including Brassicaceae crops in a rotation has a number of other advantages. Increased plant available N has been measured in soils

following mustard crops equal to that typically measured after a legume. Brassicaceae crops are highly drought tolerant and require less water than small grains. Although Brassicaceae species afford the aforementioned benefits with respect to agroecosystem sustainability and produce excellent quality oils for advanced biofuel feedstocks, acreages are limited by low financial returns to growers. An increased financial incentive to grow Brassicaceae oilseed crops will only occur if the oils and associated co-products command higher prices. Given the competing price of petroleum feedstocks, the value of oils produced from Brassicaceae species is unlikely to increase in the foreseeable future. Thus, the only way to develop an economically viable, regionally significant liquid biofuels industry based on oilseeds is to increase co-product value.

What has been done

Two different extraction procedures were designed to extract pesticidal compounds from mustard meals. The procedure for *Sinapis alba* involves hydrolyzing the glucosinolate precursor during the extraction to produce a pesticidal formulation. The procedure for *Brassica juncea* involves extracting intact glucosinolates that do not have biological activity until activated by hydrolysis. Bioassays conducted to determine phytotoxic compounds in mustard meal extracts from *S. alba* indicate multiple herbicidal compounds including SCN- as well as two additional compounds. The additional compounds have not previously been implicated in mustard meal phytotoxicity. Overall herbicidal activity is controlled by synergistic and additive impacts of these three compounds. An ion chromatographic method to measure these herbicidal compounds was developed decreasing the time required for analysis. Conditions required activating pesticides in *B. juncea* extracts were optimized including pH and the ratio of extract to enzyme. Extracts can be stored inactive until the time of use, thus increasing user safety.

Results

Our overall goal is to ensure economic viability of liquid biofuel production from *Brassica napus*, *Brassica juncea*, *Sinapis alba*, and *Camelina sativa* by developing enhanced-value co-products from the seed meals remaining after oil expression. Currently, our most promising candidate for commercial adoption is a bioherbicide for weed control in rice. We will continue efforts using *S. alba* seed meal and expand on this research by developing efficacious biopesticidal formulations for a broader range of plant pests. We will extract glucosinolates from seed meals, utilize the separated glucosinolates as biopesticides, and increase the nutritional value of the residual seed meals for animal feed. Glucosinolate extracts possess inherent advantages as biopesticides compared to the seed meals including greater ability to manipulate active ingredient additions to achieve efficacy, improved transportability, and ease of application. Our specific

objectives include the following: 1) develop an economically viable bioherbicide for rice; 2) develop extraction procedures for glucosinolates from Brassicaceae seed meals; 3) optimize biopesticidal formulations to maximize biopesticide release; 5) screen biopesticides for activity using bioassay procedures. Our specific outputs will be biopesticides targeting pests in organic crops.

4. Associated Knowledge Areas

KA Code	Knowledge Area
215	Biological Control of Pests Affecting Plants
503	Quality Maintenance in Storing and Marketing Food Products
511	New and Improved Non-Food Products and Processes

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Other (climate)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation of the PNW Pest alert network was conducted using an online survey attached to the website. Responses to the survey indicate that:

- Subscriptions to the pest alert network have increase nearly 10% over last year.
- Pesticide applications have been reduced by 12%
- 26% of the time, applications were more effective and timely
- 37% increase in field scouting before applying a pesticide

Key Items of Evaluation