PROGRESS REPORT

Vogel Project No. 3019 8334

Title: Genetic Characterization of Pythium Root Rot Tolerance in Cultivated Wheat

Researchers: Dr. Timothy Paulitz (USDA-ARS), Dr. Kimberly Campbell (USDA-ARS)

Reporting Period: January 1, 2008 to December 31, 2008

This spring and summer, 2008, we hired an undergrad student, Tiffany Spiron, to conduct growth chamber screenings with a number of PNW and Australian cultivars, as well as cultivars identified as tolerant (Sunco, KS93U161) and susceptible (Macon, OR942504) in our previous assays. She performed two runs of this experiment. In Fall, 2008, another repeat was set up, with the help of Alison Thompson, a new PhD student on the project with Dr. Campbell. The first run used soil from the Spillman farm that was contaminated by herbicide, so the results from this experiment are not usable. The second run was set up a few weeks ago. All greenhouse experiments used inoculum of *Pythium ultimum* and *P. irregulare* Group IV, pasteurized field soil, and soil amended with oatmeal to enhance virulence. All values were expressed as a percent of the mean of the non-inoculated control, in an attempt to minimize the variance and enhance our ability to pick out tolerance. Statistical analysis was performed both on the raw data and the transformed data. Three variables were measured- total plant height, length of 1st leaf, and dry weight.

ACCOMPLISHMENTS:

1. Statistical evaluation of growth chamber method.

We demonstrated that this growth chamber method has the consistency and statistical power to separate highly susceptible cultivars from less susceptible or more tolerant cultivars, and to show a differential response to the two pathogens tested**. This shows that this method could be used to easily evaluate existing germplasm, and make recommendations to growers.**

2. Evaluation of cultivar tolerance

We demonstrated that some PNW cultivars are more tolerant than others, and these results were consistent with previous results. Gala, Sunco, KS93U161, Tara 2002, and Gluyas Early were more tolerant to *P. irregulare*, and Gala, Sunco, Alpowa, and Chukar were the most tolerant to *P. ultimum.*

RESULTS

Accomplishment 1

A. There was a significant interaction between cultivars and pathogen. This indicated that the ranking of cultivar tolerance will not be the same for the two species, and cultivars respond differently to the two species (Table 1).

B. The experimental variation was higher with *P. ultimum*, especially when plants emerge, but are severely damaged. Table 2 shows the CV values, which were in the 20s for *P. irregulare* and in the 30s for *P. ultimum.*

Figures 1-6 show results expressed as box plots. The height of the diamonds indicate the 95% confidence intervals, the width indicates the number of samples. Data is indicated by dots, and the lines indicate 1X and 2 X the standard deviation.
These graphs show that *P. ultimum* causes more damage than *P. irregulare*, as indicated by the higher mean value horizontal line in the graph. These graphs also show that plant height and length of 1st leaf showed less variation than dry weight.

Accomplishment 2.

Figures 7-9 show the rankings of cultivars in response to *P. irregulare* group IV. Gala, Sunco, KS93U161, Tara 2002, Scarlet and Gluyas Early, were ranked at the top for most plant parameters, with values not statistically different from the non-inoculated control. This confirms rankings from the original Higginbotham paper and previous work with optimizing the method.

Figures 10-12 show the ranking of cultivars to *P. ultimum*. Gala, Sunco, Alpowa, and Chukar were ranked in the top five of at least two of the three plant parameter.

Figures 13-15 show the means for the three parameters, comparing the non-inoculated control to the two inoculated treatments.

Presentations that include results of Vogel research

Appeal and Pitfalls of Continuous Wheat Rotation. Spokane County Crop Improvement Association Annual Meeting, Airway Heights, WA. Nov. 20, 2007

The appeals and pitfalls of an all-wheat rotation. Kennewick Far West Associates Meeting, Dec. 11, 2007.

The appeals and pitfalls of an all-wheat rotation. Clearwater Direct Association meeting, Jan. 15, 2008.

The appeals and pitfalls of an all-wheat rotation. Walla Walla Growers, Feb. 5, 2008.

The appeals and pitfalls of an all-wheat rotation. Spokane Farm Forum, Feb.6, 2008.

Canola Disease Control Methods. Bio-Energy Workshop, Nespelam, WA. April 10, 2008.

Plant Pathology 101: Cereal Diseases. Presented to the Seed Academy, a 3-day workshop for seed workers, Pullman, WA, June 4, 2008.

Integrated control of soilborne wheat pathogens. 9th International Congress of Plant Pathology, Torino, Italy, Aug. 28, 2008.

Scientific Publications

Raaijmakers, R. M., **Paulitz, T. C.,** Steinbert, C., Alabouvette, C. and Moënne-Loccoz. 2008. The rhizosphere: a playground and battlefield for soilborne pathogens and beneficial microorganisms. Plant and Soil: in press

Abstracts

Paulitz, T. C., Schroeder, K. L. and Okubara, P. 2008. Integrated control of soilborne plant pathogens. Journal of Plant Pathology, Vol. 90 (2, Supplement) Aug. 2008 S 2.62.

Technical Reports/Extension

Paulitz, T. C. Back to back wheat rotations: What are the risks of root diseases. DirectSeed Link- the Pacific Northwest Direct Association. Vol. 9, No. 1. pg. 1-2.

Table 1. ANOVA- P values of analysis with data transformed to percent of non-inoculated control

		Plant Parameter	
Treatment	Height	1st Leaf	Dry Weight
Cultivar	0.048	0.032	0.09
Pathogen	0.002	<0.001	0.004
Cultivar X Pathogen	0.0112	0.057	0.27

Table 2. Coefficient of Variation values with data transformed to percent of non-inoculated control

		Plant Parameter	
Pathogen	Height	1st Leaf	Dry Weight
P. irregulare	13.3	23.7	28.8
P. ultimum	23.8	35.0	38.8

Figure 1. Average height of cultivars in response to *P. ultimum*

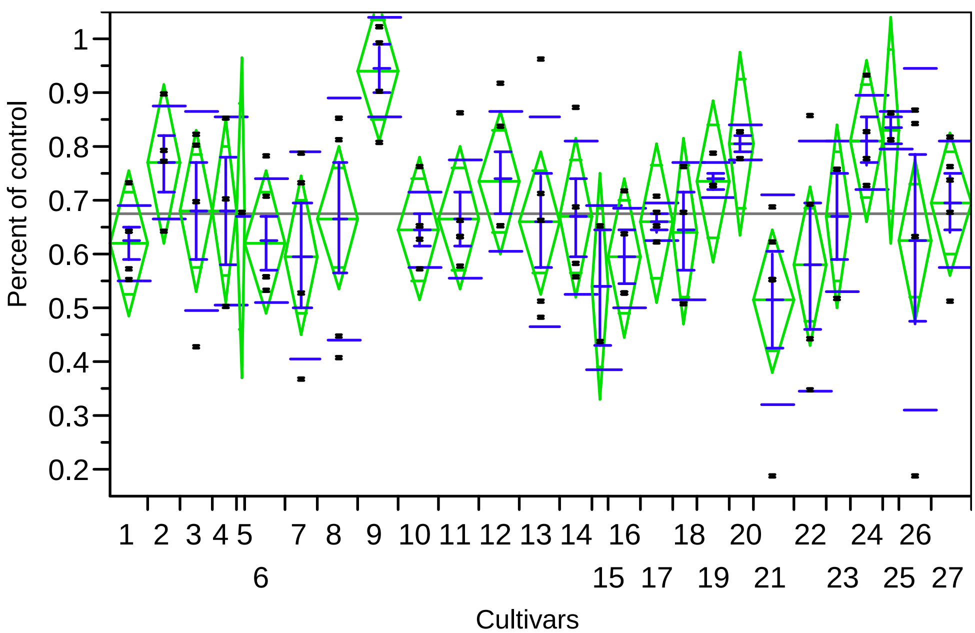


Figure 2. Average length of first leaf of cultivars in response to *P. ultimum*

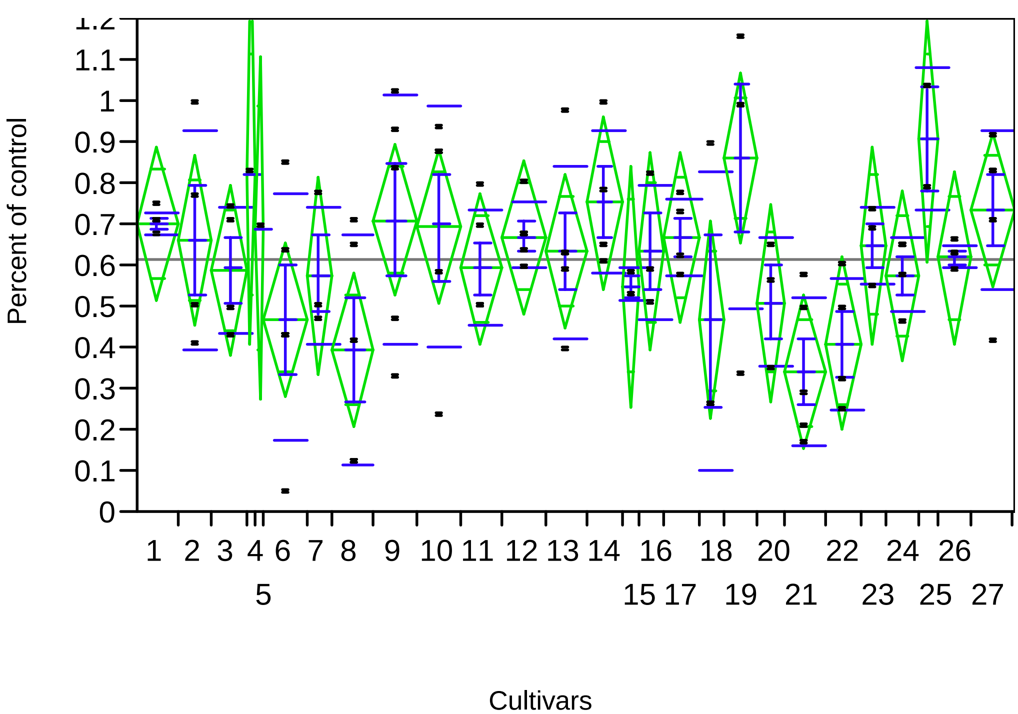


Figure 3. Average dry weight of first leaf of cultivars in response to *P. ultimum*

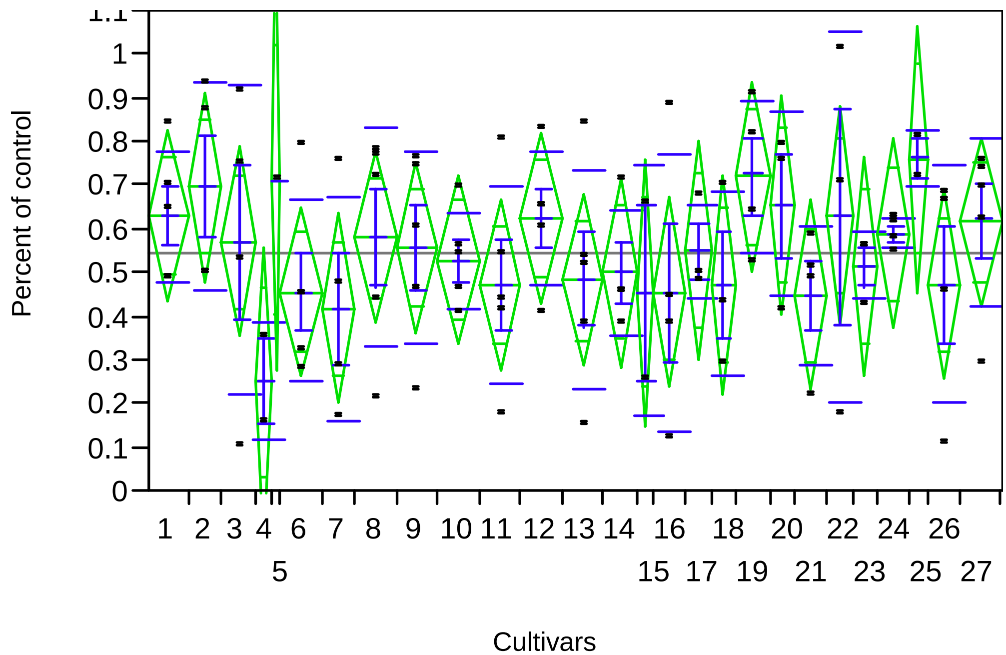


Figure 4. Average height of cultivars in response to *P. irregulare*

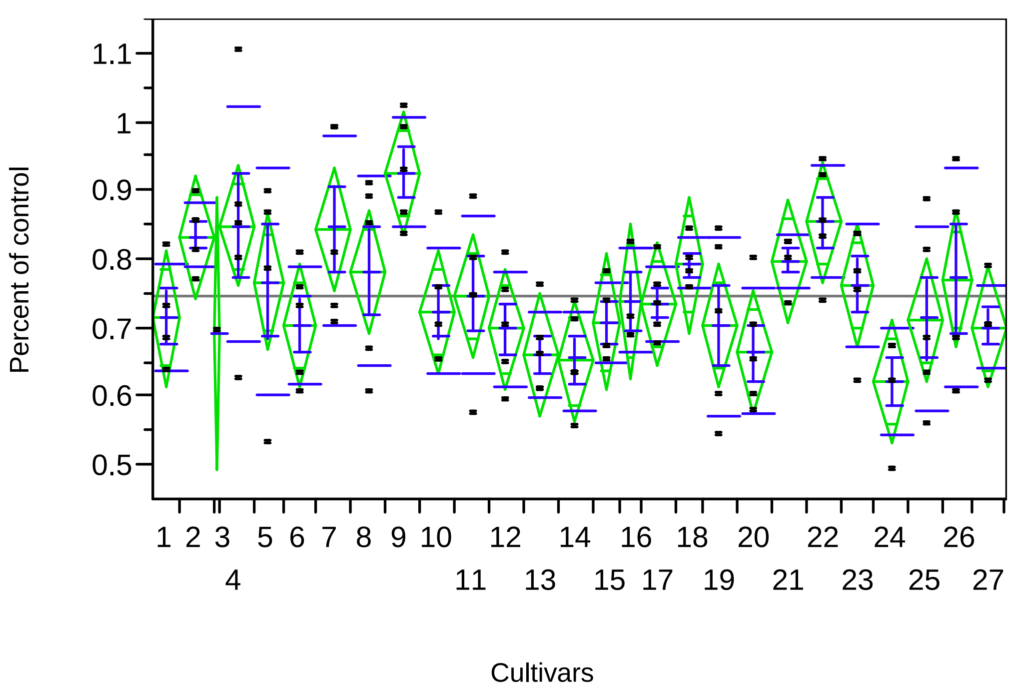


Figure 5. Average length of first leaf of cultivars in response to *P. irregulare*

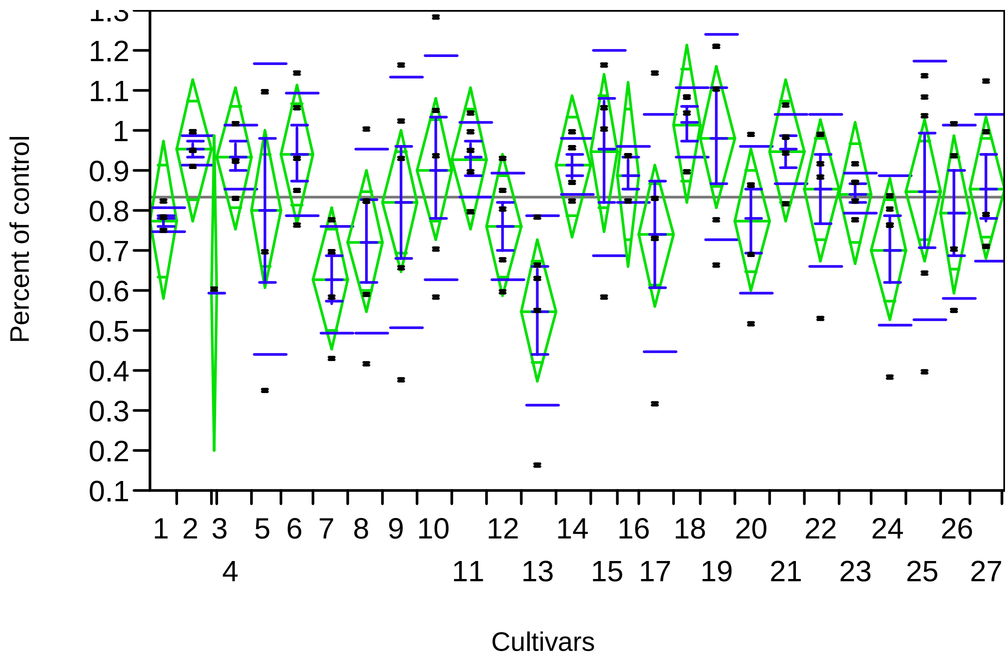
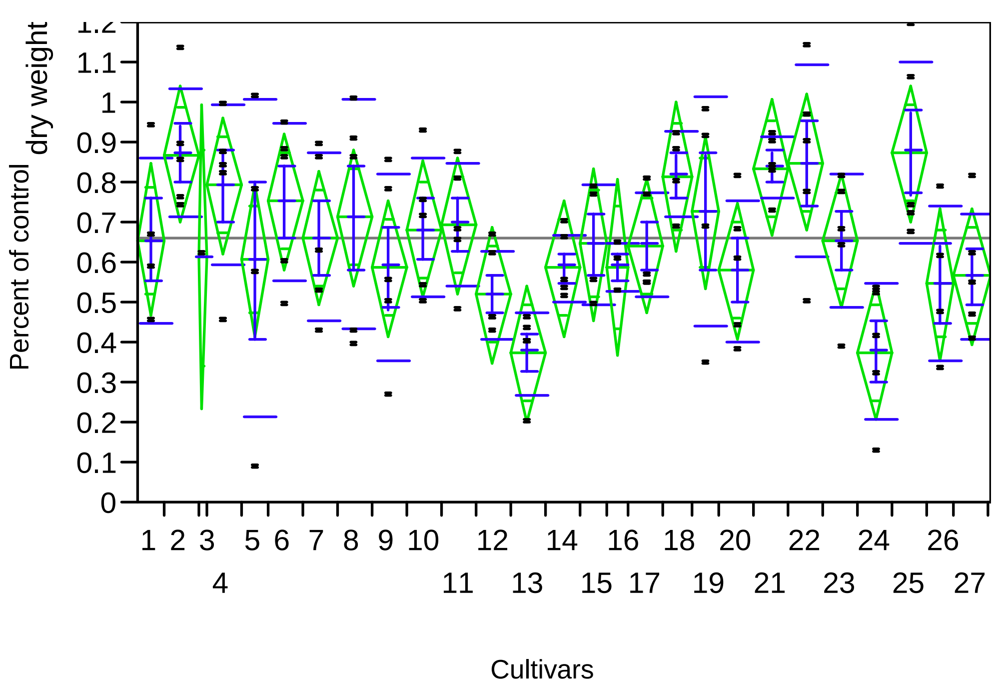


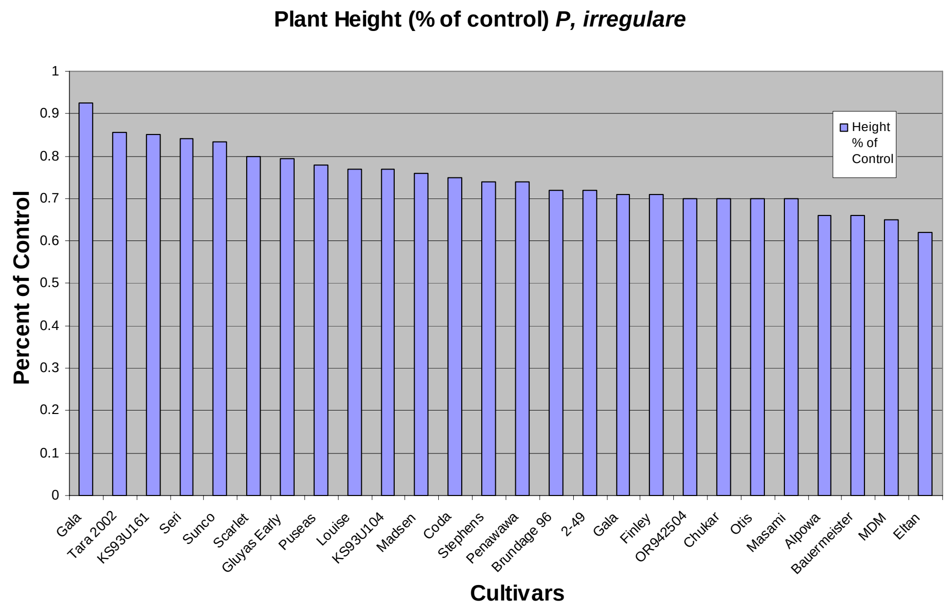
Figure 6. Average dry weight of first leaf of cultivars in response to *P. irregulare*



Legend for Cultivars

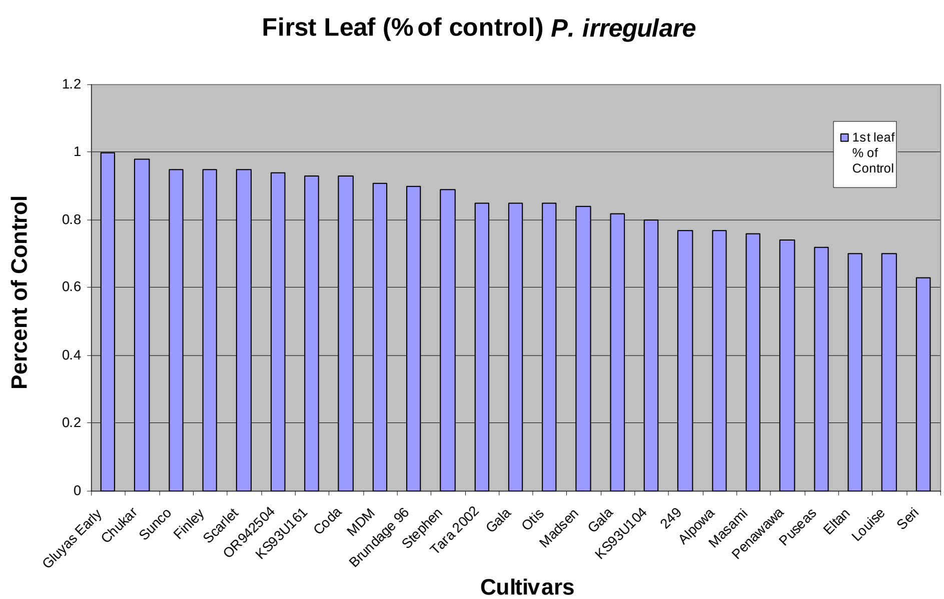
1	249
2	Sunco
3	Macon
4	KS93US61
5	KS93U104
6	OR942504
7	Seri
8	Puseas
9	Gala
10	Brundage 96
11	Coda
12	Masami
13	Bauermeister
14	MDM
15	Finley
16	Stephen
17	Penawawa
18	Gluyas Early
19	Chukar
20	Alpowa
21	Scarlet
22	Tara 2002
23	Madsen
24	Eltan
25	Gala
26	Louise
27	Otis

Figure 7.



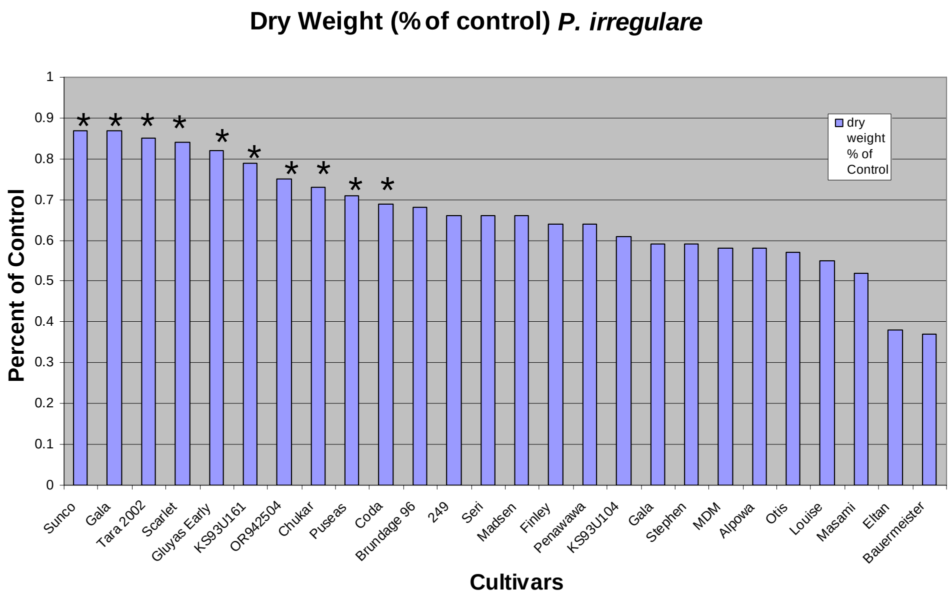
*= not significantly different from non-inoculated control

Figure 8.



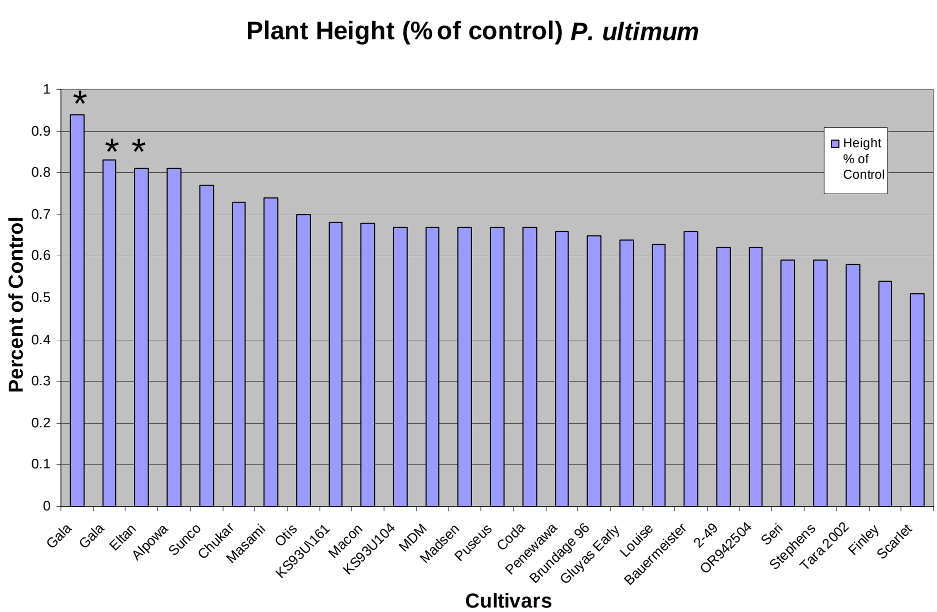
All treatments are not significantly different from non-inoculated control, except for Masami, Puseus, Seri, and Bauermeister

Figure 9



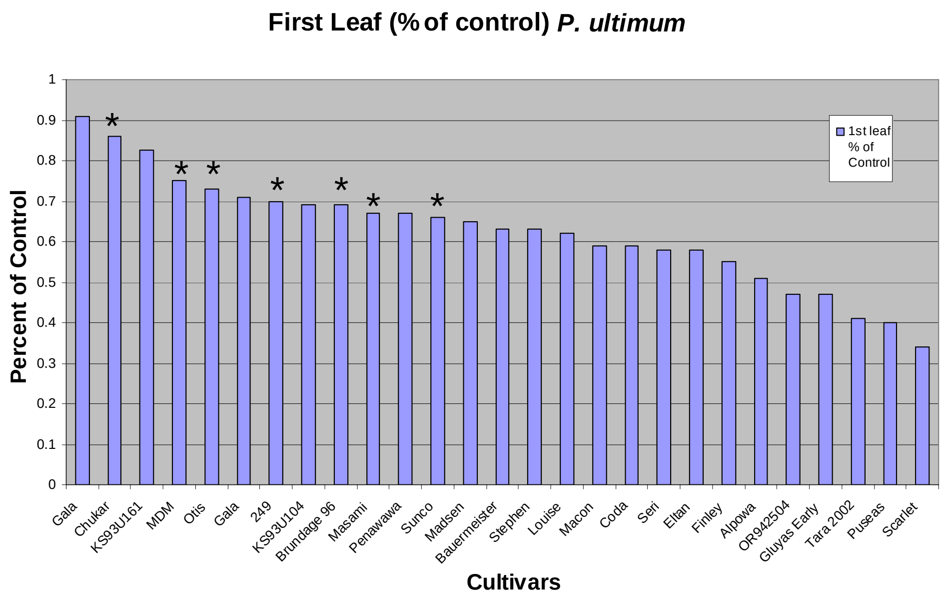
*= not significantly different from non-inoculated control

Figure 10



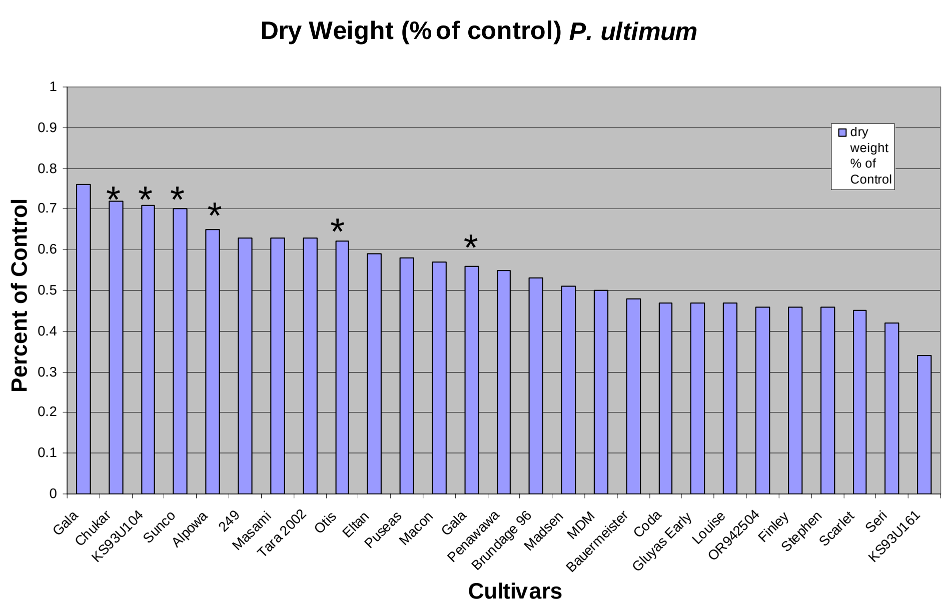
*= not significantly different from non-inoculated control

Figure 11



*= not significantly different from non-inoculated control

Figure 12



*= not significantly different from non-inoculated control

Figure 13.

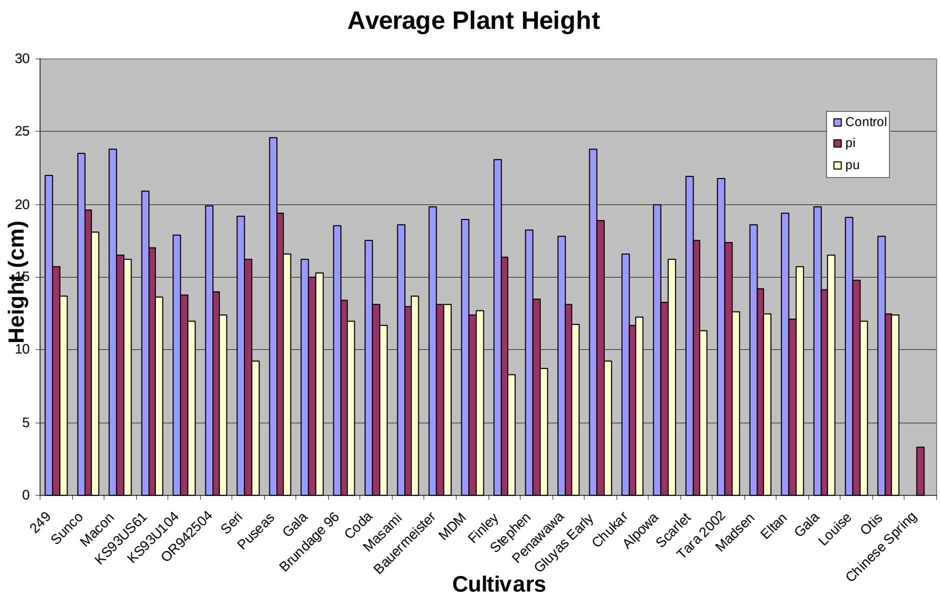


Figure 14.

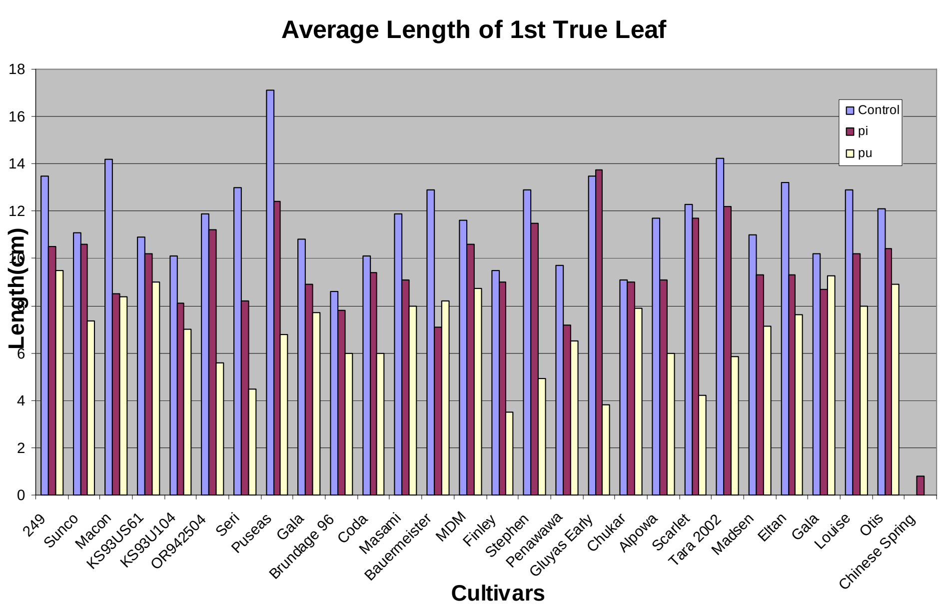
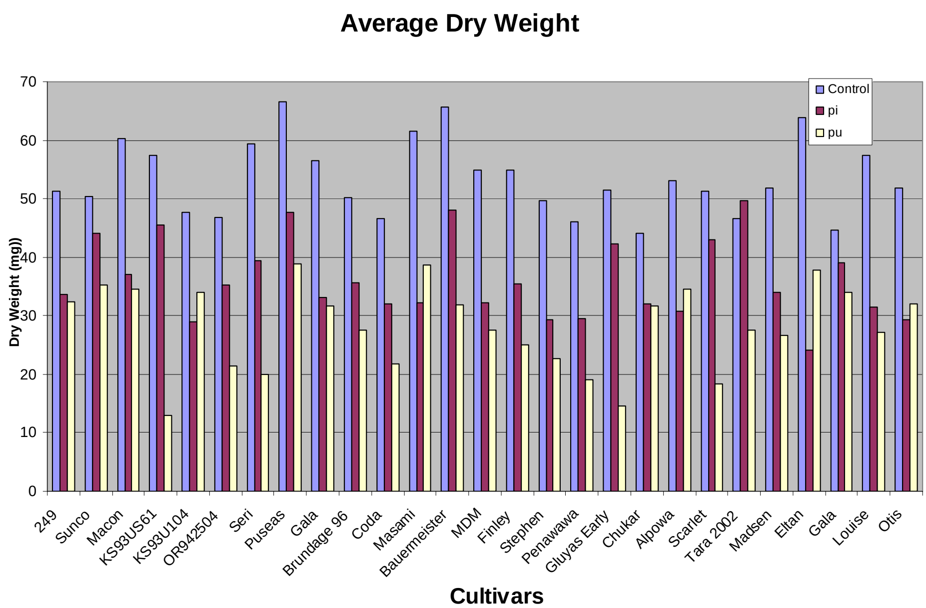


Figure 15.


Average Dry Weight
Dry Weight (mg))
Cultivars
Control
pi
pu
0
10
20
30
40
50
60
70
249
Sunco
Macon
KS93US61
KS93U104
OR942504
Seri
Puseas
Gala
Brundage 96
Coda
Masami
Bauermeister
MDM
Finley
Stephen
Penawawa
Gluyas Early
Chukar
Alpowa
Scarlet
Tara 2002
Madsen
Eltan
Gala
Louise
Otis