Spring 2009

Evaluating Hazelnut Cultivars for Yield, Quality and Disease Resistance

Sam Tobin
University of Nebraska at Lincoln

TABLE OF CONTENTS

PREFACE

I would like to thank Troy Pabst, Rich Lodes, Scott Josiah and the Nebraska Forest Service who allowed me to use the data that we have been collecting over the past two harvesting seasons in my results. I would also like to thank them for the support provided in writing and reviewing my thesis. I would also like to thank Dave Gosselin and Sara Yendra for their support in the writing and review process.

CHAPTER I: INTRODUCTION

Hazelnuts, genus *Corylus*, are primarily small trees or shrubs which are grown mostly for their nuts. They are wind-pollinated and bloom in the early spring. Ninety-nine percent of US hazelnut production is done in the Willamette Valley region of Oregon because of the ideal climate (Fulbright 183-214). US production also yields some of the largest in-shell nuts which is ideal commercial production.

Commercial hazelnut production is an industry that the United States is still attempting to break into. Turkey commands the majority of the market producing 625,000 metric tons of hazelnuts, or 74% of the world market. This is followed by Spain at 3%, Azerbaijan at 2% and the United States at 2% (USDA). The market for hazelnuts has increased greatly in the past few years and the United States is struggling to make its name (see figure 1). The majority of the hazelnut production in the United States is centered in the Pacific Northwest. The climate of the Pacific Northwest makes it ideal for hazelnut production. This study will look at two different cultivars that are both adapted to the local climate of Eastern Nebraska and exhibit traits sought after for

commercial nut production. Many of the commercial harvesting techniques used by these handfuls of Oregon producers are kept tightly under wraps from the public making it difficult for competition to develop.

Eastern Filbert Blight (EFB) is the main disease that has the ability to have a major impact on commercial nut trees in this region. EFB is a fungal disease which infects hazelnuts and is identified by small raised bumps on any part of the tree. After infection it can take over a year for hazelnuts to show signs. Most of the tree has died within 7 to 15 years of EFB infection. (Pscheidt 1-2) One of the major characteristics that will be needed to provide a cultivar for widespread commercial production is EFB resistance. There is only one way to test the susceptibility of a cultivar to EFB, and that is to inoculate the plant and to record their response. There is no current data in our UNL-East Campus hazelnut plot as to which cultivars are EFB resistant and which ones are not, but future possible inoculations will be able to identify this characteristic. These inoculations have been attempted by Tom Molnar of Rutgers University and have provided cultivars that are thought to be EFB resistant.

Why is there little hazelnut production in the central United States? This question is up for debate, climate and disease are the major factors inhibiting hazelnut production in the central United States. There are many claims of cultivars that are resistant to EFB but these claims are backed up by no factual evidence. The cultivars that will be assessed in the study are the Skinner and the Grand Traverse. The expected results are that these are the two cultivars that will exhibit most of the traits sought after for commercial hazelnut production.

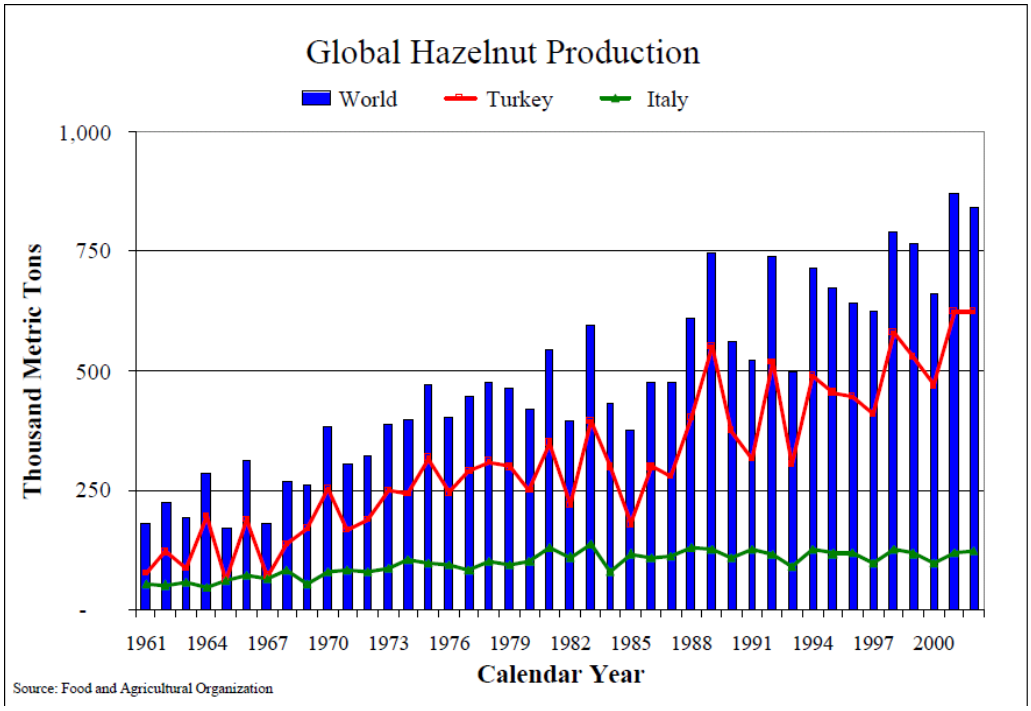


Figure 1

CHAPTER 2: THE RESEARCH PROBLEM

The main problem that is being addressed in this study is that there are no cultivars that have the proper characteristics for commercial production in the climate of Eastern Nebraska. By taking the Grand Traverse, and the Skinner cultivars and comparing yields and sought after nut characteristics I will come to a conclusion as to which is more suited for commercial nut production in Nebraska. My hypothesis is that the Skinner cultivar will have more of the desired characteristics than the Grand Traverse cultivar and will in fact be more desired for commercial nut production in Nebraska, although Skinner aren't prime for in-shell production. This hypothesis is based on

firsthand experience harvesting and processing samples of each cultivar.

CHAPTER 3: MATERIALS AND METHODS

My study site is the Nebraska Forest Service hazelnut plot on the University of Nebraska-Lincoln East Campus (40̊ 49' 53" N, 96̊ 39' 25" W). This site has approximately 600 hazelnut trees of various cultivars. Trees included in this plot include NADF (National Arbor Day Foundation), TH (Turkish Tree Hazel), GT (Grand Traverse) and SK (Skinner). Some cultivars were planted from seed, and others were grafted. Some of the trends seen so far are that plants that were grown from seed tend to produce higher yield than that of grafts, but also don't exhibit other important characteristics like disease resistance.

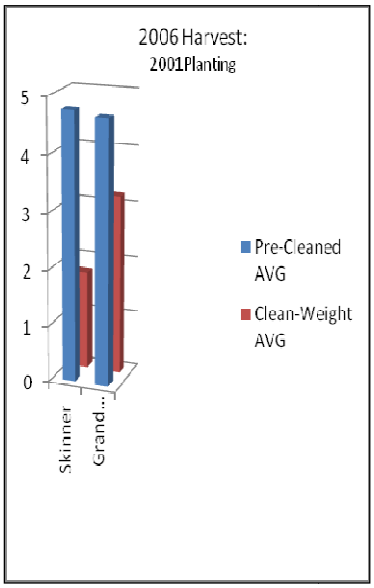
The data collection begins in the mid-late summer when the involucres begin to loosen up their hold on the actual hazelnut. This is done primarily in a qualitative way because there are so many factors that determine when the involucres will release the

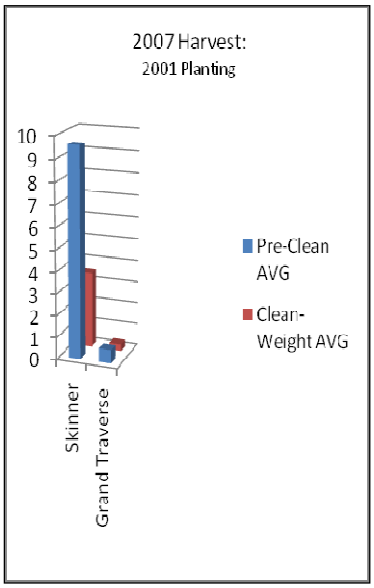
hazelnut. Collection of the samples is done by hand which tends to be very labor intensive. Collection materials include a harvesting satchel, orchard ladder and buckets. This is a process in which I have been a part of for the past two harvesting seasons. The harvesting season lasts only a few months but once harvest is complete there is the processing which also tends to be very labor intensive.

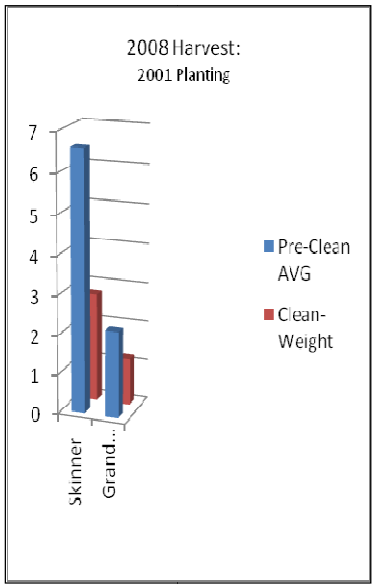
Very little of the harvest and processing that was done on this test plot was done mechanically. The reason for this goes back to the large hazelnut producers keeping their methods and mechanized equipment private. The little equipment that is used is done so in the first step of processing. The first step in processing is removing the involucres from the nut clusters. We use a simple machine that crudely removes the involucres leaving mostly cleaned nuts. What is left to clean is done by hand over the course of the winter. Once we have our cleaned samples we record the data for cleaned weight. After this we dry the samples to then record their dry weight.

CHAPTER 4: THE DATA

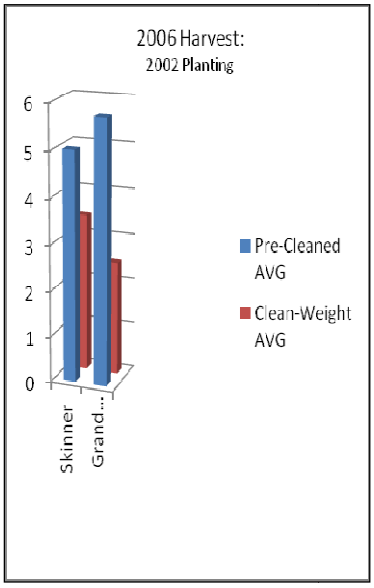
2001 PLANTING

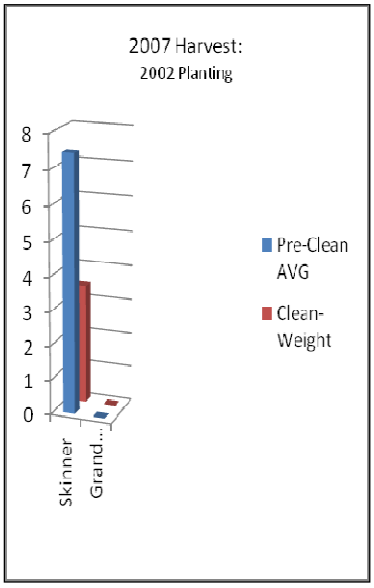


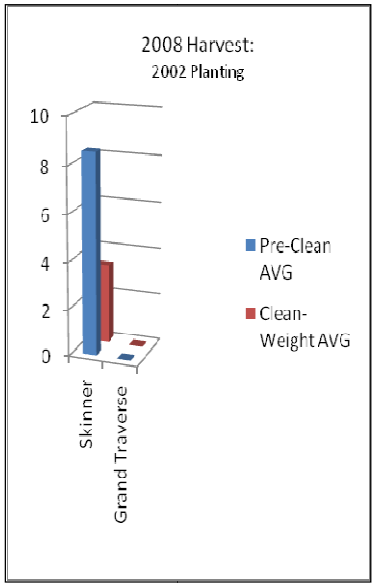




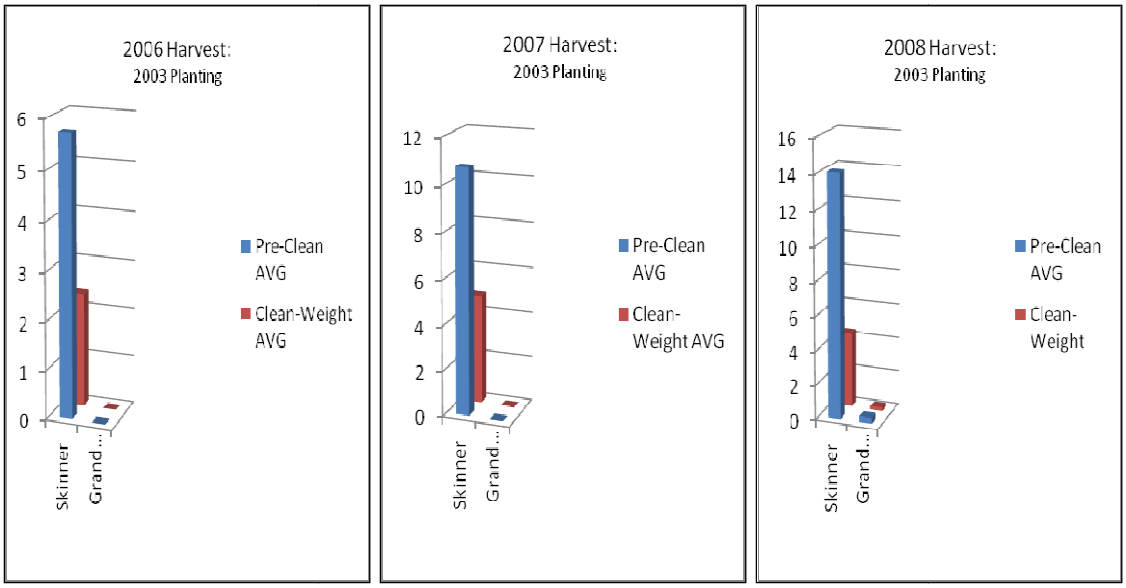
2002 PLANTING



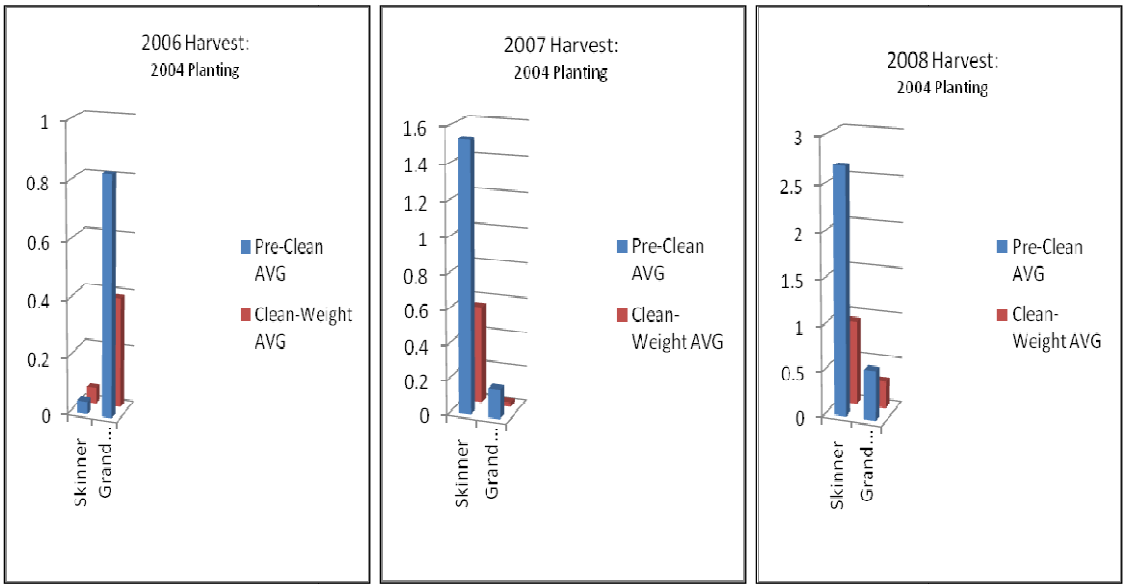




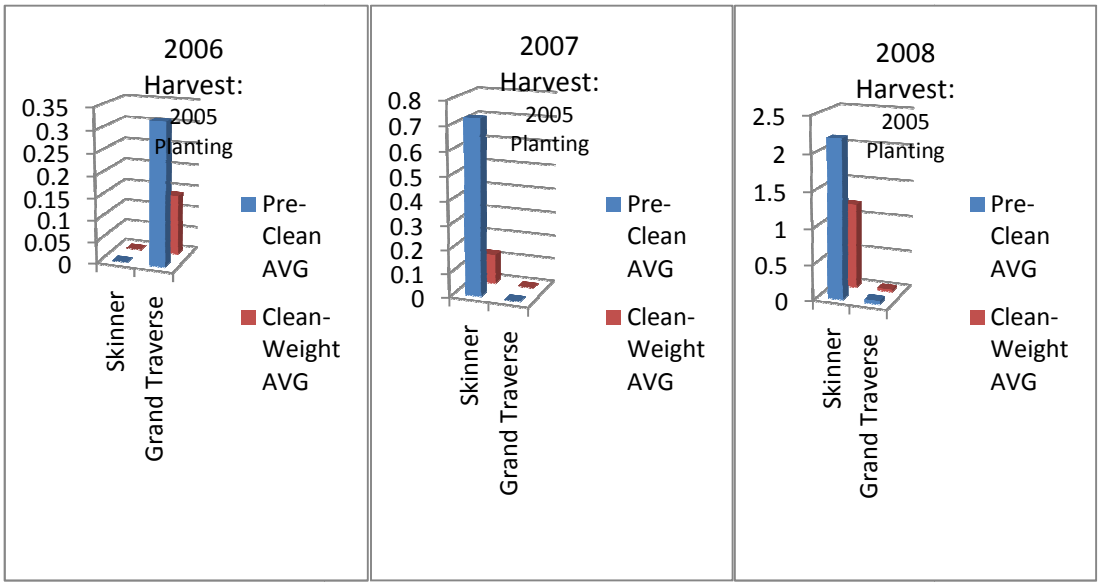
2003 PLANTING



2004 PLANTING



2005 PLANTING



CHAPTER 5: THE ANALYSIS

By separating the hazelnut harvest data into the various years it is easier to show how the different cultivars compare to one another. In the graphs I included two comparisons, a comparison of pre-cleaned weight average of Skinner against pre-cleaned weight average of Grand Traverse, and then a comparison of the clean-weight of Skinner against the clean-weight of the Grand Traverse. By seeing the progression in yield through each year of harvest, it makes it more apparent how well the yield is increasing compared to its counterpart. Since nut trees are alternate bearing you can see the trend in

the older plantings where the yield doesn't continually increase through the three harvest years. There are also other traits that can be seen in these graphs including the percentage of clean-weight from pre-clean weight which will tell you how much mass the involucres add to the initial harvest.

Looking at the comparison of Grand Traverse and Skinner yields throughout the three year harvest, Skinner yields tend to be much higher than Grand Traverse. I would recommend the Skinner cultivar to be more valuable in commercial production in regard to yield because of the pre-clean averages and the clean-weight averages. The Skinner cultivar also has the advantage that it is a smaller tree which makes manual harvesting easier, but this smaller tree could be due to grafting causing a dwarfing effect.

CHAPTER 6: CONCLUSION

With alternative agriculture practices becoming increasingly popular because of various reasons including environmental degradation, over production and inconsistent crop prices, there is always a need for more profitable crops to be grown using a fraction of the land. If there is a possibility for commercial hazelnut production to flourish in the Eastern Nebraska why would we let the market be dominated by producers in the Willamette Valley region of Oregon? Using the research being done by Troy Pabst and the Nebraska Forest Service commercial production of hazelnuts could be closer than expected. Using the data from this East Campus test plot there will be great advances in identifying cultivars that exhibit high yields, good nut characteristics and disease

resistance.

The beginning of the research for this study began with the first plantings of the Skinner and Grand Traverse cultivars in 2001 and continued with annual plantings up until 2005. After these plantings the annual harvesting and data collection began. What I have done in this thesis is put the data from the Skinner and Grand Traverse together and compared annual yields to determine which one would be more fitting for commercial production.

The future of commercial nut production in Nebraska has the possibility to be a rich one, one in which a lot of revenue can be made for agriculturalists.

REFERENCES

1. Fulbright, Dennis W.. *Nut Tree Culture in North America*. Vol. 1. Saline, MI: McNaughton and Gunn, Inc., 2003. Print.
2. Olsen, Jay. "Hazelnuts ." *Nutrient Management Guide* (2001): Print.
3. Pscheidt, Jay W.. "Detecting and Controlling Eastern Filbert Blight." (1999): Print.
4. USDA. World Hazelnut Situation & Outlook. "World Horticultural Trade & U.S. Export Opportunities." 2004: Print.

LIST OF FIGURES

2006 Harvest

2001

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
14-Sep-06	2.92	0.92	3	12	2001	SK
19-Sep-06	5.3	1.72	4	28	2001	SK
19-Sep-06	4.96	1.91	4	27	2001	SK
19-Sep-06	6.8	2.79	4	26	2001	SK
18-Sep-06	3.88	1.42	5	12	2001	SK
Averages:	4.772	1.752				

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
19-Sep-06	2.84	1.73	4	19	2001	GT
20-Sep-06	5.96	3.87	8	14	2001	GT
20-Sep-06	7.22	4.38	8	31	2001	GT
20-Sep-06	6.86	4.29	8	30	2001	GT
22-Sep-06	3.81	2.66	9	35	2001	GT
22-Sep-06	7.04	4.52	9	32	2001	GT
22-Sep-06	7.82	5.51	9	31	2001	GT
22-Sep-06	8.01	5.48	9	30	2001	GT
26-Sep-06	1.55	1.11	13	10	2001	GT
26-Sep-06	2.8	2.21	13	9	2001	GT
26-Sep-06	4.73	3.5	13	17	2001	GT
26-Sep-06	6.02	4.5	13	16	2001	GT
26-Sep-06	4.73	3.5	13	17	2001	GT
	0	0	14	11	2001	GT
8-Sep-06	0.9	0.5	16	11	2001	GT
Averages:	4.686	3.184				

2002

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
22-Sep-06	5.02	3.44	9	34	2002	GT
Averages:	5.02	3.44				

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
22-Sep-06	8.28	3.64	11	26	2002	SK
22-Sep-06	3.16	1.34	11	25	2002	SK
22-Sep-06	8.39	3.58	11	24	2002	SK
22-Sep-06	7.55	3.31	11	12	2002	SK
25-Sep-06	3.5	1.51	12	9	2002	SK
25-Sep-06	3.66	1.44	13	8	2002	SK
Averages:	5.756667	2.47				

2003

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
19-Sep-06	5.74	2.34	4	12	2003	SK
Averages:	5.74	2.34				

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
Averages:	0	0				GT

2004

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
	0	0	3	9	2004	GT
	0	0	4	17	2004	GT
	0	0	4	9	2004	GT
20-Sep-06	0.04	0.01	6	25	2004	GT
20-Sep-06	0.04	0	6	5	2004	GT
	0	0	7	5	2004	GT
20-Sep-06	0	0.33	8	5	2004	GT
	0	0	8	16	2004	GT
20-Sep-06	0.08	0.04	8	15	2004	GT
	0		8	29	2004	GT
22-Sep-06	0.43	0.33	9	33	2004	GT
	0	0	13	11	2004	GT
26-Sep-06	0.07	0.06	13	15	2004	GT
12-Sep-06	0.06	0.05	15	23	2004	GT
	0	0	15	11	2004	GT
	0	0	16	23	2004	GT
Averages:	0.045	0.054667				

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
20-Sep-06	0.64	0.24	6	16	2004	SK
20-Sep-06	0.64	0.26	7	12	2004	SK
22-Sep-06	0.73	0.46	9	29	2004	SK
20-Aug-06	1.13	0.65	9	28	2004	SK
			9	27	2004	SK
22-Sep-06	1.47	0.69	11	14	2004	SK
25-Sep-06	1.37	0.58	12	10	2004	SK
25-Sep-06	0.3	0.15	13	7	2004	SK
25-Sep-06	1.59	0.71	14	5	2004	SK
26-Sep-06	0.43	0.2	15	5	2004	SK
8-Sep-06	0.85	0.32	16	17	2004	SK
	0	0	16	5	2004	SK
Averages:	0.831818	0.387273				

2005

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
	0	0	4	18	2005	GT

Averages: 0 0

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
19-Sep-06	0.44	0.13	6	34	2005	SK
	0	0	6	12	2005	SK
25-Sep-06	0.45	0.21	12	11	2005	SK
25-Sep-06	0.31	0.2	13	12	2005	SK
26-Sep-06	0.16	0.09	14	17	2005	SK
12-Sep-06	0.58	0.2	15	17	2005	SK

Averages: 0.32333 0.1383

2007 Harvest

2001

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
14-Sep-07	6.48	2.48	8	12	2001	SK
11-Sep-07	10.76	3.41	5	12	2001	SK
11-Sep-07	9.01	3.66	4	28	2001	SK
11-Sep-07	9.02	3.91	4	27	2001	SK
11-Sep-07	11.73	3.95	4	26	2001	SK
11-Sep-07	10.6	3.51	3	12	2001	SK

Averages: 9.6 3.486667

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
24-Sep-07	0.99	0.79	16	11	2001	GT
	0.07	0	14	11	2001	GT
20_Sep-07	1.67	0.95	13	17	2001	GT
20-Sep-07	1.67	0.93	13	16	2001	GT
	0	0	13	10	2001	GT
	0	0	13	9	2001	GT
	0	0	9	35	2001	GT

	0	0	9	32	2001	GT
	0.07	0	9	31	2001	GT
	0	0	9	30	2001	GT
13-Sep-07	2.36	1.18	8	31	2001	GT
13-Sep-07	1.37	0	8	30	2001	GT
	0	0	8	14	2001	GT
11-Sep-07	0.58	0.36	4	19	2001	GT
Averages:	0.627143	0.300714				

2002

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
20-Sep-07	5.16	2.09	13	8	2002	SK
20-Sep-07	5.45	2.99	11	9	2002	SK
20-Sep-07	1.5	3.43	11	26	2002	SK
20-Sep-07	8.25	3.42	11	25	2002	SK
20-Sep-07	13	4.04	11	24	2002	SK
20-Sep-07	11.4	4.82	9	12	2002	SK
Averages:	7.46	3.465				

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
	0	0	9	34	2002	GT
Averages:	0	0				

2003

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
11-Sep-07	10.77	4.82	4	12	2003	SK
Averages	10.77	4.82				

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
None						GT

2004

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
24-Sep-07	2.19	0.87	16	17	2004	SK
	0	0	16	5	2004	SK
	0	0	15	5	2004	SK
21-Sep-07	3.06	1.44	14	5	2004	SK
	0	0	12	7	2004	SK
20-Sep-07	3.36	1.27	12	10	2004	SK
20-Sep-07	3.78	1.66	11	14	2004	SK

	0	0	9	29	2004	SK
	0	0	9	28	2004	SK
	0	0	8	27	2004	SK
13-Sep-07	3.42	1.47	7	12	2004	SK
12-Sep-07	2.63	0	6	16	2004	SK

Averages: 1.536667 0.5592

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
	2.16	0	16	23	2004	GT
	0	0	15	23	2004	GT
21-Sep-07	0.07	0.06	15	11	2004	GT
21-Sep-07	0.26	0.18	14	23	2004	GT
20-Sep-07	0.03	0.01	13	15	2004	GT
	0	0	13	11	2004	GT
	0	0	9	33	2004	GT
	0	0	8	29	2004	GT
	0	0	8	15	2004	GT
	0	0	7	5	2004	GT
12-Sep-07	0.06	0	6	5	2004	GT
	0	0	6	25	2004	GT
	0	0	5	5	2004	GT
11-Sep-07	0.17	0.09	4	9	2004	GT
	0	0	4	17	2004	GT
11-Sep-07	0.1	0.06	3	9	2004	GT
	0	0		9	2004	GT

Averages: 0.167647 0.0235

2005

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
21-Sep-07	1.13	0.48	15	17	2005	SK
	1.13	0	14	17	2005	SK
	0.35	0	13	12	2005	SK
20-Sep-07	0.33	0.14	12	11	2005	SK
13-Sep-07	1.09	0	6	34	2005	SK
13-Sep-07	0.33	0.12	6	12	2005	SK

Averages: 0.726667 0.123333

Harvest Date	P.C.-Wt.	C.-Wt.	Row	#	Year	Cult.
	0	0	4	18	2005	GT

Averages: 0 0

2008Harvest

2001

DATE	PC	WET	DRY	CULTIVAR
9/29/2008	6.14	2.7	2.28	12-8-01-SK
9/29/2008	7.55	3.22	2.75	33-6-01-SK
	0	0	0	14-6-01-SK
9/29/2008	4.55	2.05	0	12-5-01-SK
9/29/2008	10.49	3.73	3.16	28-4-01-SK
9/29/2008	11.24	4.69	3.99	27-4-01-SK
9/29/2008	12.82	5.58	4.74	26-4-01-SK
	0	0	0	12-3-01-SK
Averages:	6.59875	2.74625		

DATE	PC	WET	DRY	CULTIVAR
9/9/2008	4.28	2.29	1.91	11-16-01-GT
9/3/2008	0.86	0.56	0.49	11-14-01-GT
10/3/2008	0.74	0.35	0	17-13-01-GT
10/3/2008	1.5	0.93	0	16-13-01-GT
9/9/2008	4.51	2.33	0	10-13-01-GT
9/9/2008	5.16	2.67	0	9-13-01-GT
	0	0	0	35-9-01-GT
	0	0	0	32-9-01-GT
	0	0	0	31-9-01-GT
	0	0	0	30-9-01-GT
9/15/2008	5.78	2.74	0	31-8-01-GT
10/3/2008	1.61	0.97	0	30-8-01-GT
9/8/2008	7.4	4.3	0	14-8-01-GT
10/3/2008	0.87	0.55	0	24-6-01-GT
10/3/2008	0.24	0.15	0	19-4-01-GT
Averages:	2.196667	1.189333		

2002

DATE	PC	WET	DRY	CULTIVAR
9/30/2008	5.88	2.09	2.1	8-13-02-SK
9/30/2008	7.61	3.3	2.7	9-12-02-SK

9/29/2008	8.82	3.38	2.76	12-11-02-SK
9/29/2008	11.88	4.64	4.12	15-6-02-SK
Averages:	8.5475	3.3525		

DATE	PC	WET	DRY	CULTIVAR
	0	0		34-9-02-GT
Averages:	0	0		

2003

DATE	PC	WET	DRY	CULTIVAR
9/29/2008	14.11	4.38	3.46	12-4-03-SK
Averages:	14.11	4.38		

DATE	PC	WET	DRY	CULTIVAR
9/9/2008	0.36	0.19	0.18	11-15-03-GT
Averages:	0.36	0.19		

2004

DATE	PC	WET	DRY	CULTIVAR
9/30/2008	2.49	0.96	0.83	17-16-04-SK
9/30/2008	1.6	0.49	0.42	5-16-04-SK
9/30/2008	1.75	0.74	0.64	5-15-04-SK
9/30/2008	5.77	3.21	0	5-14-04-SK
9/30/2008	1.65	0.69	0	7-13-04-SK
9/30/2008	5.08	2	2.04	10-12-04-SK
9/29/2008	5.98	0	0	14-11-04-SK
	0	0	1.38	29-9-04-SK
	0	0	1.75	28-9-04-SK
9/29/2008	1.04	0.45	0.39	27-9-04-SK
9/29/2008	3.86	1.68	1.52	12-7-04-SK
9/29/2008	3.14		1.09	16-6-04-SK
Averages:	2.696667	0.929091		

DATE	PC	WET	DRY	CULTIVAR
	0	0		23-16-04-GT
	0	0		23-15-04-GT
9/9/2008	0.96	0.47	0.44	23-14-04-GT
9/3/2008	1.22	0.75		15-13-04-GT
9/3/2008	0.3	0.19	0.19	11-13-04-GT
9/31/2008	0.23	0.15	0.13	33-9-04-GT
9/17/2008	0.87	0.51		29-8-04-GT

9/3/2008	2.1	1.19	1.05	16-8-04-GT
9/3/2008	0.59	0.36	0.34	15-8-04-GT
9/3/2008	0.35	0.24	0.22	5-8-04-GT
9/10/2008	0.59	0.29		5-7-04-GT
	0	0		25-6-04-GT
8/26/2008	0.1	0.06	0.06	23-6-04-GT
8/26/2008	1.76	0.8	0.8	5-6-04-GT
	0	0		9-5-04-GT
8/26/2008	0.11	0.06	0.06	17-4-04-GT
8/26/2008	0.53	0.29	0.3	9-4-04-GT
8/26/2008	0.18	0		9-3-04-GT
Averages:	0.549444	0.297778		

2005

DATE	PC	WET	DRY	CULTIVAR
9/30/2008	2.37	0.97	0.79	17-15--05-SK
9/9/2008	0.82	0.31	0.27	17-14-05-SK
9/30/2008	1.12	0.46	0.41	12-13-05-SK
9/30/2008	0.35	0	0	6-13-05-SK
9/30/2008	0.15	0.06	0.07	11-12-05-SK
9/29/2008	0.93	0.37	0.35	34-6-05-SK
	0	0		12-6-05-SK
Averages:	0.82	0.31		

DATE	PC	WET	DRY	CULTIVAR
8/26/2008	0.05	0.03	0.03	18-4-05-GT
Averages:	0.05	0.03		