Managing Pressure Flattening & Pressure Bruise of Potato (*Solanum tuberosum)*

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Purpose:
The purpose of this experiment was to evaluate management practices and their influences on shrink and pressure bruise incidence in potato tubers. Management practices include pre-harvest irrigation and long-term storage conditions.

Materials and Methods:
This experiment was conducted from 2008 to 2010 and composed of both field and storage research trials. Experiments were conducted at the Hancock Agricultural Research Station, utilizing four common potato varieties (Russet Burbank, Goldrush, Russet Norkotah, and FL-1879). The studies evaluated changes in dry matter content, shrink rates in storage, and incidence of pressure flattening.

Experiment 1
The field research trial evaluating pre-harvest irrigation management used a randomized complete block design with a split plot treatment arrangement. Pre-Harvest irrigation treatments included no irrigation & no rain ("canopy"), rain only ("non"), and standard irrigation with rain ("irr"). Canopy treatment tarps were placed over the plots prior to precipitation events and were removed immediately following to avoid temperature and water evaporation differences. Soil moisture was recorded every 15 minutes using a CR 10 data-logger and CS616 Campbell Scientific Time Domain Reflectometer. The TDR probes were placed in the center of the hill at depths of 10 cm, 20 cm, and 30 cm from the top of the hill. Tuber sampling took place at pre-harvest, harvest, and post storage intervals.

Experiment 2
The storage trials used a completely randomized block design with storage burial depth and field replication as replication. This experiment received the standard Hancock ARS production plan, including post vine kill irrigation intended to maintain optimal soil moisture. The samples were harvested and placed into three bulk storage bins at three depths from the bottom of the pile: 1.2 m, 2.4 m, and 3.7 m. The bins followed the standard protocol of the Hancock Potato & Vegetable Storage Research Facility of preconditioning and ramping to set point. The bins were uniquely managed: Bin 6 had a set point of 5.6°C with a 0.83°C ΔT, Bin 7 had a set point of 3.3°C with a 0.3°C ΔT, and Bin 8 had a set point of 3.3°C with a 0.83°C ΔT. Sampling took place at harvest and at post storage intervals.

Results and Discussion:

Experiment 1
Soil moisture changed rapidly at the 10 cm depth in both years, while the 20 cm and 30.5 cm depths were slower to change (Figure 1 & 2). Soil moisture was lower in the non-irrigated treatments compared to the irrigated treatments both years, this demonstrates a rapid rate of soil moisture change post vine-kill in the Plainfield Sand soils of Hancock, WI. The differences in observed soil moisture

confirm the importance of irrigation for maintaining soil moisture content after vine-kill to minimize potential effect on potato tubers.

The dry matter content prior to harvest did not show significant differences between irrigation treatments (Table 1). Dry matter content decreased from the time of vine-kill to time of harvest across all varieties. Dry matter decreased a minimum of 0.02 across varieties from first sampling to harvest, this decrease in dry matter content suggest the tubers were gaining water from the field or losing carbohydrate due to respiration.

Shrink in storage was greatest in the irrigated treatment across all varieties (Table 2). The greater rate of shrink in the irrigated treatment is likely due to the tubers having a greater water content at harvest, which was lost through evaporation during storage.

<u>Experiment 2</u>

Differences in dry matter and bruise rate after storage unloading were not observed. This was across all ventilation strategies and varieties (Table 3). Shrink rates were the lowest for the Russet Burbank variety, as was the least incidence of pressure flattening. This suggest that the occurrence of shrink is directly related to flat spot incidence. Ventilation management did not influence shrink.

<u>Moving forward</u>

Variety selection is key factor affecting pressure bruise in storage. In addition, pulp temperature at harvest also has substantial impacts on pressure bruise. We hypothesize that shrink is highly related to pressure bruise and that variation in shrink due to bin temperature and variety is crucial for preventing pressure bruise losses. New research is underway with focus understanding factors that contribute to increased shrink, specifically water evaporation from the tuber and respiration. This research includes evaluation of vine kill method, variety, and storage temperature on respiration and shrink.

Post Vine-Kill Soil Moisture Content

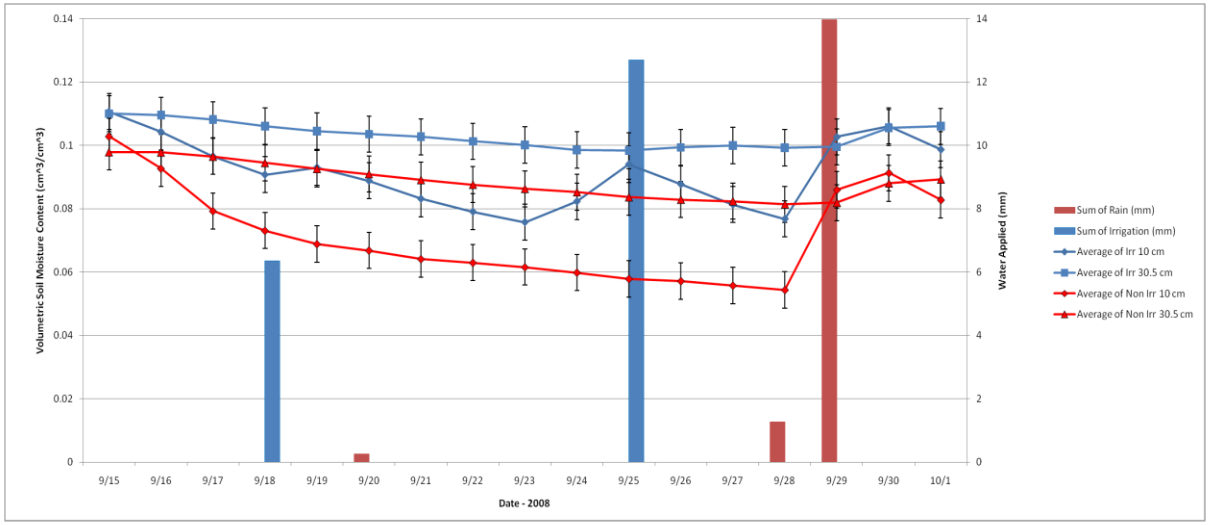

Figure 1: Volumetric soil moisture content (cm^3/cm^3) averaged across replications by treatment and depth. 2008 season following vine-kill

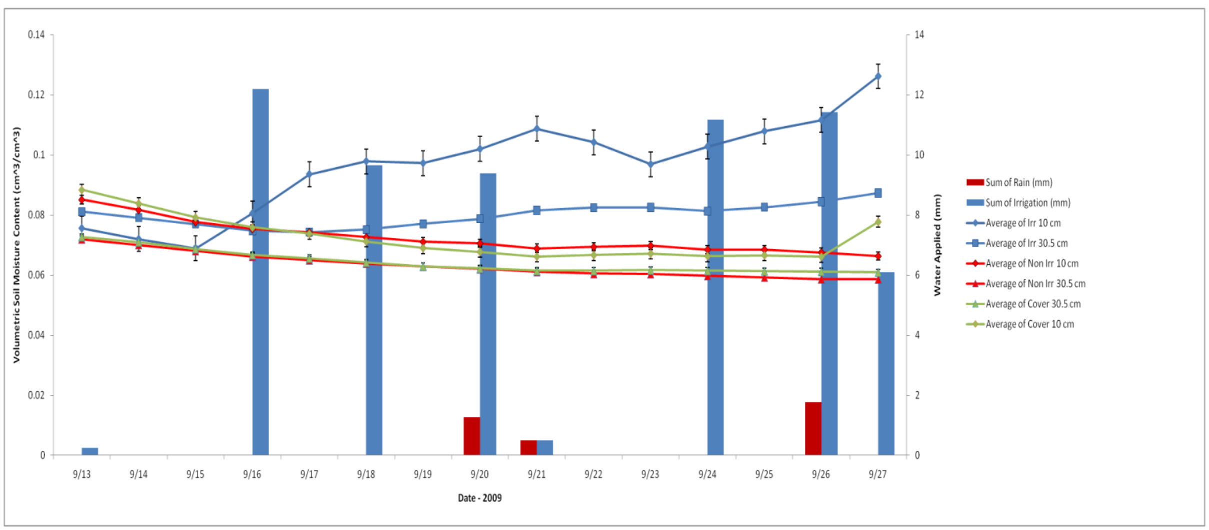

Figure 2: Volumetric soil moisture content (cm^3/cm^3) averaged across replications by treatment and depth. 2009 season following vine kill

Table 1: Irrigation Treatment Effects Pre-Harvest

	Dry Matter				
	2008		2009		
Timing:	30d post vinekill	harvest	2d post vinekill	11d post vinekill	harvest
Burbank	0.185	0.167	0.193	0.179	0.167
FL1879	0.194	0.168	0.218	0.175	0.165
Goldrush	0.153	0.146	0.196	0.139	0.140
Norkotah	0.172	0.166	0.199	0.164	0.150
LSD (0.05)	n.s.	n.s.	0.017	0.015	0.008
Irrigated	0.175	0.161	0.202	0.168	0.160
Non-Irrigated	0.177	0.162	0.202	0.145	0.151
Cover	-	-	0.202	0.174	0.152
LSD (0.05)	n.s.	n.s.	0.011	0.010	0.005
Burbank					
Irrigated	0.180	0.162	0.193	0.180	0.173
Non-Irrigated	0.190	0.172	0.193	0.174	0.154
Cover	-	-	0.193	0.183	0.168
FL1879					
Irrigated	0.197	0.162	0.218	0.175	0.168
Non-Irrigated	0.195	0.175	0.218	0.168	0.168
Cover	-	-	0.218	0.182	0.157
Goldrush					
Irrigated	0.152	0.140	0.196	0.153	0.140
Non-Irrigated	0.153	0.152	0.196	0.081	0.137
Cover	-	-	0.196	0.167	0.145
Norkotah					
Irrigated	0.176	0.181	0.199	0.165	0.157
Non-Irrigated	0.169	0.151	0.199	0.158	0.145
Cover	-	-	0.199	0.166	0.140
LSD (0.05)	n.s.	n.s.	n.s.	n.s.	n.s.

Table 1: Dry matter (g/g) for potato varieties under different post vine desiccation treatments over time in 2008 and 2009.

Table 2: Irrigation Treatment Effects in Post-Storage

	Dry Matter	Shrink	Penetration Resistance (g/cm^2)	Flat Spot Rate (no/tuber)	Bruise Rate (no/tuber)
Burbank	0.157 a	0.0245 c	1838.5 a	0.220 a	.026 a
FL1879	0.159 a	0.0340 a	1853.1 a	0.067 b	.020 a
Goldrush	0.155 b	0.0321 ab	1761.1 a	0.122 b	.058 a
Norkotah	0.152 b	0.0304 bc	1869.4 a	0.098 b	.014 a
Irrigated	0.157 a	.033 a	1804.9 ab	0.115 a	.042 a
Non-Irrigated	0.156 a	.028 b	1862.1 b	0.124 a	.013 a
Cover	0.145 b	.027 b	1847.3 a	0.151 a	.020 a
Burbank					
Irrigated	0.159 ab	0.0273 bc	1838.3 ab	0.205 b	0.037 a
Non-Irrigated	0.158 abc	0.0215 d	1823.9 c	0.156 bc	0.025 a
Cover*	0.150 bcde	0.0233 cd	1871.7 abc	0.387 a	0.000 a
FL1879					
Irrigated	0.163 abc	0.0350 a	1819.2 abc	0.058 c	0.028 a
Non-Irrigated	0.157 a	0.0319 ab	1957.6 abc	0.067 c	0.000 a
Cover*	0.152 bcde	0.0356 ab	1752.3 abc	0.090 c	0.033 a
Goldrush					
Irrigated	0.152 ef	0.0342 a	1747.6 abc	0.095 bc	0.081 a
Non-Irrigated	0.161 def	0.0318 ab	1776.2 abc	0.253 ab	0.028 a
Cover*	0.156 cde	0.0264 bcd	1771.4 abc	0.905 c	0.042 a
Norkotah					
Irrigated	0.154 bcd	0.0358 a	1814.4 abc	0.115 bc	0.026 a
Non-Irrigated	0.150 def	0.0277 bcd	1862.1 bc	0.041 c	0.000 a
Cover*	0.148 f	0.0231 cd	2000.6 a	0.143 bc	0.000 a

Table 2: Table of dry matter (g/g), shrink (g/g), penetration resistance (g/cm^2), flat rate (number per tuber) and bruise rate (number per tuber), by variety and irrigation treatment at storage removal averaged over 2008 and 2009. *The cover treatment did not occur in 2008. Means followed by same letter within a column do not significantly differ (P=0.05)

Table 3: Storage Treatment Effects in Bulk Storage Analysis

	Dry Matter	Shrink	Penetration Resistance (g/cm^2)	Flat Spot Rate (no/tuber)	Bruise Rate (no/tuber)
Burbank					
5.6 C, .83 ΔT	0.163 a	0.033 b	2292.8 a	0.493 b	0.000 a
3.3 C, .3 ΔT	0.154 a	0.036 b	2108.5 cd	0.759 b	0.024 a
3.3 C, .83 ΔT	0.151 a	0.030 b	1812.0 cd	0.481 b	0.028 a
FL1879					
5.6 C, .83 ΔT	0.166 a	0.053 a	2573.6 a	0.823 a	0.000 a
3.3 C, .3 ΔT	0.161 a	0.050 a	1691.7 e	1.007 a	0.000 a
3.3 C, .83 ΔT	0.165 a	0.042 a	1818.7 c	0.815 a	0.042 a
Goldrush					
5.6 C, .83 ΔT	0.154 a	0.068 a	2013.0 b	1.266 a	0.018 a
3.3 C, .3 ΔT	0.153 a	0.056 a	1714.1 cde	1.036 a	0.077 a
3.3 C, .83 ΔT	0.161 a	0.036 a	1768.1 cde	0.931 a	0.041 a
Norkotah					
5.6 C, .83 ΔT	0.151 a	0.043 ab	2280.4 a	0.860 ab	0.000 a
3.3 C, .3 ΔT	0.152 a	0.047 ab	1787.2 cde	1.058 ab	0.028 a
3.3 C, .83 ΔT	0.160 a	0.043 ab	1786.2 cde	0.735 ab	0.037 a

Table 3: Table of dry matter (g/g), shrink (g/g), penetration resistance (g/cm^2), flat rate (number per tuber) and bruise rate (number per tuber), by variety and storage treatment at storage removal averaged over 2008 and 2009. Means followed by same letter within a column do not significantly differ (P=0.05)