

2015 Potato Pathology Research Report - Section 2

(Research Evaluating Cultural Management Strategies for Potato Disease Control)



Skylar Eagles planting a mix of flowering plant species as a border crop to manage mosaic in Russet Norkotahs.



Different potato hill structures evaluated in the 2015 Potato Hill Structure Study for the management of powdery scab.

Andrew Houser, Rick Haslar, Skylar Eagles, Sarah Shawcroft, & Steve Keller

Colorado State University, SLV Research Center

CONTENTS

Cultural Management Disease Trials

• Use of a Flowering Crop Mix to Manage PVY Spread - 2014 & 2015 Summary.....	39
• Use of Companion Crops to Improve Potato Yield - 2015.....	45
• Evaluation of Potato Hill Structure for Powdery Scab Management - 2015.....	53
• Evaluation of Different Russet Norkotah Tuber Sizes at Harvest and the Effect Tuber Size has on PVY Level - 2014 & 2015 Summary	59

Flowering Plant Specices used as a Border Crop to Reduce the Spread of Mosaic (Summary of 2014 & 2015 Trial Data)

The purpose of this trial was to evaluate the effectiveness of using a mix of different plant species which produced flowers at different times throughout the course of the growing season for reducing the spread of PVY in a potato crop. A flowering plant species mix was planted adjacent to four rows of Russet Norkotah sel. 8 or Russet Norkotah sel. 3 potatoes . The initial level of PVY in the potatoes was either low (0% -2014 & 2.0% -2015) or high (8% in 2014 & 2015). Two control plots were also set up and evaluated (one without insecticide application and one with several insecticide applications through the season). Plants were visually evaluated for mosaic symptoms two times in the summer and a sample was collected at harvest and sent to Hawaii for evaluation in 2014 and 2015.

The results from both years were analyzed and indicated that potatoes with a high initial level of mosaic, when planted next to a flowering species mix border, reduced overall mosaic levels by 32% when compared with potatoes that had no insecticides applied. Potatoes starting with a low initial level of visual mosaic had no significant difference between no insecticides applied and a border of mixed flowers when data from 2014 and 2015 were combined. However, in 2015 potatoes planted adjacent to mixed flowers had significantly lower % mosaic (30% reduction) than potatoes that had no insecticides applied. In 2014 there was no difference (treatments were analyzed using a LSD mean separation, $p=0.05$). The use of a flowering species mix as a border, when planted adjacent to potatoes, is a tool that potato producers can use to help reduce the spread of mosaic.

List of Plant Species used in Flowering Mix	
Alyssum	Marigolds
Babies Breath	Nitro Radish
Berseem Clover	Persian Clover
Blue Corn Flower	Phacelia (Balo)
Brown Mustard	Poppies
Buckwheat (Mancan)	Spring Forage Peas
Calendulas	Spring Lentils
Cosmos	Sunflower
Crimson Clover (Dixie)	White Mustard
Flax (Selby)	Wooly Pod Vetch

EVALUATION OF USING A FLOWERING SPECIES MIX TO REDUCE PVY SPREAD IN THE POTATO CULTIVAR RUSSET NORKOTAH SELECTION 8, SLVRC, 2014

- Researcher:** Andrew J. Houser, Colorado State University, SLVRC (in cooperation with Brendon Rockey of Rockey Farms)
- Location:** San Luis Valley Research Center, Center, CO
- Cultivar:** Russet Norkotah sel. 8
- Objective:** To evaluate the use of a flowering species mix to manage the spread of Potato Virus Y (PVY).
- Treatments:**
1. Insecticides Used - Russet Norkotah sel. 8 (0% initial PVY level)
 2. No Insecticides Used - Russet Norkotah sel. 8 (0% initial PVY level)
 3. Flowering crop mix - Russet Norkotah sel. 8 (0% initial PVY level)
 4. Insecticides Used - Russet Norkotah sel. 8 (8% initial PVY level)
 5. No Insecticides Used - Russet Norkotah sel. 8 (8% initial PVY level)
 6. Flowering crop mix - Russet Norkotah sel. 8 (8% initial PVY level)
- Planted:** May 8 & 9, 2014 (planted the potatoes); June 3, 2014 (planted the flowering species mix)
- Plot Design:** Complete Block Design
- Plot Size:** 1-80 foot row per treatment per replication
- Plant Spacing:** 12 inches
- Row Spacing:** 34 inches
- Replications:** Four
- Irrigation:** Solid set sprinkler, rate based on ET
- Fertilizer:** 80N-60P-0K-25S-2.5Z, preplant, 60N through sprinkler after tuber set.
- Herbicide:** Dual Magnum @ 1.25 pt/A + Eptam @ 4.0 pt/A + 0.17 lb Sencor/A (trts 2,3,5,6); Outlook (trts 1 & 4)
- Insecticide:** Leverage 360 @ 2.8 oz./A & Belay @ 2.8 oz/A & Movento @ 5.0 oz/A (trts 1 & 4); None on trts 2,3,5,6.
- Fungicide:** Quadris @ 1.6 pt/A & Luna Tranquility @ 11.2 floz/A (trts 1 & 4); Endura @ 2.5 oz/A (trts 2,3,5,6).
- Vine Killer:** Applied Reglone on August 12 & 13, 2014.
- Harvested:** September 16 & 17, 2014
- DATA:**
- Mosaic Readings:** Evaluated all plants for mosaic symptoms twice during the summer (June 23 & July 22, 2014). Also pulled a sample of 80 tubers (evenly distributed down each row) per treatment per replication. The samples were gassed with Rindite (November 7, 2014) and planted (December 1st & 2nd) on Oahu, HI and were evaluated for mosaic on January 15, 2015. A total percentage of potato plants with mosaic symptoms was calculated from each disease reading.

EVALUATION OF USING A FLOWERING SPECIES MIX TO REDUCE MOSAIC LEVELS IN THE POTATO CULTIVAR RUSSET NORKOTAH SELECTION 8 & SEL. 3, SLVRC, 2015.

- Researcher:** Andrew J. Houser, Colorado State University, SLVRC (in cooperation with Brendon Rockey of Rockey Farms)
- Location:** San Luis Valley Research Center, Center, CO
- Cultivar:** Russet Norkotah sel. 8 & Russet Norkotah sel. 3
- Objective:** To evaluate the use of a flowering species mix to manage the Levels of Mosaic caused primarily by Potato Virus Y (PVY).
- Treatments:**
1. Insecticides Used - Russet Norkotah sel. 3 (2.0% initial PVY level)
 2. No Insecticides Used - Russet Norkotah sel. 3 (2.0% initial PVY level)
 3. Flowering crop mix - Russet Norkotah sel. 3 (2.0% initial PVY level)
 4. Insecticides Used - Russet Norkotah sel. 8 (8% initial PVY level)
 5. No Insecticides Used - Russet Norkotah sel. 8 (8% initial PVY level)
 6. Flowering crop mix - Russet Norkotah sel. 8 (8% initial PVY level)
- Planted:** May 13 & 14, 2015 (planted the potatoes); June 5, 2015 (planted the flowering species mix)
- Plot Design:** Complete Block Design
- Plot Size:** 1-80 foot row per treatment per replication
- Plant Spacing:** 12 inches
- Row Spacing:** 34 inches
- Replications:** Four
- Irrigation:** Solid set sprinkler, rate based on ET
- Fertilizer:** 80N-60P-0K-25S-2.5Z, preplant, 40N (trts 1 & 4) and 60N (trts 2,3,5,6) through sprinkler after tuber set.
- Herbicide:** Dual Magnum @ 1.25 pt/A + Eptam @ 4.0 pt/A + Sencor @ 0.17 lbs/A - All trts; In addition, Matrix @ 1.5 oz/A was applied to trts 1 & 4.
- Insecticide:** Platinum applied In-furrow, Leverage 360 @ 2.8 oz./A & Belay @ 2.8 oz/A in-season (trts 1,4); None on trts 2,3,5,6.
- Fungicide:** Omega applied in-furrow, Quadri Opti @ 1.6 pts/A & Luna Tranquility @11.2 floz/A applied in-season(trts 1 & 4); Endura @ 2.5 oz/A (trts 2,3,5,6).
- Vine Killer:** Applied Reglone @ 2.0 pt/A on August 19, 2015.
- Harvested:** September 14, 15, & 16, 2015
- DATA:**
- Mosaic Readings:** Evaluated all plants for mosaic symptoms twice during the summer (June 23 & July 7, 2015). Also pulled a sample of 80 tubers (evenly distributed down each row) per treatment per replication at harvest. The samples were gassed with Rindite (October 16, 2015) and planted (November 5, 2015) on Oahu, HI and were visually evaluated for mosaic on December 21, 2015. A total percentage of potato plants with mosaic symptoms was calculated from each disease reading.

Table 1. Effect of a flowering species mix on reducing PVY spread in the potato cultivar Russet Norkotah sel. 8 or sel. 3, Colorado State University, San Luis Valley Research Center, Colorado, 2014 & 2015.

Trt. #	Treatment	First Summer Mosaic Reading ^a			Second Summer Mosaic Reading ^b			PHT Mosaic Reading ^c		
		2014	2015 ^f	Mean	2014	2015 ^f	Mean	2014	2015 ^f	Mean
1	Low Initial PVY Level ^c									
	Insecticides Used	2.2 a	1.6	1.9	3.5 a	3.2	3.3	7.1 a	19.2 b	13.1 b
2	No Insecticides Used	0.3 b	1.7	1.0	1.1 b	3.7	2.4	10.6 a	44.2 a	27.4 a
3	Flowering Species Mix	0.5 b	0.7	0.6	0.8 b	3.7	2.2	11.1 a	30.5 b	20.8 a
	LSD (P=0.05)	1.61	NS	NS	1.08	NS	NS	NS	12.93	7.41
	CV	93.72	118.69	107.62	34.68	84.33	81.17	39.04	30.07	41.71
	F value	0.0459	0.6057	0.1167	0.0016	0.9606	0.5483	0.327	0.0265	0.0136

Trt. #	Treatment	First Summer Mosaic Reading ^a			Second Summer Mosaic Reading ^b			PHT Mosaic Reading ^c		
		2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
4	High Initial PVY Level ^c									
	Insecticides Used	9.6 a	8.6 b	7.3 a	6.4 a	5.1	7.5 b	16.4 b	21.4 b	18.6 c
5	No Insecticides Used	6.7 a	12.7 ab	5.1 b	8.5 a	3.5	10.6 a	39.0 a	48.9 a	43.9 a
6	Flowering Species Mix	7.9 a	15.6 a	6.1 ab	7.4 a	4.3	11.5 a	25.2 b	33.0 b	29.1 b
	LSD (P=0.05)	NS	NS	1.58	NS	NS	2.46	9.25	12.07	5.83
	CV	26.16	29.99	29.44	21.02	43.67	28.59	19.90	22.57	21.03
	F value	0.2306	0.0939	0.0762	0.2468	0.5338	0.0289	0.0028	0.0203	<.0001

^aPercentage of plants expressing mosaic symptoms on June 23, 2014 & July 7, 2015, one 80 ft row per treatment per replication, mean of four replications.

^bPercentage of plants expressing mosaic symptoms on July 22, 2014 & July 16, 2015, one 80 ft row per treatment per replication, mean of four replications.

^cA sample of 80 drop seed sized potatoes (3–4 ounces each) was collected from each treatment/replication and were planted in Oahu, HI. The percentage of plants expressing visual mosaic symptoms was recorded on January 15, 2015 (2014 crop) & December 21, 2015 (2015 crop).

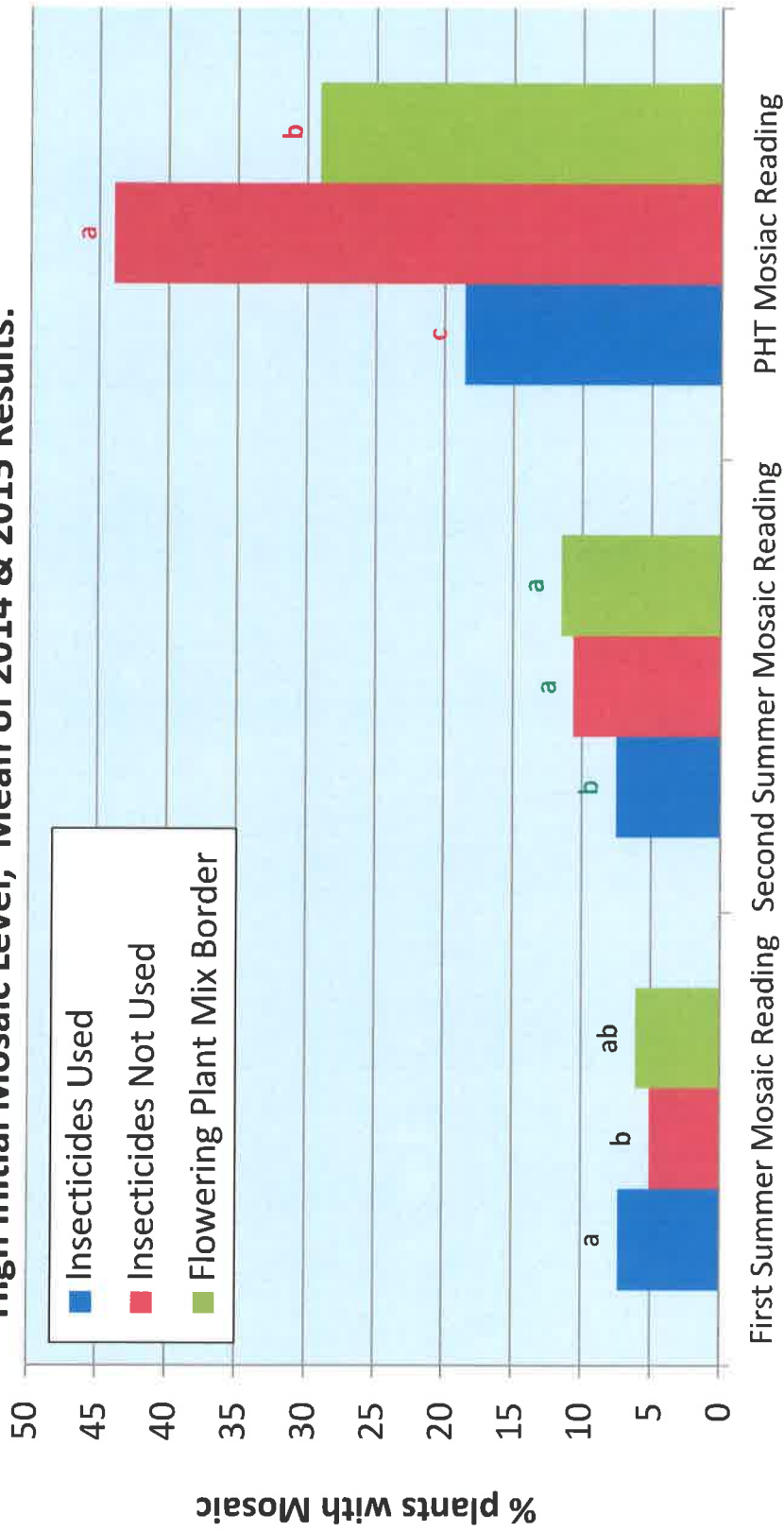
^dSeed used to plant each treatment had a low mosaic level (2014 = 0% mosaic; 2015 = 2% mosaic), based on the winter test reading.

^eSeed used to plant each treatment had a high mosaic level (2014 = 8% mosaic; 2015 = 8% mosaic), based on the winter test reading.

^fIn 2015, the potato cultivar Russet Norkotah sel. 3 was used for the the low initial PVY Level.

Means followed by the same letters are not significantly different at P=0.10 (LSD).

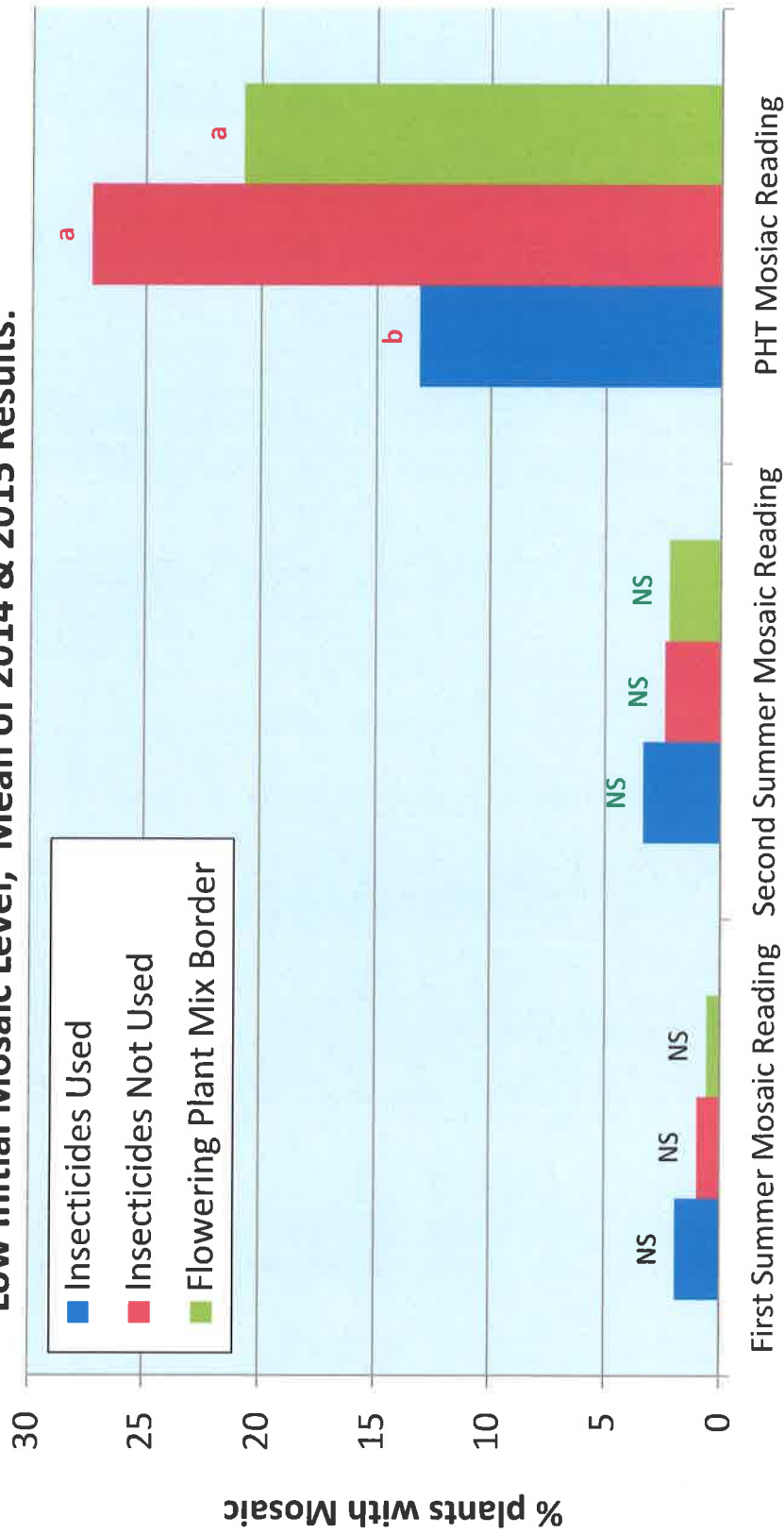
Evaluation of the Use of a Flowering Plant Species Mix to Reduce Mosaic Levels in the Potato Cultivar Russet Norkotah sel. 8. High Initial Mosaic Level, Mean of 2014 & 2015 Results.



Reading Date

The three treatments (Insecticides used, Insecticides not used, and Flowering plant mix border) were analyzed for each of the Reading dates. Different letters indicate a statistical difference between means (black letters = First Summer Mosaic Reading; green letters = Second Summer Mosaic Reading; red letters = PHT Mosaic Reading). LSD Mean Separation, P-value=0.10.

**Evaluation of the Use of a Flowering Plant Species Mix to Reduce Mosaic Levels in Russet Norkotah sel. 8(2014) & sel. 3(2015).
Low Initial Mosaic Level, Mean of 2014 & 2015 Results.**



Reading Date

The three treatments (Insecticides used, Insecticides not used, and Flowering plant mix border) were analyzed for each of the Reading dates. Different letters indicate a statistical difference between means (black letters = First Summer Mosaic Reading; green letters = Second Summer Mosaic Reading; red letters = PHT Mosaic Reading). LSD Mean Separation, P-value=0.10.

Evaluation of a Companion Crop used to Reduce the Spread of Mosaic and Improve Potato Yields

The purpose of this trial was to evaluate the effectiveness of using a companion crop with potatoes. Data was collected on the spread of potato viruses (which can result in visual mosaic symptoms) as well as yield and quality. The use of companion crops were evaluated under four different cropping scenarios (1. no insecticides were applied, 2. no insecticides applied + flowers as a border, 3. insecticides applied, and 4. insecticides applied to the crop that was adjacent to a plot of potatoes with a flower border). Two different potato seed lots (Russet Norkotah sel. 8 with an initial mosaic level of 8%; and Russet Norkotah sel. 3 with an initial mosaic level of 2.0%) were tested at each location with and without a companion crop. Plants were visually evaluated for mosaic levels two times in the summer and a sample was collected at harvest and sent to Hawaii for evaluation. At harvest, yield and quality data was also collected at each location for each seed lot, with and without a companion crop.

The results from this study indicate that the use of a companion crop can provide benefits to a potato crop. When a border of flowering plants was planted next to potatoes planted with a companion crop, the level of mosaic was reduced for seed lots with different initial levels of mosaic (32% reduction in the low mosaic seed lot and 47% reduction in the high initial mosaic seed lot, respectively) when compared with potatoes having no insecticide applications. The impact of a companion crop on yields is less conclusive. There were no differences among treatments for the seed lot with low initial mosaic levels. There was only one location with a significant decrease in marketable yield for the potatoes planted with a companion crop in the seed lot with a high initial mosaic level. This plot had additional stress since there were two fungicide applications and two watering events that it did not receive through the 2015 growing season, due to an avoidance of an insecticide application. This additional stress could have resulted in a reduction in yield potential, rather than solely the result of the potatoes being planted with a companion crop. Treatments were analyzed using a LSD mean separation, $p=0.05$. The use of a companion crop with potatoes, appears to reduce the spread of potato viruses (including PVY), after one year of evaluations.

**EVALUATION OF USING A COMPANION CROP TO REDUCE MOSAIC LEVELS AND IMPROVE
YIELDS IN THE POTATO CULTIVARS:
RUSSET NORKOTAH SELECTION 8 & SEL. 3, SLVRC, 2015.**

Researcher: Andrew J. Houser, Colorado State University, SLVRC (in cooperation with Brendon Rockey of Rockey Farms)

Location: San Luis Valley Research Center, Center, CO

Cultivar: Russet Norkotah sel. 8 & Russet Norkotah sel. 3

Companion Crop: Species include Field Peas, Desi Chick Peas, Chickling Vetch, and Buckwheat. Seeding rate of 10 lbs/A

Objective: To evaluate the use of a companion crop to manage virus spread and tuber yield and quality.

Treatments:

1. Flower Border, with Companion Crop
2. Flower Border
3. No Insecticides Used, with Companion Crop
4. No Insecticides Used
5. Insecticides Used, with Companion Crop
6. Insecticides Used
7. Flower Border, planted next to field with Insecticides, with Companion Crop
8. Flower Border, planted next to field with Insecticides

Planted: May 13 & 14, 2015 (planted the potatoes & companion crop); June 5, 2015 (planted the flowering species mix)

Plot Design: Complete Block Design

Plot Size: 1-80 foot row (trts 2-8), 1-55 foot row (trt 1) per treatment per replication

Plant Spacing: 12 inches

Row Spacing: 34 inches

Replications: Four

Irrigation: Solid set irrigation (trts 1-4) or Center Pivot irrigation (trts 5-8), rate based on ET

Fertilizer: 80N-60P-0K-25S-2.5Z, preplant, 40N (trts 1 & 4) and 60N (trts 2,3,5,6) through sprinkler after tuber set.

Herbicide: Dual Magnum @ 1.25 pt/A + Eptam @ 4.0 pt/A + Sencor @ 0.17 lbs/A - trts 2,4,6,8; In addition, Matrix @ 1.5 oz/A was applied to trts 8. No herbicides were applied to trts 1,3,5,7.

Insecticide: Platinum applied In-furrow, Leverage 360 @ 2.8 oz./A & Belay @ 2.8 oz/A in-season (trts 5,6); None on trts 1-4,7,8.

Fungicide: Omega applied in-furrow, Quadri Opti @ 1.6 pts/A & Luna Tranquility @ 11.2 fl oz/A applied in-season (trts 5-8); Endura @ 2.5 oz/A (trts 1-4).

Vine Killer: Applied Reglone @ 2.0 pt/A on August 19, 2015.

Harvested: September 14, 15, & 16, 2015

DATA:

Mosaic Readings: Evaluated all plants for mosaic symptoms twice during the summer (June 23 & July 7, 2015). Also pulled a sample of 45 tubers (trt 1) or 74 tubers (trts 2-8) -evenly distributed down each row per treatment per replication at harvest. The samples were gassed with Rindite (October 16, 2015) and planted (November 5, 2015) on Oahu, HI and were visually evaluated for mosaic on December 21, 2015. A total percentage of potato plants with mosaic symptoms was calculated from each disease reading.

Yield & Grade: 1-40 foot row per treatment per replication, total yield expressed in cwt/A. By hand, percent tubers by weight in kilograms < 4 oz., 4-10 oz., > 10 oz., US #2's & culls.

Table 1. Effect of the use of a companion crop and a flowering species mix border crop on tuber yield and quality in the cultivar Russet Norkotah sel. 8 and Russet Norkotah sel. 3, Colorado State University, San Luis Valley Research Center, Colorado, 2015.

Russet Norkotah sel 3 (2% Mosaic, 2014 PHT)	Percent ^a			US #2's & culls	Total CWT ^b	CWT w/o 2's & culls ^c
	<4 oz.	4-10 oz.	>10 oz.			
Flowering Species Mix, CC	11.1 c	49.6 cd	31.1 a	8.2 ab	368.9	338.8
Flowering Species Mix	16.1 c	43.2 d	31.6 a	9.2 a	387.5	352.1
No Insecticides Used, CC	15.6 c	51.4 bcd	25.8 ab	7.3 abc	417.1	387.1
No Insecticides Used	16.5 bc	53.9 abc	24.1 ab	5.6 bcd	415.8	393.0
Insecticides Used, CC	22.4 ab	54.9 abc	20.8 bc	2.0 e	400.8	393.0
Insecticides Used	13.9 c	51.1 bcd	32.0 a	3.0 de	436.2	423.0
Flower Border, next to field with Insecticides, CC	28.0 a	59.8 ab	7.7 d	4.6 cde	379.0	361.2
Flower Border, next to field with Insecticides	22.9 a	61.7 a	12.2 cd	3.3 de	404.0	390.4
LSD (P=0.05)	6.24	10.13	9.96	2.77	NS	NS
CV	23.35	13.05	29.51	35.17	8.87	9.24
F value	0.0002	0.0268	0.0001	0.0001	0.2003	0.0517

Russet Norkotah sel 8 (8% Mosaic, 2014 PHT)	Percent ^a			US #2's & culls	Total CWT ^b	CWT w/o 2's & culls ^c
	<4 oz.	4-10 oz.	>10 oz.			
Flowering Species Mix, CC	16.2 bc	49.1	29.4 a	5.4	358.5 ab	339.2
Flowering Species Mix	16.6 bc	41.8	31.7 a	10.0	386.0 a	347.7
No Insecticides Used, CC	17.7 bc	50.1	26.5 a	5.8	408.0 a	384.3
No Insecticides Used	16.7 bc	46.5	29.5 a	7.3	392.4 a	363.4
Insecticides Used, CC	18.3 bc	52.6	23.5 a	5.8	353.4 ab	334.6
Insecticides Used	11.0 c	46.0	34.8 a	8.3	400.6 a	369.8
Flower Border, next to field with Insecticides, CC	36.2 a	54.4	4.7 b	4.6	296.3 b	281.7
Flower Border, next to field with Insecticides	22.0 b	63.0	7.6 b	7.5	391.5 a	362.5
LSD (P=0.05)	7.38	NS	14.76	NS	67.29	NS
CV	26.18	19.95	43.14	53.49	12.35	14.33
F value	0.0001	0.1729	0.0015	0.4909	0.0433	0.1876

^aBased on tuber weight in kilograms, mean of four replications.

^bTotal yield expressed as hundred weight per acre, 1-40 foot rows per treatment per replication, mean of four replications.

^cHundred weight per acre minus the US #2s and culls, 1-40 foot rows per treatment per replication, mean of four replications. Means followed by the same letters are not significantly different at P=0.05 (LSD).

Table 1. Effect of a flowering species mix on reducing PVY spread in the potato cultivar Russet Norkotah sel. 3 (Low Initial Mosaic Level = 2.0%) and Russet Norkotah sel. 8 (High Initial Mosaic Level = 8%), Colorado State University, San Luis Valley Research Center, CO, 2015.

	First Mosaic Reading July 7, 2015 ^a	Second Mosaic Reading July 16, 2015 ^b	Final Mosaic Reading December 21, 2015 ^c
Russet Norkotah sel 3 (2% Mosaic, 2014 PHT)			
Flowering Species Mix, CC	0.5	2.5	30.0 bc
Flowering Species Mix	0.7	3.7	30.8 abc
No Insecticides Used, CC	1.4	4.2	41.8 ab
No Insecticides Used	1.7	3.7	44.0 a
Insecticides Used, CC	1.4	1.4	15.3 d
Insecticides Used	1.6	3.2	19.0 cd
Flower Border, next to field with Insecticides, CC	1.4	2.9	12.5 d
Flower Border, next to field with Insecticides	1.7	2.3	8.3 d
LSD (P=0.05)	NS	NS	13.85
CV	92.64	68.81	37.59
F value	0.7397	0.601	0.0001

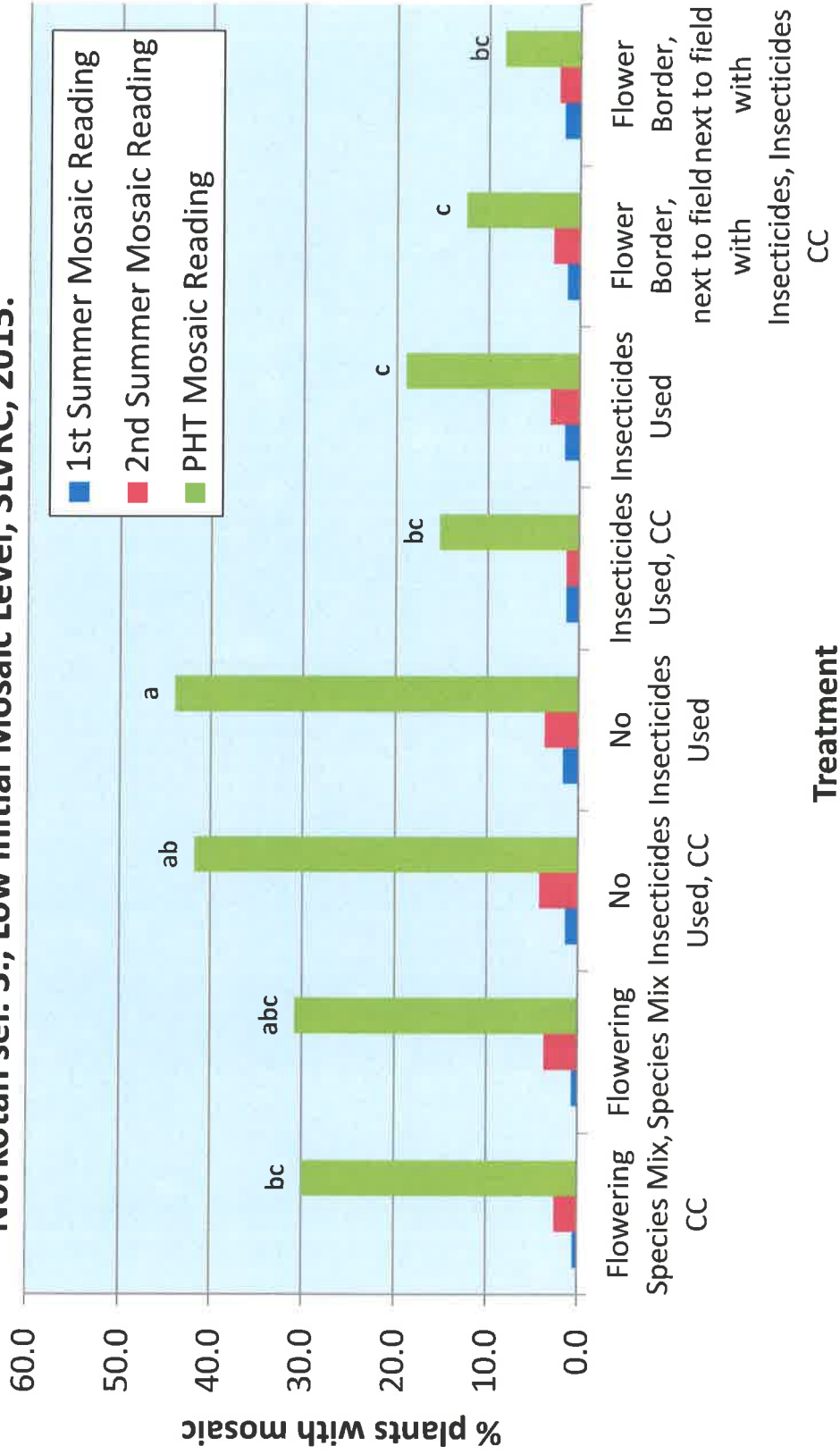
	First Mosaic Reading July 7, 2015 ^a	Second Mosaic Reading July 16, 2015 ^b	Final Mosaic Reading December 21, 2015 ^c
Russet Norkotah sel 8 (8% Mosaic, 2014 PHT)			
Flowering Species Mix, CC	3.2	17.3 a	26.3 bc
Flowering Species Mix	4.3	15.6 a	33.0 abc
No Insecticides Used, CC	3.8	12.9 ab	41.3 ab
No Insecticides Used	3.5	12.7 ab	49.0 a
Insecticides Used, CC	5.1	9.8 b	26.0 bc
Insecticides Used	5.1	8.6 b	21.3 c
Flower Border, next to field with Insecticides, CC	5.9	16.3 a	17.3 c
Flower Border, next to field with Insecticides	7.0	17.9 a	27.0 bc
LSD (P=0.05)	NS	5.47	16.27
CV	59.54	26.99	36.81
F value	0.5573	0.0119	0.0101

^aPercentage of plants expressing visual mosaic symptoms on July 7, 2015, one 80 foot row per treatment per replication, mean of four replications.

^bPercentage of plants expressing visual mosaic symptoms on July 16, 2015, one 80 foot row per treatment per replication, mean of four replications.

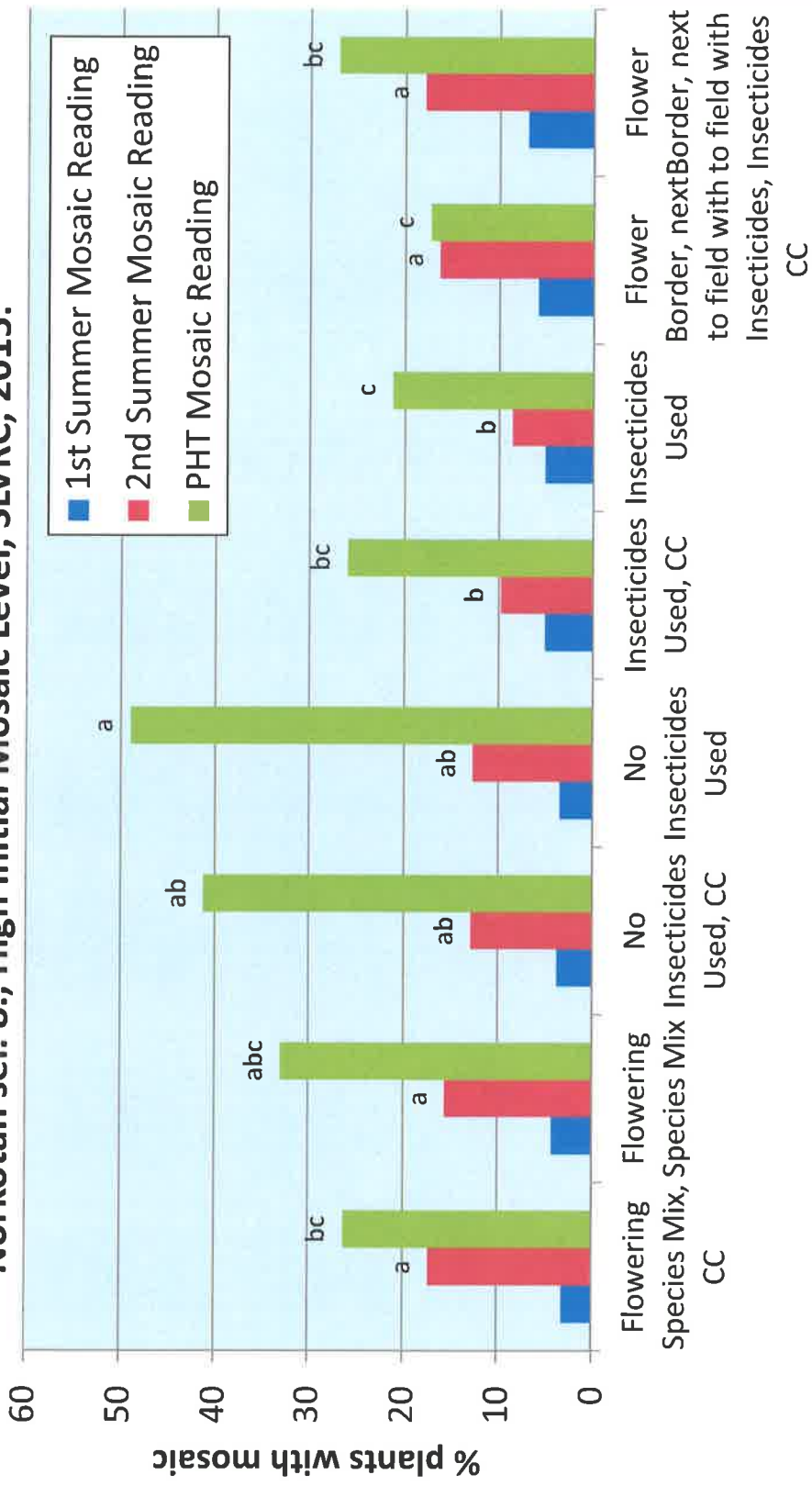
^cA sample of 80 drop seed sized potatoes (3-4 ounces each) was collected from each treatment/replication and were planted in Oahu, HI. The percentage of plants expressing visual mosaic symptoms was recorded on December 21, 2015, Means followed by the same letters are not significantly different at P=0.05 (LSD).

Evaluation of the Use of a Flowering Plant Species Mix and a Companion Crop to Reduce Mosaic Levels in the Potato Cultivar Russet Norkotah sel. 3., Low Initial Mosaic Level, SLVRC, 2015.



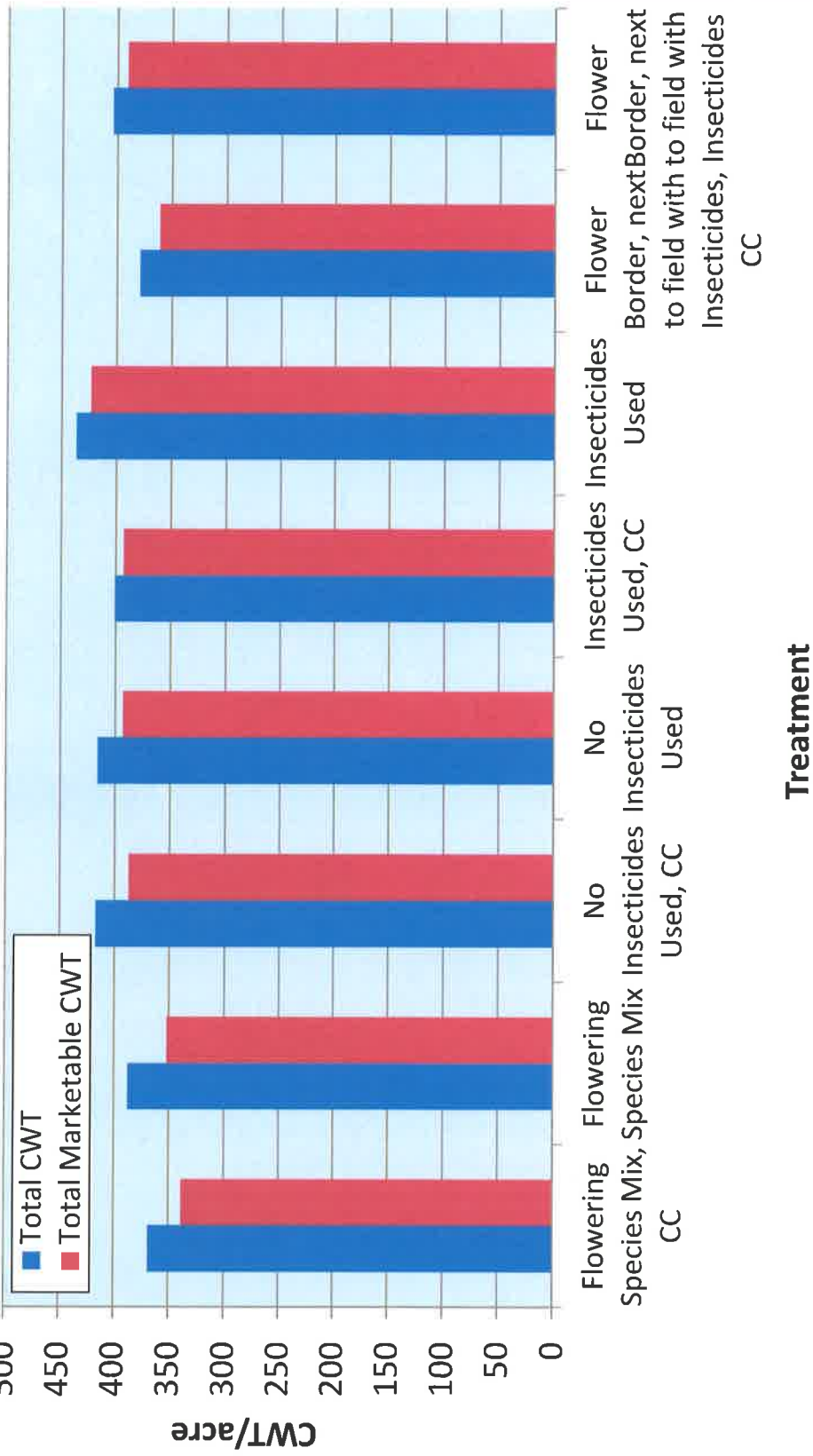
Different letters indicate a statistical difference between means at different reading dates. LSD Mean Separation, P-value=0.05.

Evaluation of the Use of a Flowering Plant Species Mix and a Companion Crop to Reduce Mosaic Levels in the Potato Cultivar Russet Norkotah sel. 8., High Initial Mosaic Level, SLVRC, 2015.



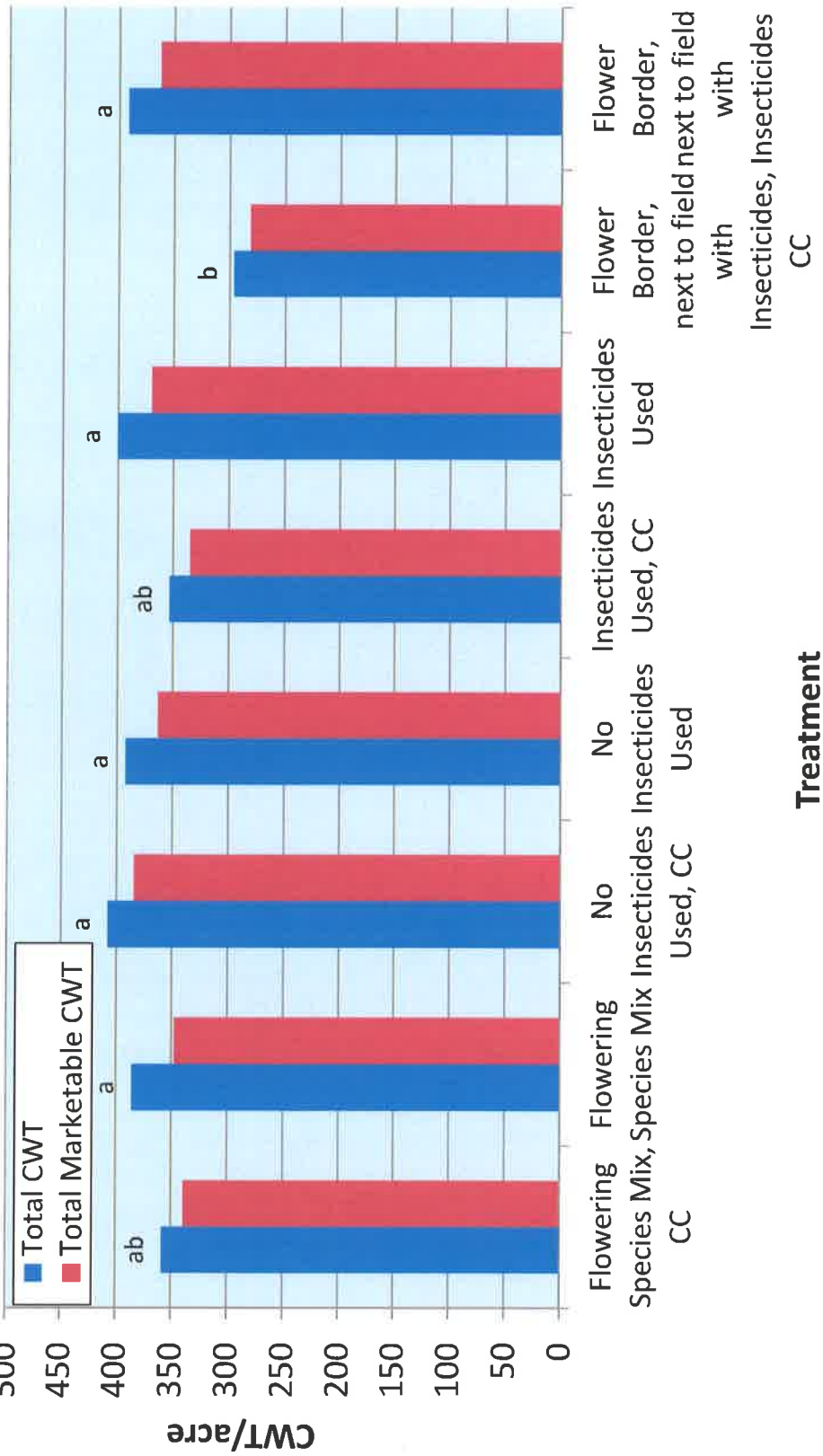
Different letters indicate a statistical difference between means at different reading dates. LSD Mean Separation, P-value=0.05.

Evaluation of the Use of a Flowering Plant Species Mix and a Companion Crop on Total CWT and Marketable CWT in the Potato Cultivar Russet Norkotah sel. 3., Low Initial Mosaic Level, SLVRC, 2015.



There were no significant differences between treatments at P=0.05, LSD.

Evaluation of the Use of a Flowering Plant Species Mix and a Companion Crop on Total CWT and Marketable CWT in the Potato Cultivar Russet Norkotah sel. 8., High Initial Mosaic Level, SLVRC, 2015.



Different letters indicate a statistical difference between means for different treatments. LSD Mean Separation, P-value=0.05.

2015 Powdery Scab Bed Study

The hill structure in potato production in the San Luis Valley typically involves a single row with one seed piece every 10 to 14 inches within each row. There is a distance of 34-36 inches between rows. The management of potato diseases, such as powdery scab, involves the use of fungicides or a change in farming practices (e.g. use of disease free seed, disease resistant seed, avoiding fields with high levels of disease inoculum, etc.). Since fungicides do not completely control powdery scab, I evaluated different row/hill structures and two different irrigation timings to manage powdery scab. The potato cultivar CO00277-2R was used in this study, which is highly susceptible to powdery scab.

There are two main take homes we can take away from this study. One is that by watering on a schedule that provides the plants with excess water in one irrigation and a deficit the following irrigation event, the level of powdery scab increases when potatoes are planted in single rows. This indicates that the irrigation schedule is critical in the management of powdery scab. Irrigating potatoes in such a way that increases the number of times the soil is saturated past field capacity can result in high powdery scab levels of powdery scab in susceptible cultivars. The second take home is that the use of a bed, instead of the typical single row, can result in fewer tubers with powdery scab when soil conditions are favorable. The use of a bed is a potential strategy for managing powdery scab in the San Luis Valley.

EVALUATION OF DIFFERENT POTATO HILL STRUCTURES FOR THE MANAGEMENT OF POWDERY SCAB, SAN LUIS VALLEY RESEARCH CENTER, CSU, 2015

- Researcher:** Andrew J. Houser, Colorado State University, SLVRC
Location: San Luis Valley Research Center, Center, CO
Cultivar: CO00277-2R
Objective: To evaluate different potato hill structures and irrigation timings for the management of powdery scab. Data was collected on powdery scab tuber incidence, severity and overall yield.
- Hill Structures:** There were three different hill structure scenerios evaluated. 1. Two standard rows on a 34 inch spacing, seed pieces were placed in the center of each hill at a 12 inch spacing between seed pieces. 2. One bed was 68 inches wide, in each bed the potatoes were arranged in two lines 34 inches apart, there was 12 inches between seed pieces in each line. 3. One bed was 68 inches wide, in each bed the potatoes were arranged in 3 lines that were 17 inches apart, there was 12 inches between seed pieces.
- Irrigation Timings:** Standard Irrigation (16.3 inches) vs Alternate Irrigation (17.0 inches) through the growing season. Starting July 13th through the final irrigation (August 24th), the plot irrigated with the alternate irrigation regime had a an alternating irrigation with one irrigation twice as much as the ET was recommending and the next irrigation was 1/2 the amount of irrigation the ET was recommending. This created more extreme differences in soil moisture between the standard and alternate irrigated plots.
- Treatments:**
1. Two Single Rows (std irr.)
 2. Two Potato Rows in One Bed (std. Irr)
 3. Three Potato Rows in One Bed (std. Irr)
 4. Two Single Rows (alt. irr.)
 5. Two Potato Rows in One Bed (alt. Irr)
 6. Three Potato Rows in One Bed (alt. Irr)
- Planted:** May 27, 2015
Plot Design: Randomized split plot
Plot Size: 2-30 foot rows (trts 1 & 4) and 1-30 foot bed (trts 2,3,5,6) per treatment per replication
- Plant Spacing:** 12 inches
Row Spacing: 34 inches
Replications: Six
Irrigation: Solid set irrigation, rate based on ET
Fertilizer: 80N-60P-0K-25S-2.5Z, preplant
Herbicide: Dual Magnum @ 1.5 pt/A + Sencor @ 0.33 lb/A + Chateau @ 1.0 oz/A
Insecticide: None
Fungicide: None
Vine Killer: Vines were chopped on September 11, 2015.
Harvested: Septemeber 28 & 29, 2015
- DATA:**
- Disease Readings:** Powdery scab tuber readings were taken on 2-20 foot rows (trts 1 & 4) and 1-15 foot of bed (trts 2,3,5,& 6) at harvest on September 28 & 29, 2015. All tubers in the 4-10 oz size range were evalutated for powdery scab.
- Yield & Grade:** 2-20 foot rows (trts 1 & 4) and 1-15 foot of bed (trts 2,3,5,& 6) per treatment per replication, total yield expressed in cwt/A. By hand, percent tubers by weight in kilograms < 4 oz., 4-10 oz., > 10 oz., US #2's & culls.

Table 1. Powdery Scab Bed Trial - Evaluation of planting potatoes in a bed compared with planting in single rows for managing powdery scab severity and tuber yield and quality in the CO00277-2R, Colorado State University, San Luis Valley Research Center, Colorado, 2015.

Trt. #	Products/Timing	Percent ^a				US #2's & culls	Total CWT ^b	CWT w/o US #2's & culls ^c
		<4 oz.	4-10 oz.	>10 oz.				
1	Two Single Rows (std irr.)	31.2 bc	54.8 a	11.6	2.4	290.9 b	284.3 bc	
2	Two Potato Rows in One Bed (std. Irr)	35.4 bc	54.8 a	7.7	2.2	273.3 b	266.3 c	
3	Three Potato Rows in One Bed (std. Irr)	45.4 a	46.0 b	6.7	1.9	284.1 b	279.2 c	
4	Two Single Rows (alt. irr.) ^d	29.6 c	56.1 a	11.3	3.1	374.2 a	362.9 ab	
5	Two Potato Rows in One Bed (alt. Irr)	30.8 bc	53.8 ab	11.8	3.6	379.3 a	365.1 a	
6	Three Potato Rows in One Bed (alt. Irr)	39.9 ab	46.3 b	10.1	3.7	416.4 a	400.7 a	
LSD (P=0.05)		9.11	8.08	NS	NS	82.35	80.03	
CV		21.63	13.07	66.11	73.77	20.59	20.61	
F value		0.0089	0.0444	0.6426	0.5302	0.004	0.0063	

^aBased on tuber weight in kilograms, mean of four replications.

^bTotal yield expressed as hundred weight per acre; 2-20 foot rows (Trts 1 & 4), 1 - 15 foot bed planted to 30 seed pieces (Trts 2 & 5), 1 - 15 foot bed planted to 45 seed pieces (Trts 3 & 6), per treatment per replication, mean of four replications.

^cHundred weight per acre minus the US #2s and culls, mean of four replications.

^dThe study was irrigated with a solid set sprinkler system. Treatments 1, 2, and 3 were irrigated based on standard ET calculations, treatments were irrigated 3x per week on average. Treatments 4, 5, & 6 were irrigated based on standard ET calculations, treatments were irrigated 2x per week on average.

Means followed by same letter do not significantly differ (P=0.05)

Table 2. Powdery Scab Bed Trial - Evaluation of planting potatoes in a bed compared with planting in single rows for the management of powdery scab on tuber lesion development in the potato CO00277-2R, Colorado State University, San Luis Valley, Colorado, 2015.

Treatment (Products/Timing)	Tuber symptoms			
	Percent Incidence ^a	Percent Healthy ^b	Severity Index ^c	Percent Unmarketable ^d
1. Two Single Rows (std irr.)	1.8 b	98.2 a	1.8 b	0.0
2. Two Potato Rows in One Bed (std. Irr)	0.4 b	99.6 a	0.4 b	0.0
3. Three Potato Rows in One Bed (std. Irr)	1.5 b	98.5 a	1.5 b	0.1
4. Two Single Rows (alt. irr.) ^d	4.1 a	95.9 b	4.1 a	0.0
5. Two Potato Rows in One Bed (alt. Irr)	1.4 b	98.6 a	1.4 b	0.0
6. Three Potato Rows in One Bed (alt. Irr)	2.1 b	97.9 a	2.1 b	0.0
LSD (P=0.05)	1.9	1.9	1.89	NS
CV	84.63	1.63	85.13	391.97
F value	0.0126	0.0126	0.0119	0.4381

^aPercent incidence = mean percent of medium sized tubers (4-10oz) with one or more powdery scab lesion at harvest. Mean of four replications.

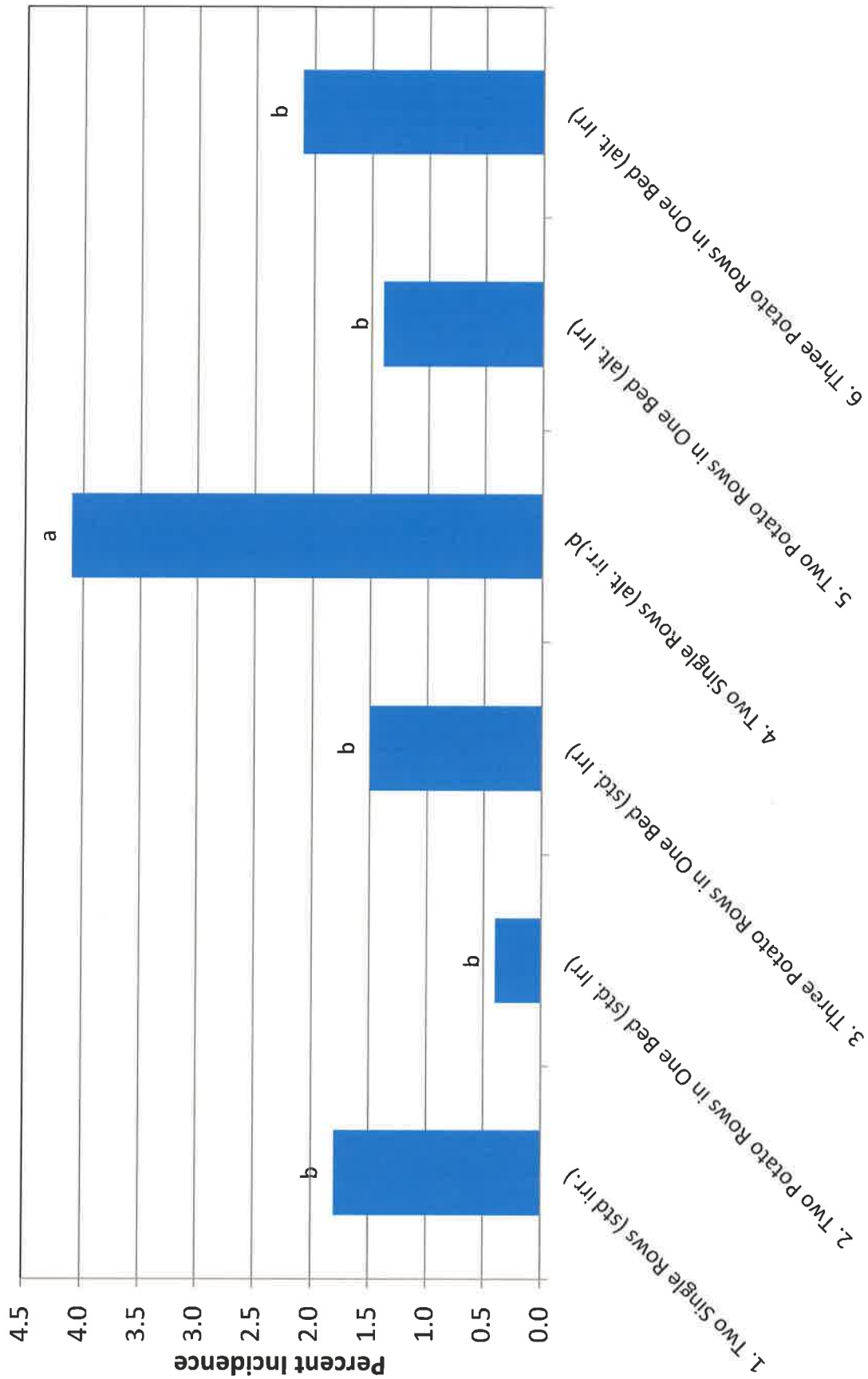
^bPercent healthy = mean percent of medium sized tubers (4-10oz) with zero powdery scab lesions at harvest. Mean of four replications.

^cSeverity Index = mean percent incidence multiplied by the avg. severity of the lesions, where 1 = very little or no disease and 5 = heavily infested. Mean of four replications.

^dPercent Unmarketable = mean percent of the total number of medium sized tubers (4-10oz) with a lesion severity rating of three or higher at harvest. Mean of four replications.

Means followed by same letter do not significantly differ (P=0.05)

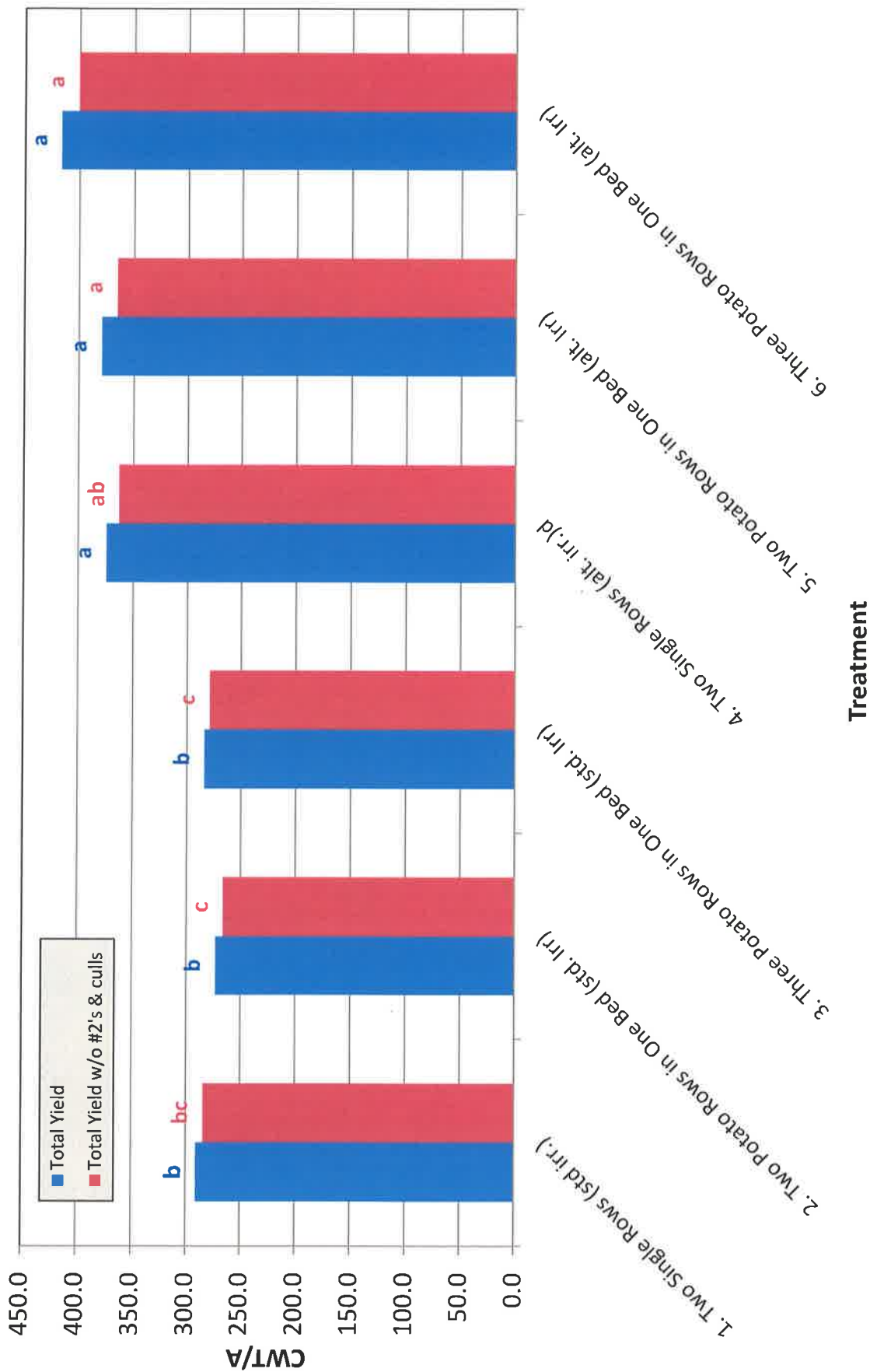
**2015 Powdery Scab Bed Evaluation Trial
Percent Tubers (4-10 oz) at Harvest with Powdery Scab Lesions,
September 28 & 29, 2015, SLVRC, CO**



Treatment

Different letters indicate a statistical difference between means for different treatments.
LSD Mean Separation, P-value=0.05.

2015 Powdery Scab Bed Evaluation Trial Total Yield at Harvest, Harvested on September 28 & 29, 2015, SILVRC, CO



Different letters indicate a statistical difference between means for different treatments.
LSD Mean Separation, P-value=0.05.

Evaluation of PVY levels in Russet Norkotah Seed of Different Sizes (8-12 oz. vs. <4 oz.)

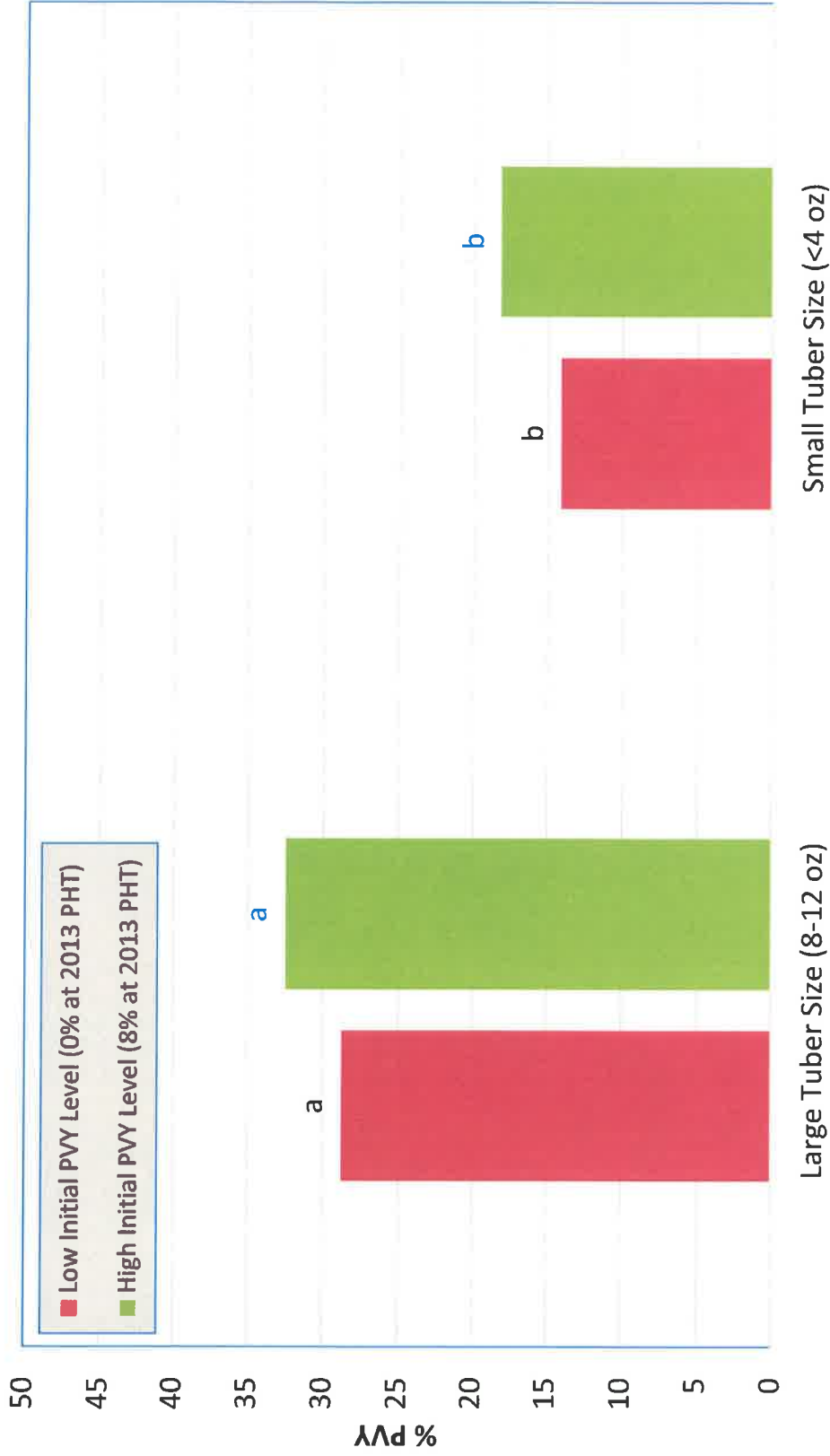
The purpose of this trial was to evaluate the amount of PVY that is in potato seed tubers of different size. Working for Colorado Potato Certification Service (PCS), the question occasionally comes up regarding the size of tubers that are collected for the post harvest test (PHT) sample. PCS requires a tuber size of 2-4 oz for the 400 tuber sample required for the PHT in order to certify a seed lot. The question that is sometimes raised is that a potato plant infected with PVY is diseased and is therefore less healthy than a plant not infected with PVY. A potato plant that is less healthy is thought to produce smaller daughter tubers. Tuber size is thought to be an indicator of potato plant health (eg. a healthy plant produces larger tubers than a diseased plant), however this concept may not always be the case depending on the variety.

PCS does not accept seed tubers larger than 4 oz for the PHT sample, due to shipping and planting constraints in Hawaii. The argument has arisen that the testing of small tubers provides an unrealistically high percentage of PVY in the seed lot. The purpose of this study was to determine whether or not this assumption is valid. The results from 2014 and 2015 indicate that tubers less than 4 oz in size had a lower percentage of PVY than seed tubers > 8oz in size in Russet Norkotah. This indicates that the collecting of tubers smaller than 4 oz for the PHT sample is a good practice. A sample of 400 tubers < 4 oz in size gives a fairly accurate representation of the amount of PVY that will be planted back in the seed lot the following summer.

**EFFECT OF TUBER SIZE ON PVY LEVELS FOR PHT SAMPLE COLLECTION IN THE POTTATO
CULTIVARS RUSSET NORKOTAH SELECTION 8 & 3, SLVRC, 2014 & 2015.**

Researcher:	Andrew J. Houser, Colorado State University, SLVRC
Location:	San Luis Valley Research Center, Center, CO
Cultivar:	Russet Norkotah sel. 8 & Russet Norkotah sel. 3
Objective:	To evaluate the effect of tuber size on PVY levels for PHT sample collection.
Treatments:	1. Large Tubers (8-12 oz) - Russet Norkotah sel. 8 (0% initial PVY level - 2014) & Russet Norkotah sel. 3 (2% initial Mosaic level - 2015) 2. Small Tubers (<4 oz) - Russet Norkotah sel. 8 (0% initial PVY level - 2014) & Russet Norkotah sel. 3 (2% initial Mosaic level - 2015) 3. Large Tubers (8-12 oz) - Russet Norkotah sel. 8 (8% initial PVY level - 2014 & 2015) 4. Small Tubers (8-12 oz) - Russet Norkotah sel. 8 (8% initial PVY level - 2014 & 2015)
Planted:	May 8 & 9, 2014; May 13 & 14, 2015
Plot Design:	Complete Block Design
Plot Size:	1-80 foot row per treatment per replication
Plant Spacing:	12 inches
Row Spacing:	34 inches
Replications:	Four
Irrigation:	Solid set sprinkler, rate based on ET
Fertilizer:	80N-60P-0K-25S-2.5Z, preplant, 60N through sprinkler after tuber set.
Herbicide:	Dual Magnum @ 1.25 pt/A + Eptam @ 4.0 pt/A + Sencor @ 0.17 lbs/A
Insecticide:	Leverage 360 @ 2.8 oz./A & Belay @ 2.8 oz/A for both years. Movento @ 5.0 oz/A was also applied in 2015.
Fungicide:	Luna Tranquility @ 11.2 floz/A & Endura @ 2.5 oz/A for both years. Quadris @ 1.6 pt/A was also applied in 2014. Quadris Opti was also applied in 2015.
Vine Killer:	Applied Reglone on August 12 & 13, 2014; August 19, 2015.
Harvested:	September 16 & 17, 2014 & September 14, 15, & 16, 2015.
DATA:	
Mosaic Readings:	A random sample of 20 tubers from each treatment/replication was collected at harvest. The tubers were treated with Rindite and planted in the Greenhouse. An ELISA test was performed to on each plant to determine the PVY levels for each treatment/replication.

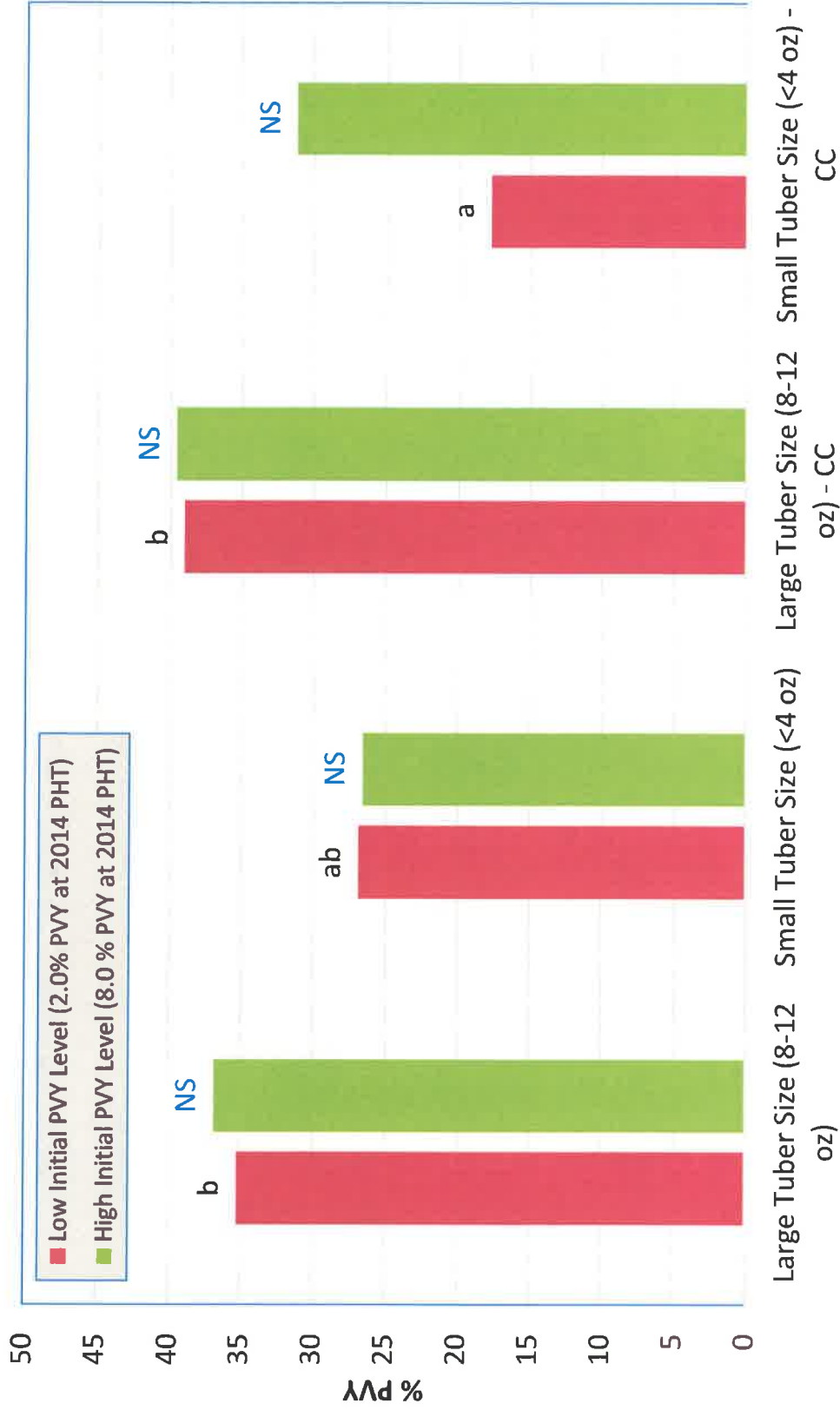
**Evaluation of PVY levels in Russet Norkotah Seed of Different Sizes
(8-12oz. vs. <4 oz.), SLV Research Center, Center, CO 2014.**



Initial PVY Level/Seed Size

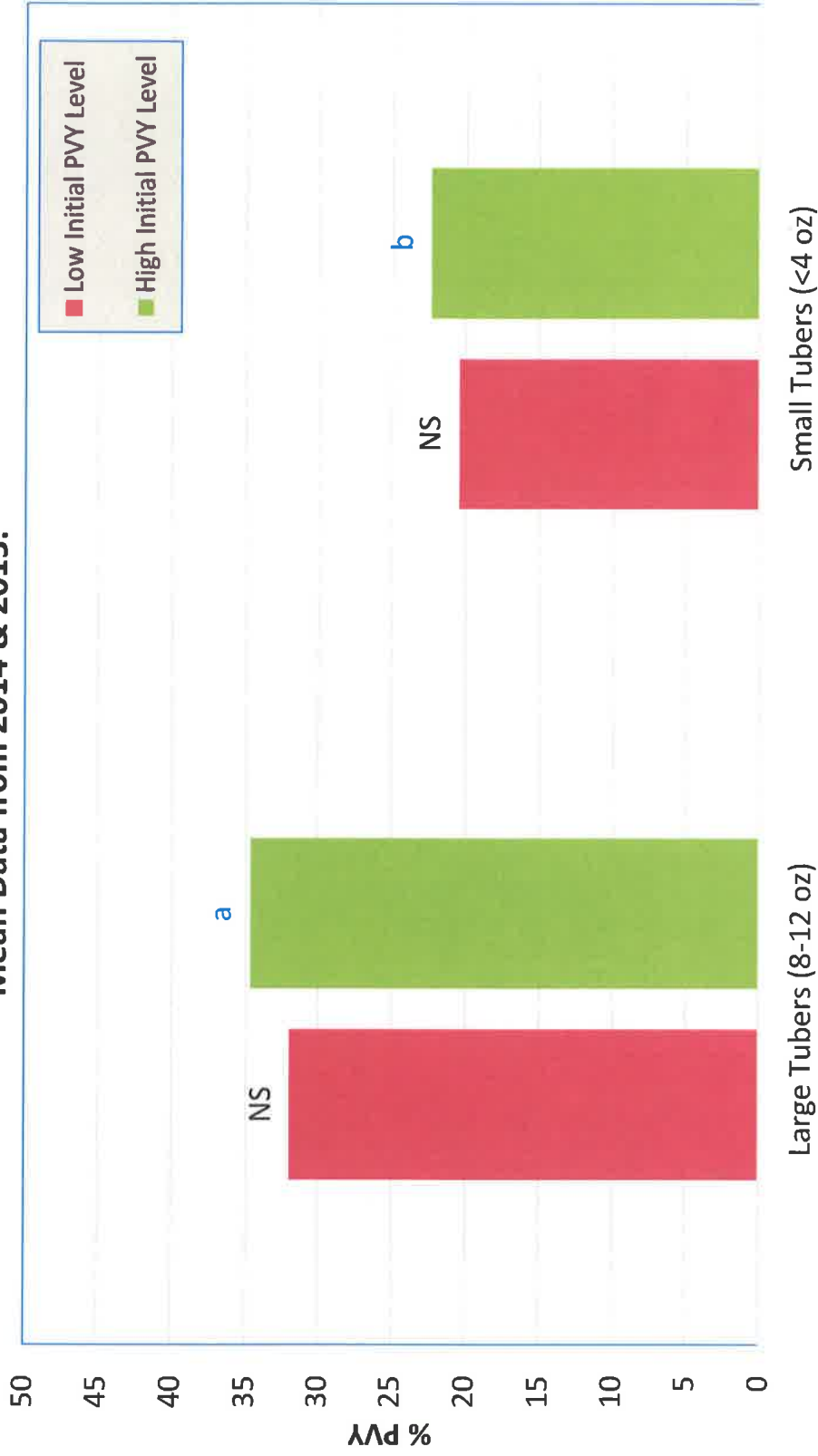
The Low Initial PVY Level was not compared against the High Initial PVY Level samples. Different letters indicate a statistical difference between means within a PVY level (black letters = Low PVY Level, Blue letters = High PVY Level). LSD Mean Separation, P-value=0.10.

Evaluation of PVY levels in Russet Norkotah Seed of Different Sizes (8-12oz. vs. <4 oz.), SLV Research Center, Center, CO 2015.



The Low Initial PVY Level was not compared against the High Initial PVY Level samples. Different letters indicate a statistical difference between means within a PVY level (black letters = Low PVY Level, Blue letters = High PVY Level). LSD Mean Separation, P-value=0.10.

**Evaluation of PVY levels in Russet Norkotah Seed of Different Sizes
(8-12oz. vs. <4 oz.), SLV Research Center, Center, CO.
Mean Data from 2014 & 2015.**



Initial PVY Level/Seed Size

The Low Initial PVY Level was not compared against the High Initial PVY Level samples. Different letters indicate a statistical difference between means within a PVY level (black letters = Low PVY Level, Blue letters = High PVY Level). LSD Mean Separation, P-value=0.10.