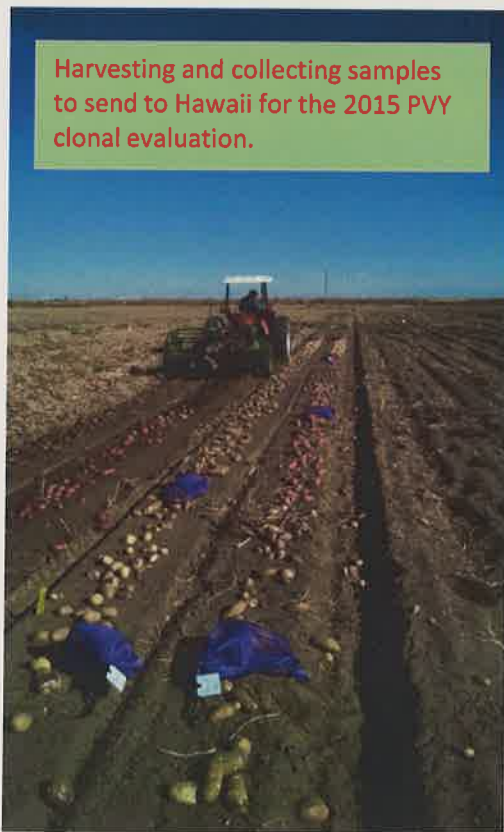


2015 Potato Pathology Research Report - Section 3

(Advanced Clone Evaluations and Degree Day Reporting)



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2014 & 2015 Powdery Scab Clonal Evaluation Trials

In 2014, there were 26 cultivars, including 15 new clones from the Colorado Potato Breeding Program were evaluated for powdery scab resistance. One new clone was found to be resistant to powdery scab root galling (CO05175-1RU). There were several red and specialty clones that were found to be either resistant or resistant to powdery scab lesion development (CO05037-2R/Y, CO05037-3W/Y, TC05276-7P/PW, CO04056-3P/PW).

In 2015, there were 21 cultivars, including 16 new clones from the Colorado Potato Breeding Program were evaluated for powdery scab resistance. Several new clone were found to be resistant to powdery scab root galling (AC05039-2RU, CO05028-11P/RWP, CO05068-1RU, CO05037-3W/Y). There were several red and specialty clones that were found to be either resistant or resistant to powdery scab lesion development (CO05028-11P/RWP, AC05153-1W).

Unfortunately, for root galling, the clones that had a high resistance in either 2014 or 2015, were not resistant in both years. The resistant cultivar, Mesa Russet, was shown to be resistant in both years. For tuber lesion development, there were no new clones that were found to be resistant to powdery scab both years. However, the susceptible control, DT6063-1R, had a higher level of powdery scab severity index rating than the cultivars found to be resistant to powdery scab in 2014 or 2015, for cultivars evaluated both years.

EVALUATION OF ADVANCED CLONES FOR SUSCEPTIBILITY TO POWDERY SCAB, 2014

Researchers:	Andrew J. Houser, Colorado State University, SLVRC
Location:	San Luis Valley Research Center, Greenhouse, Center, CO
Objective:	To evaluate the susceptibility of advanced potato clones to powdery scab.
Treatments:	<ol style="list-style-type: none">1. AC05153-1W2. AC05175-3P/Y3. CO05037-2R/Y4. CO05037-3W/Y5. CO05068-1RU6. CO05110-6RU7. CO05175-1RU8. CO05189-2RU9. CO05228-4R10. TC05276-7P/PW11. AC00206-2W12. CO04056-3P/PW13. CO04063-4R/R14. CO04067-8R/Y15. CO04099-3W/Y16. DT6063-1R17. Mesa Russet18. Jelly19. Sierra Gold20. Mesa Russet (White Mutation)21. Rio Grande (Std)22. Rio Grande Ln 3 (White Mutation)23. Rio Grande Ln 5 (White Mutation)24. Red McClure (Std)25. Red McClure Ln 2 (White Mutation)26. Red McClure Ln 3 (White Mutation)
Planted:	January 26th, 2015
Plot Design:	Randomized complete block
Plot Size:	Two 6" pots per treatment per replication.
Seed:	Potato eyes were removed from seed tubers using a melon scoop and allowed to suberize for several days. One eyeball was planted per pot, two inches deep in the soil.
Replications:	Four
Irrigation:	Overhead irrigation, rate predetermined based on the optimal irrigation regime for powdery scab symptom development.
Fertilizer:	20N-20P-20K, applied six times
Herbicide:	-
Insecticide:	-
Fungicide:	-
Vine Killer:	Vines were removed at harvest time.
Harvested:	May 28th & 29th, 2015
DATA:	Mean percent per pot showing galls on roots, rated 0 to 4; 0 = none, 4 = heavily infected. Mean percent of per pot showing one or more powdery scab lesions at harvest multiplied by the severity of the lesions, where 1 = very little or no disease and 5 = heavily infested. Mean percent of tubers per pot which are unmarketable due to powdery scab severity. Both root gall and tuber readings were taken on September 3rd, October 1st & 2nd, 2015.

Table 1. Evaluation of advanced clones for tuber and root susceptibility to powdery scab in a greenhouse environment, San Luis Valley, Center, CO, 2014.

Treatment	Tuber Symptoms					Fresh Root Weight ^f
	% Stand ^a	% Incidence ^b	% Healthy ^c	Severity Index ^d	% Unmarketable ^e	
1 AC05153-1W	100.0	87.5 a-d	12.5 c-f	275.0 bcd	50.0 b-e	3.0 c-i
2 AC05175-3P/Y	75.0	100.0 a	0.0 f	166.7 def	33.3 def	3.0 a-d
3 CO05037-2R/Y	100.0	68.8 cd	31.3 cd	68.8 fg	0.0 f	4.0 a
4 CO05037-3W/Y	100.0	72.5 bcd	27.5 cde	107.5 efg	0.0 f	3.5 abc
5 CO05068-1RU	100.0	0.0 f	100.0 a	0.0 g	0.0 f	2.3 def
6 CO05110-6RU	100.0	37.5 e	62.5 b	37.5 g	0.0 f	2.5 c-f
7 CO05175-1RU	100.0	0.0 f	100.0 a	0.0 g	0.0 f	0.3 g
8 CO05189-2RU	100.0	64.2 d	35.8 c	89.2 fg	0.0 f	3.0 a-d
9 CO05228-4R	100.0	100.0 a	0.0 f	325.0 abc	87.5 ab	3.7 ab
10 TC05276-7P/PW	100.0	83.4 a-d	16.7 c-f	166.7 def	29.2 ef	3.5 abc
11 AC00206-2W	100.0	100.0 a	0.0 f	275.0 bcd	54.2 b-e	3.0 a-d
12 CO04056-3P/PW	100.0	100.0 a	0.0 f	175.0 def	25.0 ef	3.8 ab
13 CO04063-4R/R	100.0	87.5 a-d	12.5 c-f	250.0 bcd	29.2 ef	3.5 abc
14 CO04067-8R/Y	100.0	91.7 abc	8.3 def	341.7 ab	70.9 a-d	3.8 ab
15 CO04099-3W/Y	100.0	95.0 ab	5.0 ef	240.0 bcd	60.0 b-e	3.8 ab
16 DT6063-1R	100.0	100.0 a	0.0 f	400.0 a	100.0 a	3.0 a-d
17 Mesa Russet	100.0	0.0 f	100.0 a	0.0 g	0.0 f	1.8 ef
18 Jelly	100.0	100.0 a	0.0 f	225.0 b-e	25.0 ef	4.0 a
19 Sierra Gold	100.0	8.3 f	91.7 a	8.3 g	0.0 f	3.3 a-d
20 Mesa Russet (White Mutation)	100.0	12.5 ef	87.5 ab	25.0 g	0.0 f	1.5 f
21 Rio Grande (Std)	100.0	0.0 f	100.0 a	0.0 g	0.0 f	3.0 a-d
22 Rio Grande Ln 3 (White Mutation)	100.0	65.8 d	34.2 c	222.5 cde	42.5 cde	2.8 b-e
23 Rio Grande Ln 5 (White Mutation)	100.0	83.3 a-d	16.7 c-f	341.7 ab	70.8 a-d	3.3 a-d
24 Red McClure (Std)	100.0	100.0 a	0.0 f	300.0 abc	75.0 abc	3.0 a-d
25 Red McClure Ln 2 (White Mutation)	100.0	100.0 a	0.0 f	250.0 bcd	46.7 cde	2.7 d-i
26 Red McClure Ln 3 (White Mutation)	100.0	100.0 a	0.0 f	400.0 a	100.0 a	3.5 abc
LSD (P=0.05)	NS	25.70	25.70	118.26	39.89	1.07
CV	9.90	26.9	56.1	46.4	81.6	25.0
F value	0.4782	0.0001	0.0001	0.0001	0.0001	0.0001
						0.0052

^aPercent Stand is based on the number of pots (four reps with two pots per rep) with growing plants that produced one or more tubers and/or a measurable amount of root mass for disease evaluation – if stand is less than 50%, the results are considered questionable.

^bPercent Incidence = Mean percent of tubers with powdery scab lesions.

^cPercent Healthy = Mean percent of tubers with no powdery scab lesions.

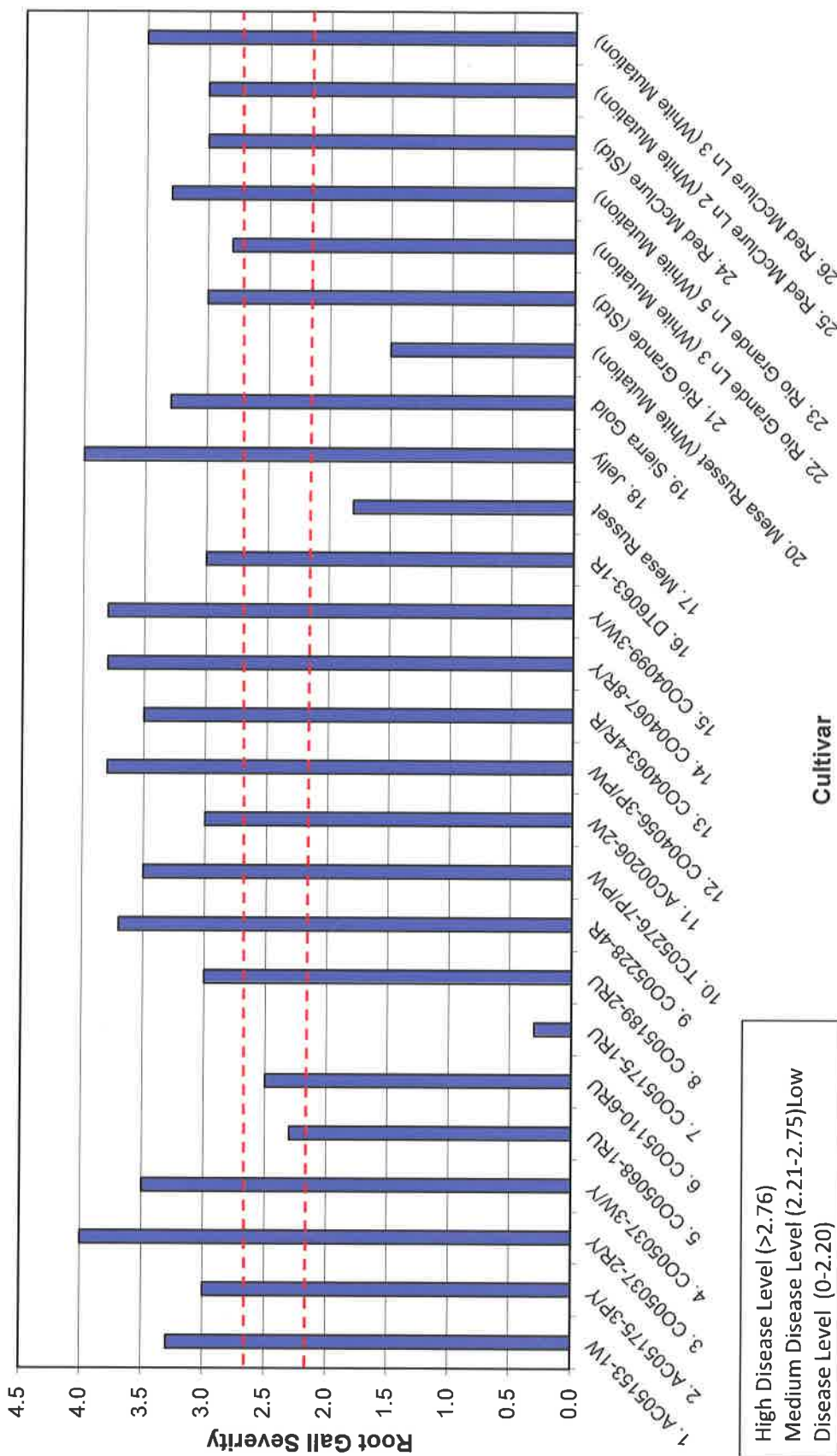
^dSeverity Index = mean percent of the number of affected tubers multiplied by the severity of the lesions, where 1 = very little or no disease and 5 = heavily infested.

^ePercent Unmarketable = Mean percent of tubers per pot which are unmarketable due to powdery scab severity (lesion severity >3).

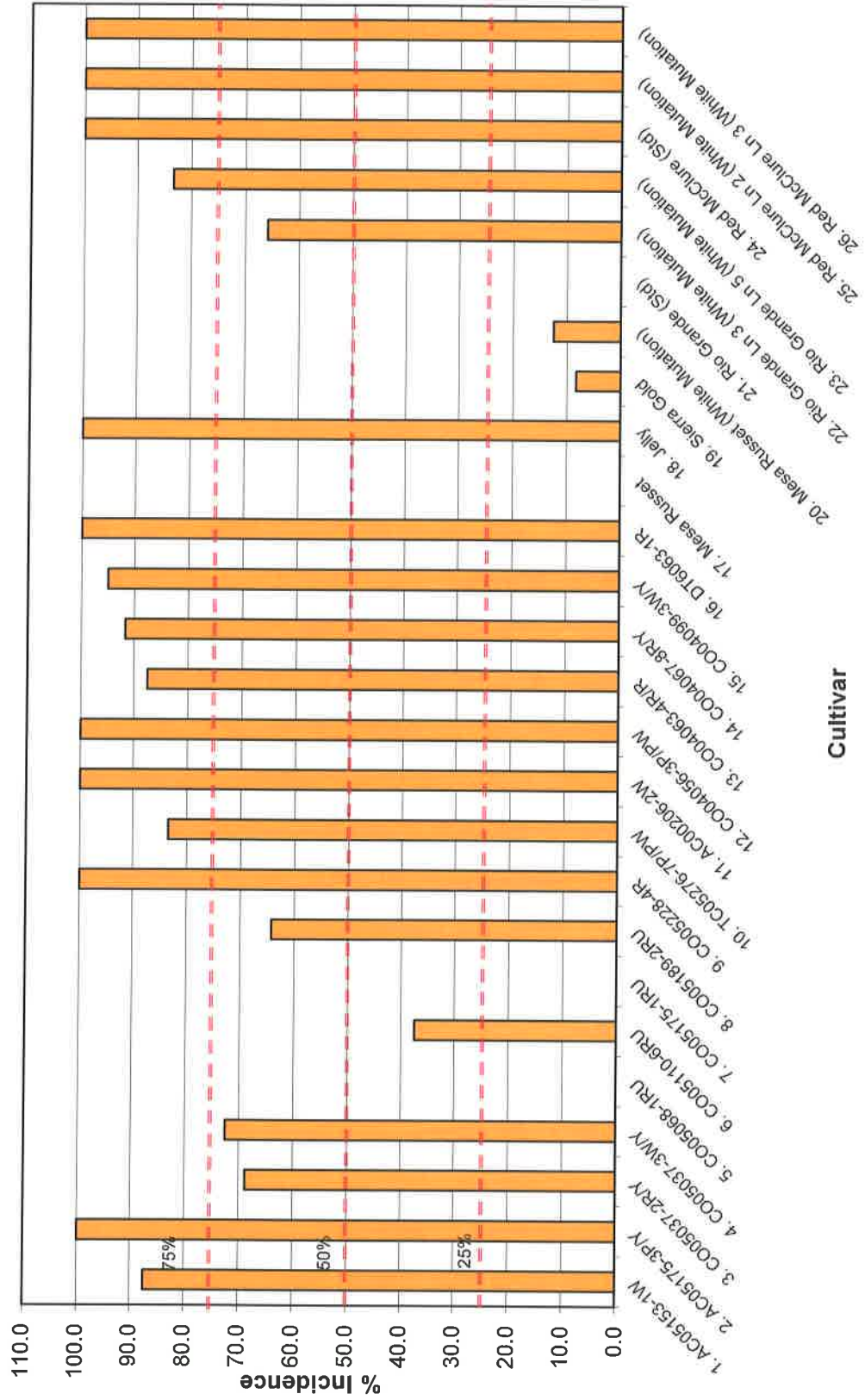
^fRoot Gall Rating = visual analysis of roots for the presence of powdery scab root galls, where 0 = no root galls and 4 = extensive root galls.

^gMean fresh root weight data was collected when disease readings were taken. Root weight varied in some cases due to disease severity, which had an impact on the root gall reading. Where root weights are low (i.e. < 1 gram), root gall readings are considered questionable. Means followed by the same letters are not significantly different at P=0.05.

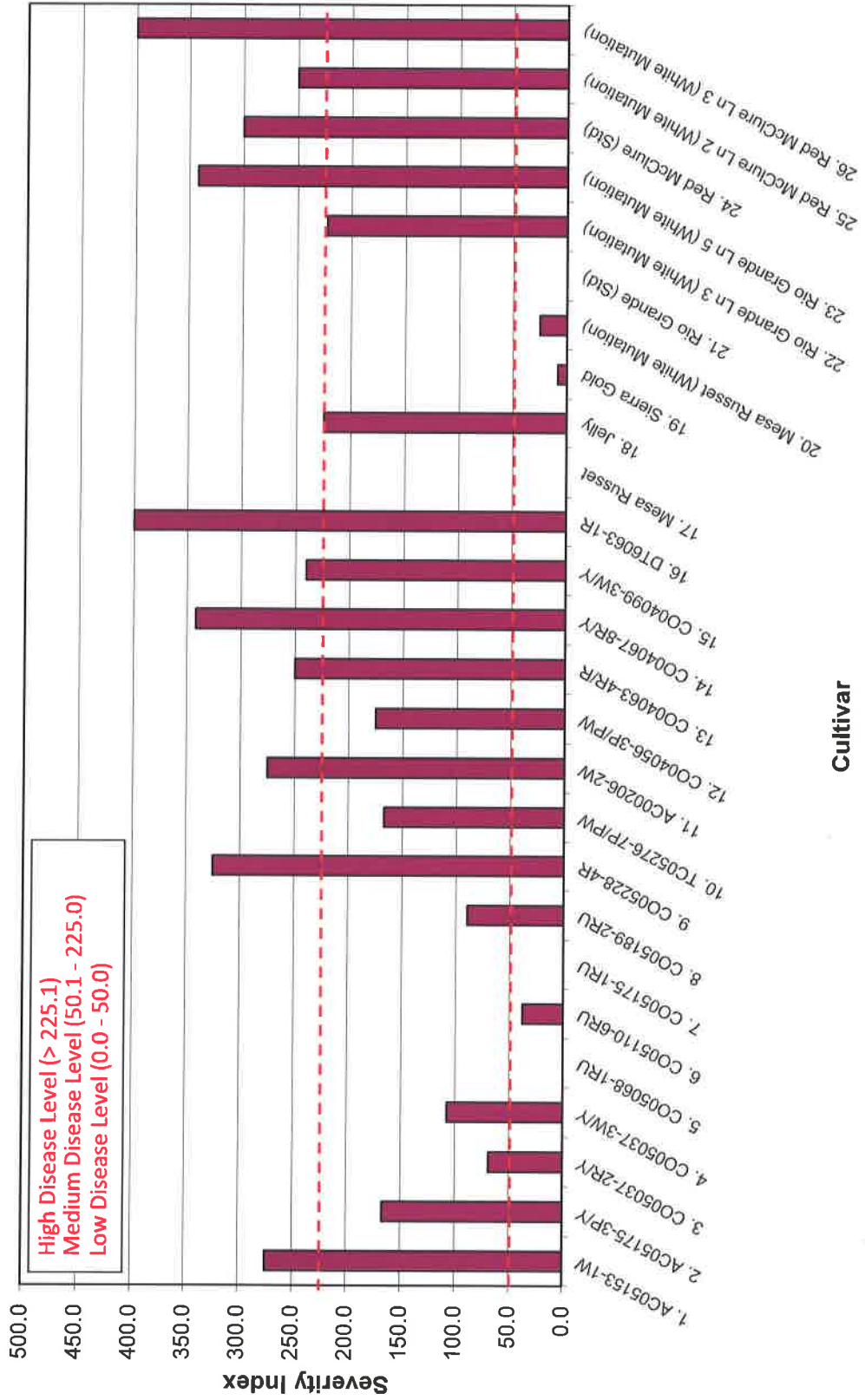
**Root Gall Severity(0-4, where 0=no galls & 4 = roots are heavily infested with root galls)
 Evaluation of Advanced Clones for Susceptibility to Powdery Scab Root Galing
 San Luis Valley Research Center, Greenhouse Trial, Colorado, 2014**



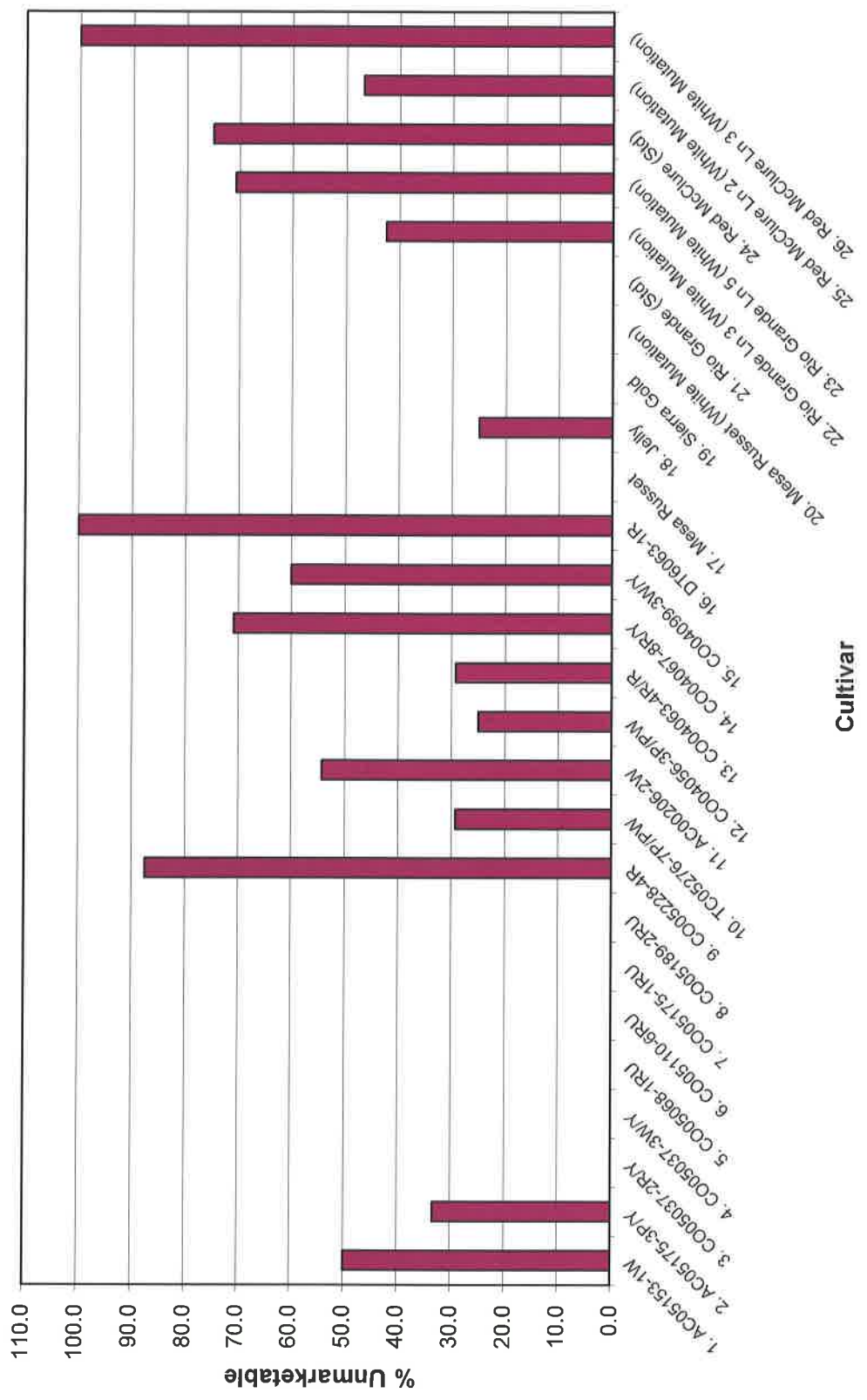
**Percent Incidence - Tubers with Powdery Scab
 Evaluation of Advanced Clones for Tuber Susceptibility to Powdery Scab
 San Luis Valley Research Center, Greenhouse Trial, Colorado, 2014**



Powdery Scab Severity Index - percent tubers with powdery scab x severity: 1 to 5
Evaluation of Advanced Clones for Tuber Susceptibility to Powdery Scab
San Luis Valley Research Center, Greenhouse Trial, Colorado, 2014



**Percent Unmarketable - Based on Powdery Scab Severity (severity rating >3)
 Evaluation of Advanced Clones for Tuber Susceptibility to Powdery Scab
 San Luis Valley Research Center, Greenhouse Trial, Colorado, 2014**



EVALUATION OF ADVANCED CLONES FOR SUSCEPTIBILITY TO POWDERY SCAB, 2015

- Researchers:** Andrew J. Houser, Colorado State University, SLVRC
Location: San Luis Valley Research Center, Greenhouse, Center, CO
Objective: To evaluate the susceptibility of advanced potato clones to powdery scab.
- Treatments:**
1. AC03452-2W
 2. AC05039-2RU
 3. CO05028-4P/PY
 4. CO05028-11P/RWP
 5. CO05035-1PW/Y
 6. AC05153-1W
 7. CO05068-1RU
 8. AC05175-3P/Y
 9. CO05110-6RU
 10. CO05037-2R/Y
 11. CO05037-3W/Y
 12. CO05175-1RU
 13. CO00405-1RF
 14. CO02024-9W
 15. CO03276-4RU
 16. CO04159-1R
 17. Crestone Russet
 18. Mercury Russet
 19. Colorado Rose
 20. DT6063-1R
 21. Mesa Russet
- Planted:** July 10th, 2015
Plot Design: Randomized complete block
Plot Size: Two 6" pots per treatment per replication.
Seed: Potato eyes were removed from seed tubers using a melon scoop and allowed to suberize for several days. One eyeball was planted per pot, two inches deep in the soil.
Replications: Four
Irrigation: Overhead irrigation, rate predetermined based on the optimal irrigation regime for powdery scab symptom development.
Fertilizer: 20N-20P-20K, applied six times
Herbicide: -
Insecticide: -
Fungicide: -
Vine Killer: Vines were removed at harvest time.
Harvested: October 12th - 15th, 2015
- DATA:** Mean percent per pot showing galls on roots, rated 0 to 4; 0 = none, 4 = heavily infected. Mean percent of per pot showing one or more powdery scab lesions at harvest multiplied by the severity of the lesions, where 1 = very little or no disease and 5 = heavily infested. Mean percent of tubers per pot which are unmarketable due to powdery scab severity. Both root gall and tuber readings were taken on January 30th, February 1st & 2nd, 2016.

Table 1. Evaluation of advanced clones for tuber and root susceptibility to powdery scab in a greenhouse environment, San Luis Valley, Center, CO, 2015.

Treatment	Tuber Symptoms					Root Gall Rating ^f	Fresh Root Weight ^g
	% Stand ^a	% Incidence ^b	% Healthy ^c	Severity Index ^d	% Unmarketable ^e		
1. AC03452-2W	100.0 a	94.5 ab	5.6 ef	313.9 a-e	71.5 abc	2.0 abc	16.4 a
2. AC05039-2RU	100.0 a	0.0 f	100.0 a	0.0 f	0.0 e	0.3 f	1.6 cd
3. CO05028-4P/PY	87.5 b	92.9 ab	7.2 ef	371.4 abc	77.4 abc	1.5 cde	6.2 bcd
4. CO05028-11P/RWP	100.0 a	51.3 c	48.7 d	78.0 f	3.3 e	0.3 f	2.0 bcd
5. CO05035-1PW/Y	100.0 a	100.0 a	0.0 f	425.0 a	97.2 a	3.0 a	9.7 a-d
6. AC05153-1W	100.0 a	93.9 ab	6.1 ef	210.5 e	41.4 d	1.5 cde	2.3 bcd
7. CO05068-1RU	100.0 a	3.6 ef	96.4 ab	3.6 f	0.0 e	0.5 ef	10.8 ab
8. AC05175-3P/Y	100.0 a	100.0 a	0.0 f	400.0 ab	86.5 ab	0.8 def	0.9 d
9. CO05110-6RU	100.0 a	22.2 de	77.9 bc	29.3 f	0.0 e	2.0 abc	16.4 a
10. CO05037-2R/Y	100.0 a	89.9 ab	10.1 ef	250.3 de	54.2 cd	1.3 c-f	3.8 bcd
11. CO05037-3W/Y	100.0 a	97.9 ab	2.1 ef	343.8 a-d	86.7 ab	0.3 f	1.0 d
12. CO05175-1RU	100.0 a	2.1 ef	97.9 ab	2.1 f	0.0 e	2.0 abc	10.7 ab
13. CO00405-1RF	100.0 a	84.0 ab	16.0 ef	252.1 de	54.8 cd	1.8 bcd	1.8 bcd
14. CO02024-9W	100.0 a	93.2 ab	6.8 ef	261.4 cde	55.5 cd	1.0 c-f	4.4 bcd
15. CO03276-4RU	100.0 a	6.5 ef	93.6 ab	6.5 f	0.0 e	2.0 abc	5.2 bcd
16. CO04159-1R	100.0 a	82.5 ab	17.5 ef	287.5 b-e	64.5 bcd	1.5 cde	6.3 bcd
17. Crestone Russet	100.0 a	0.0 f	100.0 a	0.0 f	0.0 e	0.5 ef	10.1 abc
18. Mercurie Russet	100.0 a	38.1 cd	61.9 cd	38.1 f	0.0 e	1.5 cde	1.2 cd
19. Colorado Rose	75.0 c	77.5 b	22.5 e	387.5 ab	77.5 abc	0.8 def	2.4 bcd
20. DT6063-1R	100.0 a	86.4 ab	13.6 ef	389.3 ab	75.7 abc	2.8 ab	3.2 bcd
21. Mesa Russet	100.0 a	0.0 f	100.0 a	0.0 f	0.0 e	0.5 ef	4.9 bcd
LSD (P=0.05)	11.62	21.31	21.31	118.32	29.60	1.23	9.02
CV	8.36	26.0	35.8	43.4	52.0	66.2	110.6
F value	0.0134	0.0001	0.0001	0.0001	0.0001	0.0001	0.0079

^aPercent Stand is based on the number of pots (four reps with two pots per rep) with growing plants that produced one or more tubers and/or a measurable amount of root mass for disease evaluation – if stand is less than 50%, the results are considered questionable.

^bPercent Incidence = Mean percent of tubers with powdery scab lesions.

^cPercent Healthy = Mean percent of tubers with no powdery scab lesions.

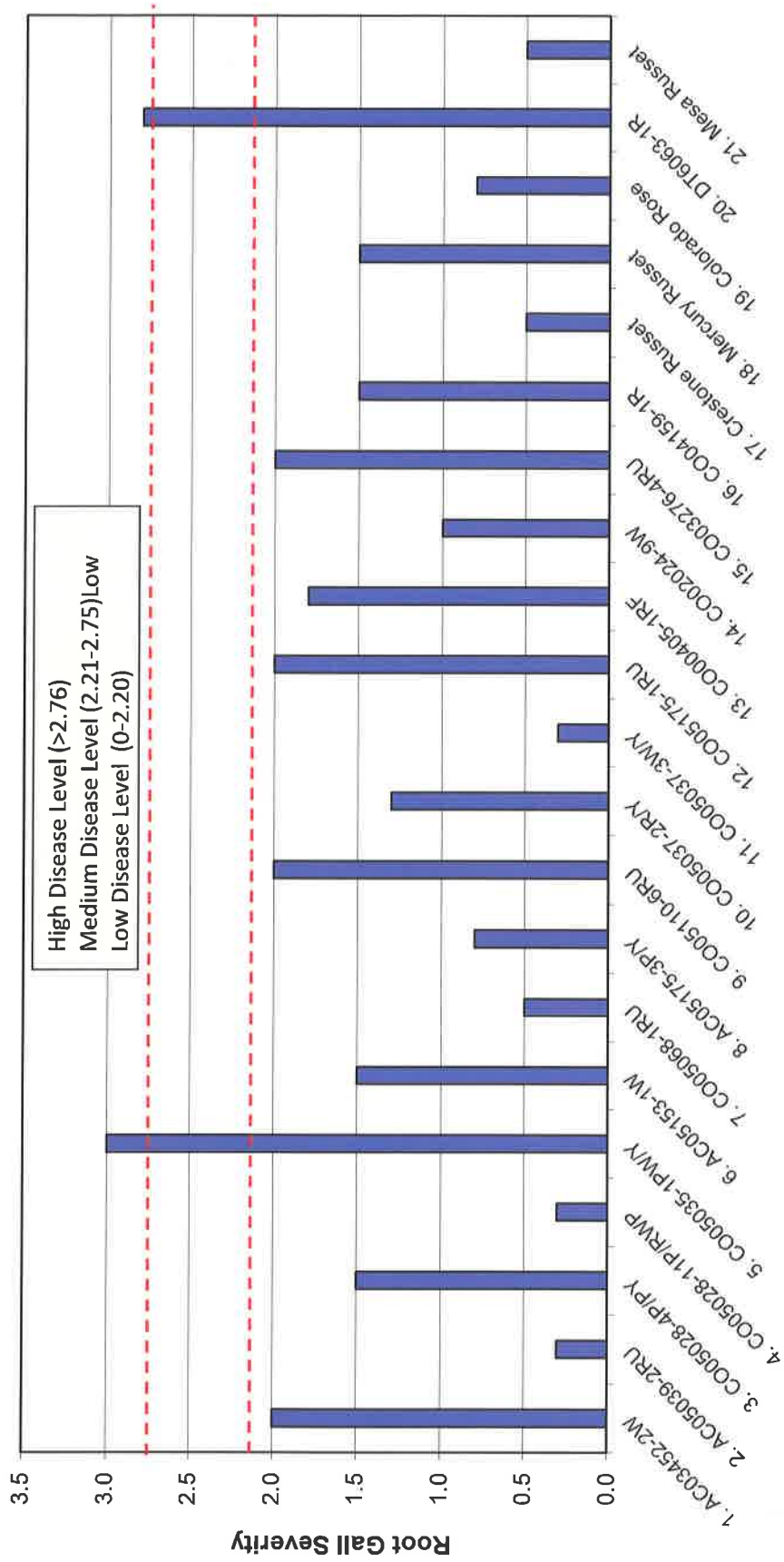
^dSeverity Index = mean percent of the number of affected tubers multiplied by the severity of the lesions, where 1 = very little or no disease and 5 = heavily infested.

^ePercent Unmarketable = Mean percent of tubers per pot which are unmarketable due to powdery scab severity (lesion severity >3).

^fRoot Gall Rating = visual analysis of roots for the presence of powdery scab root galls, where 0 = no root galls and 4 = extensive root galls.

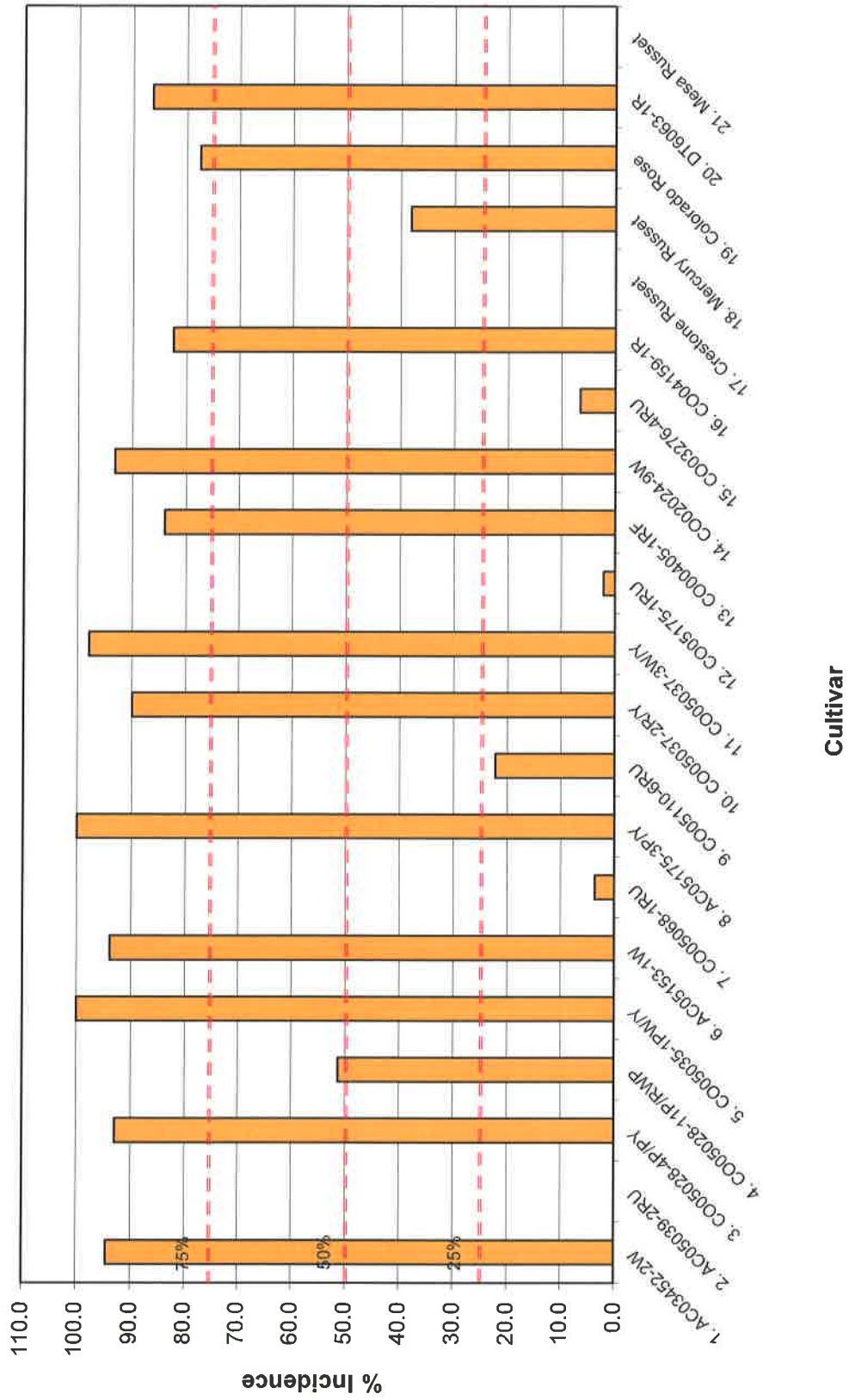
^gMean fresh root weight data was collected when disease readings were taken. Root weight varied in some cases due to disease severity, which had an impact on the root gall reading. Where root weights are low (i.e. < 1 gram), root gall readings are considered questionable. Means followed by the same letters are not significantly different at P=0.05.

**Root Gall Severity(0-4, where 0=no galls & 4 = roots are heavily infested with root galls)
 Evaluation of Advanced Clones for Susceptibility to Powdery Scab Root Galling
 San Luis Valley Research Center, Greenhouse Trial, Colorado, 2015**

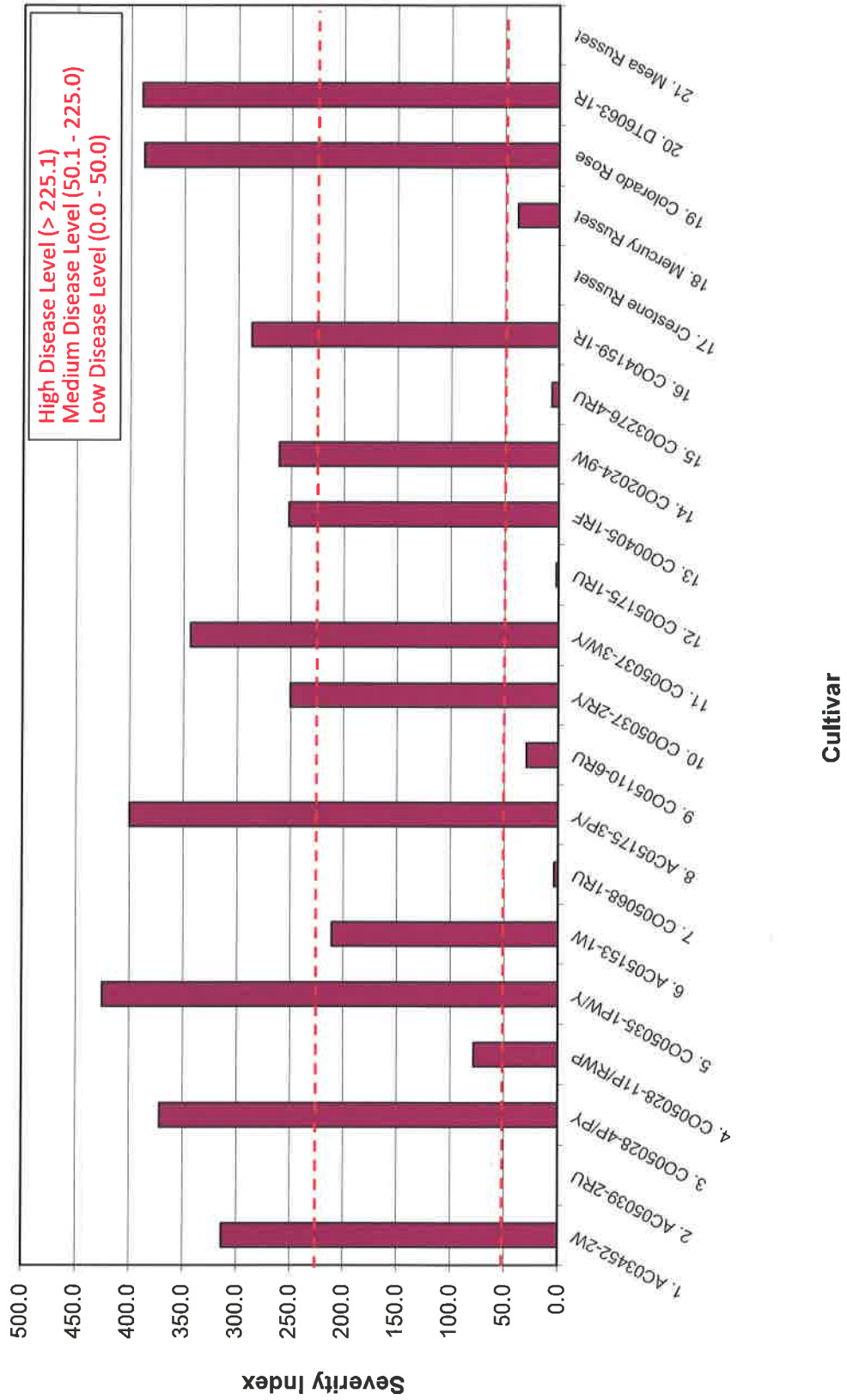


Cultivar

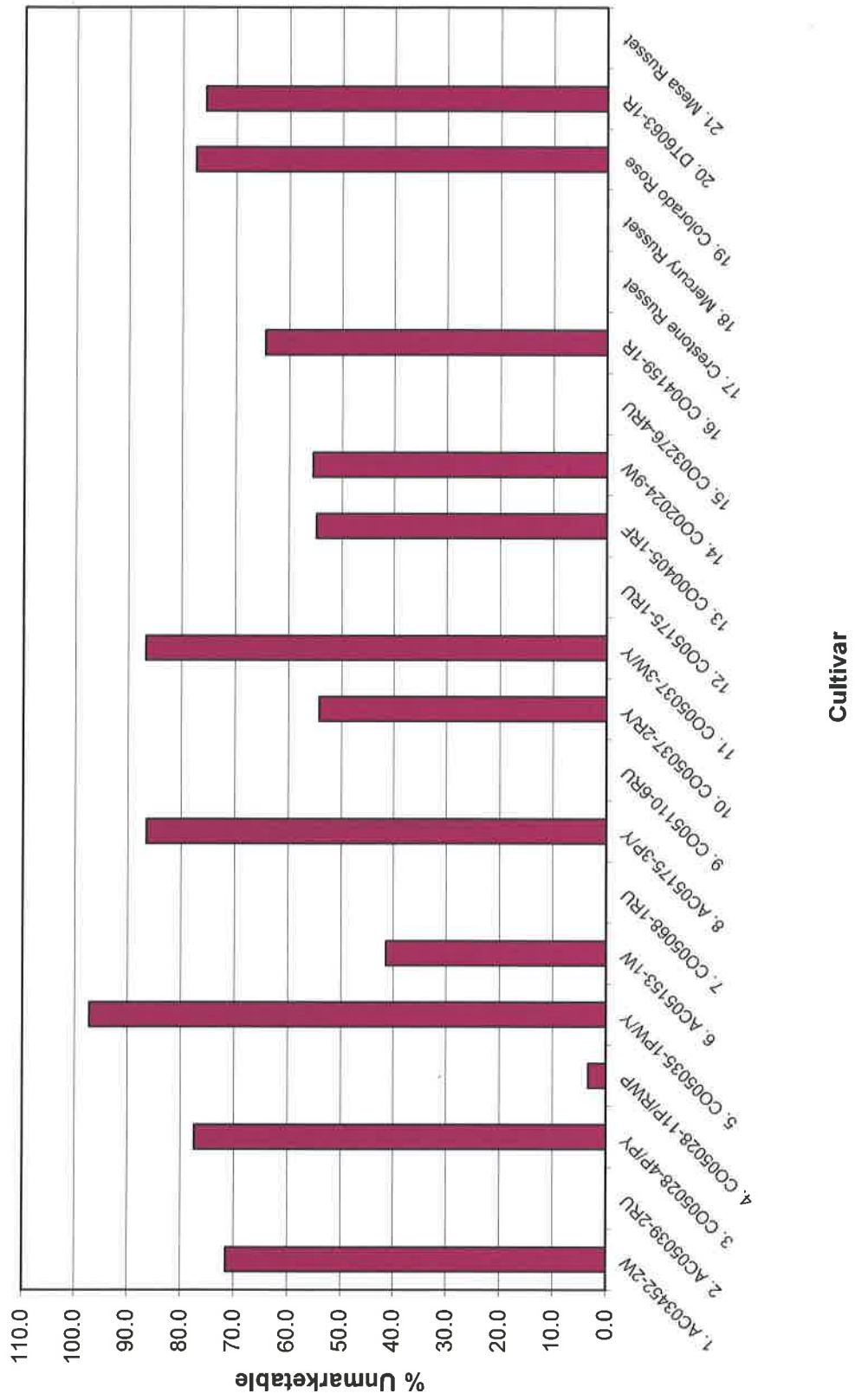
**Percent Incidence - Tubers with Powdery Scab
 Evaluation of Advanced Clones for Tuber Susceptibility to Powdery Scab
 San Luis Valley Research Center, Greenhouse Trial, Colorado, 2015**



Powdery Scab Severity Index - percent tubers with powdery scab x severity: 1 to 5
Evaluation of Advanced Clones for Tuber Susceptibility to Powdery Scab
San Luis Valley Research Center, Greenhouse Trial, Colorado, 2015



**Percent Unmarketable - Based on Powdery Scab Severity (severity rating >3)
 Evaluation of Advanced Clones for Tuber Susceptibility to Powdery Scab
 San Luis Valley Research Center, Greenhouse Trial, Colorado, 2015**



2014 Storage Rot Clonal Evaluation

In 2014, 33 potato cultivars evaluated for soft rot (caused by *Pectobacterium* sp.) and dry rot (caused by *Fusarium* sp.) resistance, 28 of these were new clones from the Colorado Potato Breeding Program. There was a wide range of symptom development in all the clones evaluated. Clones that had relatively low levels of dry rot included CO07049-1RU, CO07329-1P/Y, and Canela Russet. Clones with relatively low levels of bacterial soft rot included CO07015-4RU, CO07049-1RU, CO07329-1P/Y, AC05039-2RU, CO05035-1PW/Y, AC05175-3P/Y, CO05037-2R/Y, Russet Norkotah S-3, Rio Grande Russet, and Canela Russet. In 2015, there were 22 new clones evaluated for soft and dry rot resistance. These results are still pending.

EVALUATION OF ADVANCED CLONES FOR SUSCEPTIBILITY TO DIFFERENT STORAGE ROTS, 2014

- Researchers:** Andrew J. Houser, Colorado State University
- Location:** San Luis Valley Research Center, Center, CO
- Objective:** To evaluate the susceptibility of advanced potato clones to *Fusarium* sp. and *Pectobacterium* sp.
- Inoculation Protocol:** For *Pectobacterium* sp. - 50ul of 7.0 x 10⁴ cfu/ml was injected into 3 inoculation sites per tuber near the stem end on December 22, 2014; two tubers per replication, three replications. For *Fusarium* sp. - 50ul of 250 spores/tuber was injected into 3 inoculation sites per tuber near the stem end on December 18 & 19, 2014; four tubers per replication, three replications.
- Temperature:** Tubers kept at 55-60°F after inoculation for 4-6 weeks.
- Cultivars:**
- | | |
|---------------------|-------------------------|
| 1. CO07015-4RU | 18. CO06057-3RU |
| 2. CO07049-1RU | 19. AC05153-1W |
| 3. CO07070-10W | 20. CO05068-1RU |
| 4. CO07070-13W | 21. AC05175-3P/Y |
| 5. CO07102-1R | 22. CO05110-6RU |
| 6. CO07131-1W/Y | 23. CO05037-2R/Y |
| 7. CO07153-3RW/Y | 24. CO05037-3W/Y |
| 8. CO07205-4RU | 25. CO05175-1RU |
| 9. CO07322-3R | 26. Russet Norkotah S-3 |
| 10. CO07329-1P/Y | 27. Russet Nugget |
| 11. CO07370-1W/Y | 28. Sangre S-10 |
| 12. AC03534-2R/Y | 29. Rio Grande Russet |
| 13. AC05039-2RU | 30. Canela Russet |
| 14. CO05028-4P/PY | 31. CO05189-2RU |
| 15. CO05028-11P/RWP | 32. TC05276-7P/PW |
| 16. CO05035-1PW/Y | 33. CO05228-4R |
| 17. CO05079-4P/PW | |
- Plot Design:** Completely Randomized Design
- Seed:** Four potatoes were evaluated per cultivar per replication.
- Replications:** Three
- Rating Scale:**
- 1 = No symptoms
 - 2 = Localized damage
 - 3 = 25-50% tuber damage
 - 4 = > 50% tuber damage
 - 5 = 100% tuber damage
- Data Collection:** Tubers were cut and evaluated using the above rating scale on February 26th, 2015 for the *Fusarium* sp. inoculation and on March 20th, 2015 for the *Pectobacterium* sp. inoculation. Grade loss occurs at 2+ for *Fusarium* a sp., 3+ for *Pectobacterium* sp.

Table 1. Evaluation of advanced clones for tuber susceptibility to soft rot (*Pectobacterium* sp.) and dry rot (*Fusarium* sp.), Colorado State University, San Luis Valley Research Center, Center, CO, 2014.

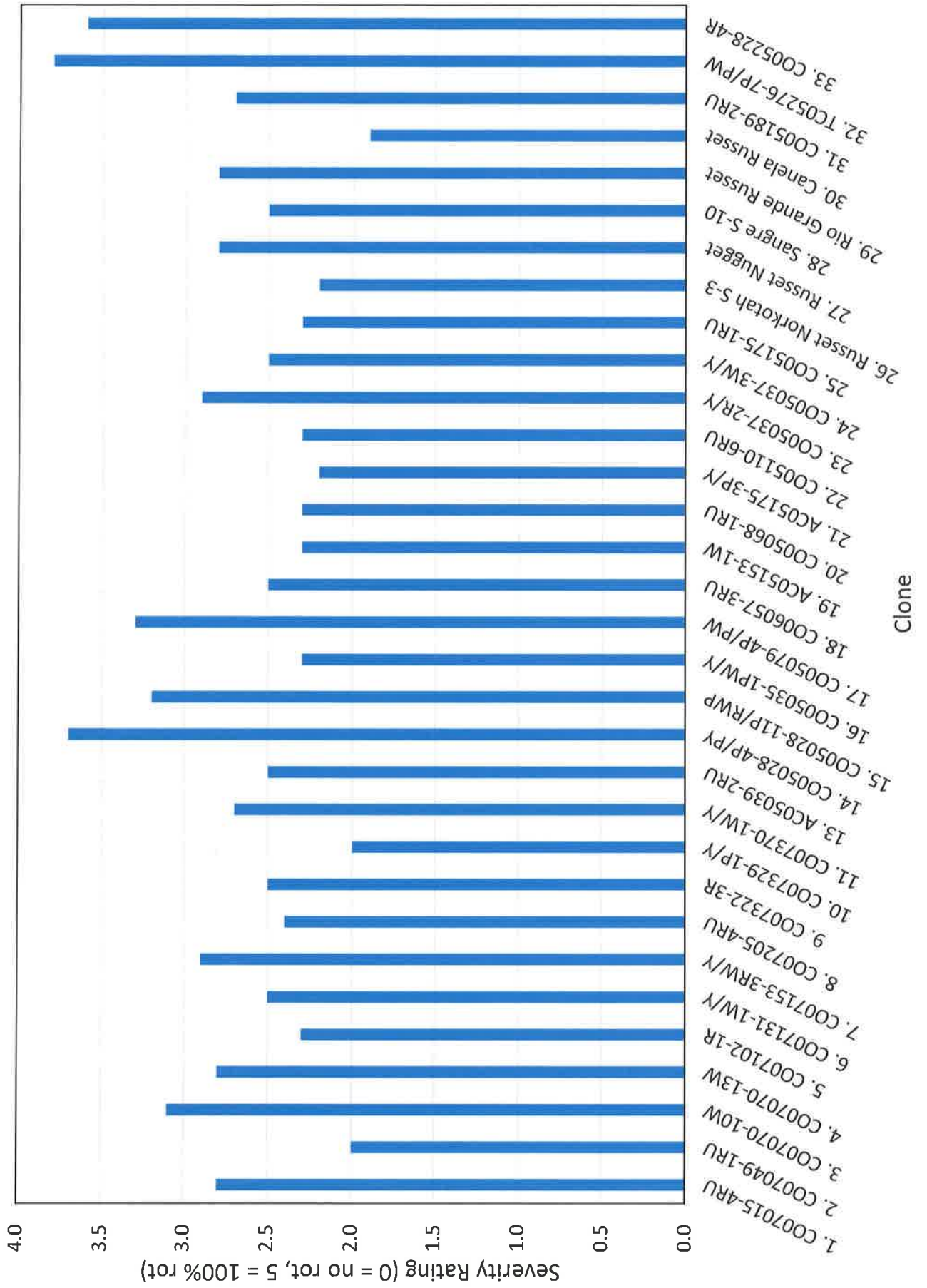
Clone	Soft Rot (<i>Pectobacterium</i> sp.)	
	Severity ^a	Dry Rot (<i>Fusarium</i> sp.) Severity ^b
1. CO07015-4RU	1.3 k	2.8 b-h
2. CO07049-1RU	1.6 ijk	2.0 gh
3. CO07070-10W	2.1 g-k	3.1 a-f
4. CO07070-13W	2.8 d-g	2.8 b-h
5. CO07102-1R	3.9 abc	2.3 e-h
6. CO07131-1W/Y	4.6 a	2.5 d-h
7. CO07153-3RW/Y	2.8 d-g	2.9 a-g
8. CO07205-4RU	2.3 g-k	2.4 d-h
9. CO07322-3R	3.7 a-d	2.5 d-h
10. CO07329-1P/Y	1.8 h-k	2.0 gh
11. CO07370-1W/Y	3.6 b-e	2.7 c-h
12. AC03534-2R/Y	-	-
13. AC05039-2RU	1.9 g-k	2.5 d-h
14. CO05028-4P/PY	2.1 g-k	3.7 ab
15. CO05028-11P/RWP	2.3 g-k	3.2 a-e
16. CO05035-1PW/Y	1.7 ijk	2.3 e-h
17. CO05079-4P/PW	4.3 ab	3.3 a-d
18. CO06057-3RU	2.8 d-g	2.5 d-h
19. AC05153-1W	2.2 g-k	2.3 d-h
20. CO05068-1RU	2.3 g-j	2.3 d-h
21. AC05175-3P/Y	1.6 ijk	2.2 fgh
22. CO05110-6RU	2.1 g-k	2.3 d-h
23. CO05037-2R/Y	1.8 h-k	2.9 a-g
24. CO05037-3W/Y	2.2 g-k	2.5 d-h
25. CO05175-1RU	2.2 g-k	2.3 e-h
26. Russet Norkotah S-3	1.7 ijk	2.2 fgh
27. Russet Nugget	2.7 e-h	2.8 b-h
28. Sangre S-10	2.3 g-k	2.5 d-h
29. Rio Grande Russet	1.6 ijk	2.8 b-h
30. Canela Russet	1.4 jk	1.9 h
31. CO05189-2RU	2.5 f-i	2.7 c-h
32. TC05276-7P/PW	3.3 c-f	3.8 a
33. CO05228-4R	3.9 abc	3.6 abc
LSD (P=0.05)	1.0	1.0
CV	24.55	22.59
F value	0.0001	0.0123

^aAvg. severity rating for soft rot caused by *Pectobacterium* sp., readings taken on March 20, 2015, mean of 3 reps.

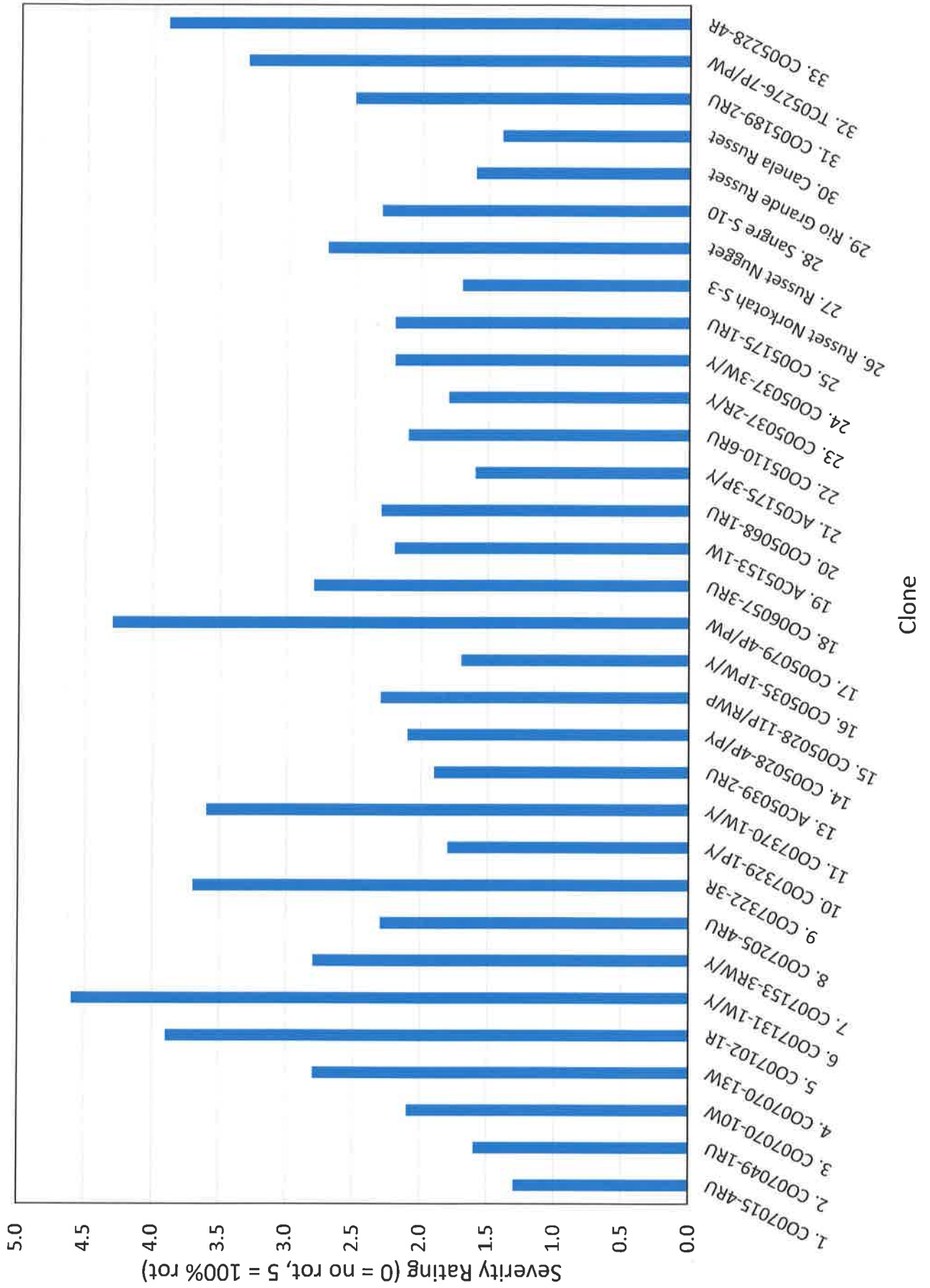
^bAvg. severity rating for dry rot caused by *Fusarium* sp., readings taken on February 26, 2015, mean of 3 reps.

Means followed by the same letters are not significantly different at P=0.05.

**Clonal Evaluation of Tuber Dry Rot caused by *Fusarium* sp.,
SLV Research Center, Center, CO 2014**



**Clonal Evaluation of Tuber Soft Rot caused by *Pectobacterium* sp.,
SLV Research Center, Center, CO 2014**



2015 Potato Virus Y (PVY) Clonal Evaluation

In 2015, a trial was set up to determine the level of PVY resistance in new potato stocks as well as in potato cultivars that are currently being grown in the San Luis Valley. An approach was implemented which took advantage of high PVY inoculum levels and natural aphid spread in a field planted to Russet Norkotah potatoes. Forty different potato clones and cultivars were evaluated using this strategy. As expected, the Russet Norkotahs that were included in the trial showed a high level of PVY spread. This cultivar has been known to be highly susceptible to PVY, which was confirmed in this trial. Conversely, Fortress Russet has been known to be highly resistant to PVY, which was also confirmed in this trial. Several of the new clones that were evaluated in this trial showed some moderate resistance to PVY. These clones could be used by growers to manage PVY on their farms where PVY is a concern.

EVALUATION OF POTATO CLONES FOR SYMPTOM EXPRESSION AND RESISTANCE TO POTATO VIRUS Y (PVY), SLVRC, 2015

Researcher: Andrew J. Houser, Colorado State University, SLVRC
Location: Off-station, on a commercial potato growers farm, SLV
Objective: To evaluate new potato clones for symptom expression and resistance to PVY.

Clones:

1. AC01144-1W	23. Masquerade
2. AC08094-2W	24. Midnight Moon
3. CO08029-1RF/R	25. Red Luna
4. CO08065-2RU	26. Russet Burbank
5. CO08155-2RU/Y	27. Sangre-S10
6. CO08231-1RU	28. Canela Russet
7. CO08352-2P/P	29. Classic Russet
8. NDC081655-1R	30. Crestone Russet
9. CO07015-4RU	31. Innovator
10. CO07049-1RU	32. La Ratte
11. CO07070-10W	33. Mercury Russet
12. CO07070-13W	34. Mesa Russet
13. CO07102-1R	35. Pacific Russet
14. CO07131-1W/Y	36. Rio Grande
15. CO07329-1P/Y	37. Russet Norkotah sel 3
16. CO07370-1W/Y	38. Russet Nugget
17. CO05035-1PW/Y	39. Teton Russet
18. Penobscot	40. Yukon Gold
19. WNC230-14RU	41. Russet Norkorkotah 296 (Border 1)
20. Ute Russet	42. Russet Norkorkotah 296 (Border 2)
21. Centennial Russet	43. Russet Norkorkotah 296 (Border 3)
22. Fortress Russet	44. Russet Norkorkotah 296 (Border 4)

Planted: May 7 & 8, 2015
Plot Design: Randomized Complete Block Design
Plot Size: 1-15 foot row per treatment per replication
Plant Spacing: 12 inches
Row Spacing: 34 inches
Replications: Three
Irrigation: Center Pivot, rate based on ET
Fertilizer: NA
Herbicide: NA
Insecticide: NA
Fungicide: NA
Vine Killer: NA
Harvested: September 18, 2015

DATA:

Mosaic Readings: Evaluated all plants for mosaic symptoms twice during the summer (June 16 & July 26, 2015). Also pulled a sample of 15 tubers (evenly distributed throughout each plot) per cultivar per replication. The samples were gassed with Rindite (October 15, 2015) and planted (November 5th) in Oahu, HI and were evaluated for mosaic on December 14, 2015. A total percentage of potato plants with mosaic symptoms was calculated from each disease reading.

Table 1. Evaluation of advanced clones for susceptibility to Potato Virus Y (PVY) spread, Colorado State University, San Luis Valley, Center, CO, 2015.

Clone	% PVY June 26, 2015 ^a	% PVY July 16, 2015 ^b	% PVY January 15, 2015 ^c	% Stand ^d	Visual Rating ^e
1. AC01144-1W	0.0 e	0.0 d	3.0 gh	44.3 jk	NA
2. AC08094-2W	0.0 e	0.0 d	20.4 b-h	80 a-g	4
3. CO08029-1RF/R	2.4 de	4.9 bcd	6.9 gh	68.7 e-i	2 & 3
4. CO08065-2RU	0.0 e	16.7 abc	48.2 ab	80 a-g	NA
5. CO08155-2RU/Y	0.0 e	19.0 ab	2.2 gh	88.7 a-e	4
6. CO08231-1RU	21.4 a	21.4 a	20.3 b-h	89 a-e	3
7. CO08352-2P/P	0.0 e	4.8 cd	0.0 h	49 ijk	NA
8. NDC081655-1R	2.2 de	4.4 cd	19.0 c-h	95.3 ab	4
9. CO07015-4RU	0.0 e	0.0 d	7.3 gh	91 a-d	3 & 4
10. CO07049-1RU	0.0 e	4.4 cd	7.4 fgh	57.7 hij	5
11. CO07070-10W	0.0 e	0.0 d	16.3 d-h	86.7 a-e	4
12. CO07070-13W	2.4 de	4.9 bcd	16.7 c-h	89 a-e	2
13. CO07102-1R	0.0 e	5.6 bcd	0.0 h	80 a-g	NA
14. CO07131-1W/Y	0.0 e	0.0 d	12.3 e-h	91 a-d	4
15. CO07329-1P/Y	4.4 de	4.4 cd	16.1 d-h	71.3 c-h	5
16. CO07370-1W/Y	0.0 e	0.0 d	2.6 gh	95.7 ab	NA
17. CO05035-1PW/Y	0.0 e	0.0 d	2.8 gh	69 d-i	3
18. Penobscot	0.0 e	4.4 cd	14.9 e-h	75.3 b-h	4 & 5
19. WNC230-14RU	11.9 a-d	11.9 a-d	17.8 c-h	69 d-i	NA
20. Ute Russet	0.0 e	0.0 d	2.6 gh	91.3 abc	2
21. Centennial Russet	0.0 e	0.0 d	6.7 gh	97.7 a	2
22. Fortress Russet	0.0 e	0.0 d	0.0 h	89 a-e	NA
23. Masquerade	0.0 e	0.0 d	0.0 h	93.3 abc	NA
24. Midnight Moon	0.0 e	0.0 d	0.0 h	91 a-d	NA
25. Red Luna	0.0 e	0.0 d	0.0 h	78 a-h	NA
26. Russet Burbank	15.0 abc	8.9 a-d	58.7 a	82 a-g	4
27. Sangre-S10	17.8 ab	17.8 abc	16.7 c-h	33.3 k	3
28. Canela Russet	0.0 e	0.0 d	8.9 e-h	57.7 hij	NA
29. Classic Russet	9.6 b-e	17.1 abc	15.2 d-h	84.3 a-f	NA
30. Crestone Russet	11.1 bcd	17.8 abc	61.6 a	86.7 a-e	NA
31. Innovator	0.0 e	7.3 a-d	20.8 b-h	62.3 f-j	3
32. La Ratte	0.0 e	0.0 d	3.0 gh	88.7 a-e	2
33. Mercury Russet	6.7 cde	8.9 a-d	43.0 a-d	84.3 a-f	4
34. Mesa Russet	0.0 e	0.0 d	24.5 b-h	91 a-d	2
35. Pacific Russet	0.0 e	0.0 d	35.4 a-f	95.3 ab	3
36. Rio Grande	0.0 e	4.8 cd	7.3 gh	91 a-d	2
37. Russet Norkotah sel 3	0.0 e	11.3 a-d	36.7 a-e	80 a-g	2
38. Russet Nugget	0.0 e	2.1 d	30.0 b-g	60 g-j	NA
39. Teton Russet	0.0 e	0.0 d	3.0 gh	69 d-i	4
40. Yukon Gold	0.0 e	0.0 d	15.8 d-h	78 a-h	NA
41. R Nork Border 1	5.8 cde	8.3 a-d	36.7 a-e	80 a-g	3
42. R Nork Border 2	8.1 b-e	11.1 a-d	44.4 abc	100 a	3
43. R Nork Border 3	8.5 b-e	10.7 a-d	35.5 a-e	84.7 a-e	3
44. R Nork Border 4	5.1 de	8.1 a-d	22.1 b-h	91.3 abc	3
LSD (P=0.05)	9.82	14.11	28.05	22.08	-
CV	200.00	157.70	99.06	16.95	-
F value	0.0003	0.0252	0.0001	0.0001	-

^aPercent potato plants expressing visual mosaic symptoms on June 26, 2015, mean of three replications (reps).

and/or a measurable amount of root mass for disease evaluation – if stand is less than 50%, the results are considered

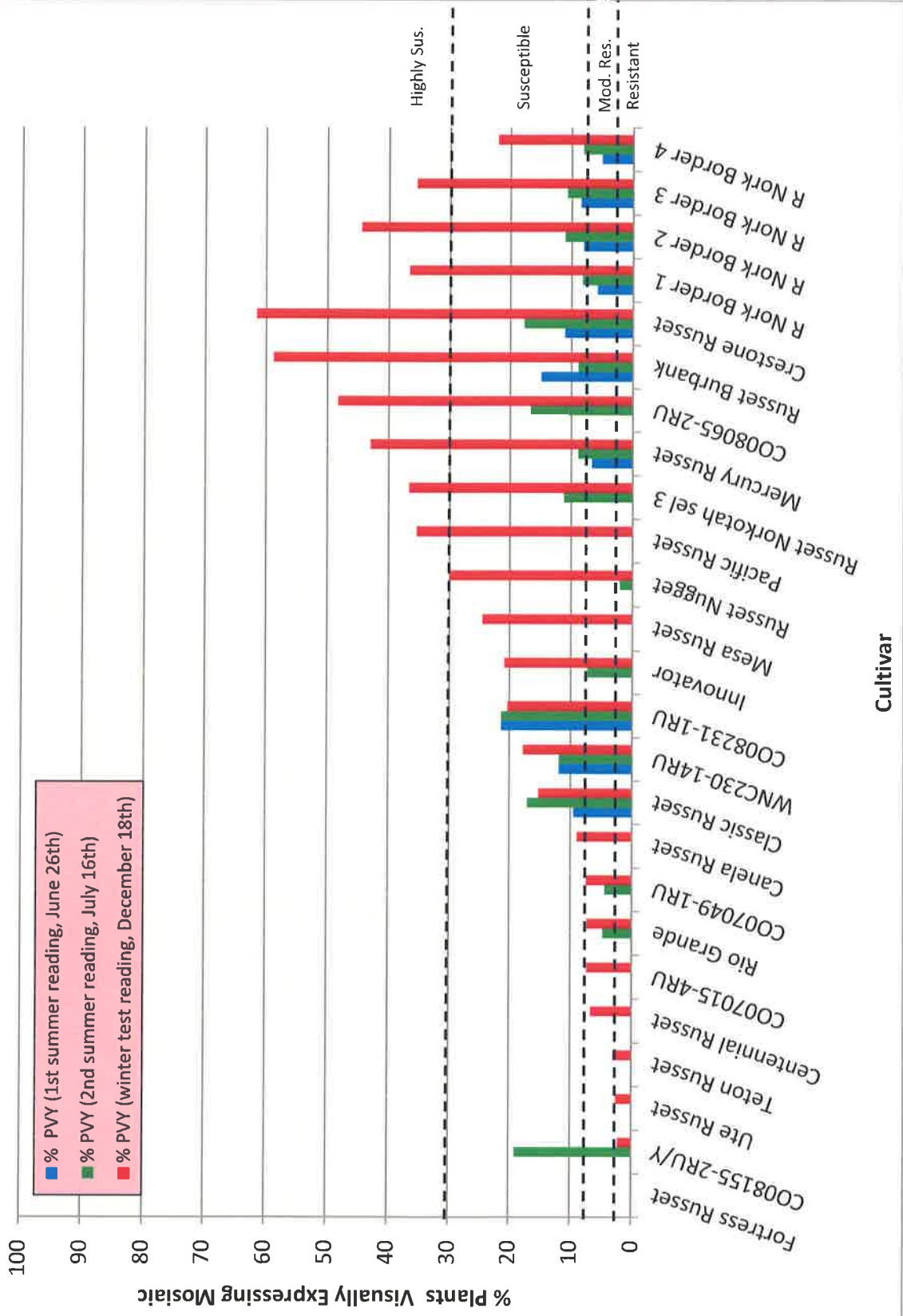
^cA sample of 15 tubers, representing one tuber per plant, was taken at harvest and was sent to Oahu, HI to be evaluated for mosaic symptoms. Percent potato plants expressing visual mosaic symptoms on December 14, 2015, mean of 3 reps.

^dPercentage of plants emerged on December 14, 2015 in Oahu, HI; mean of 4 reps.

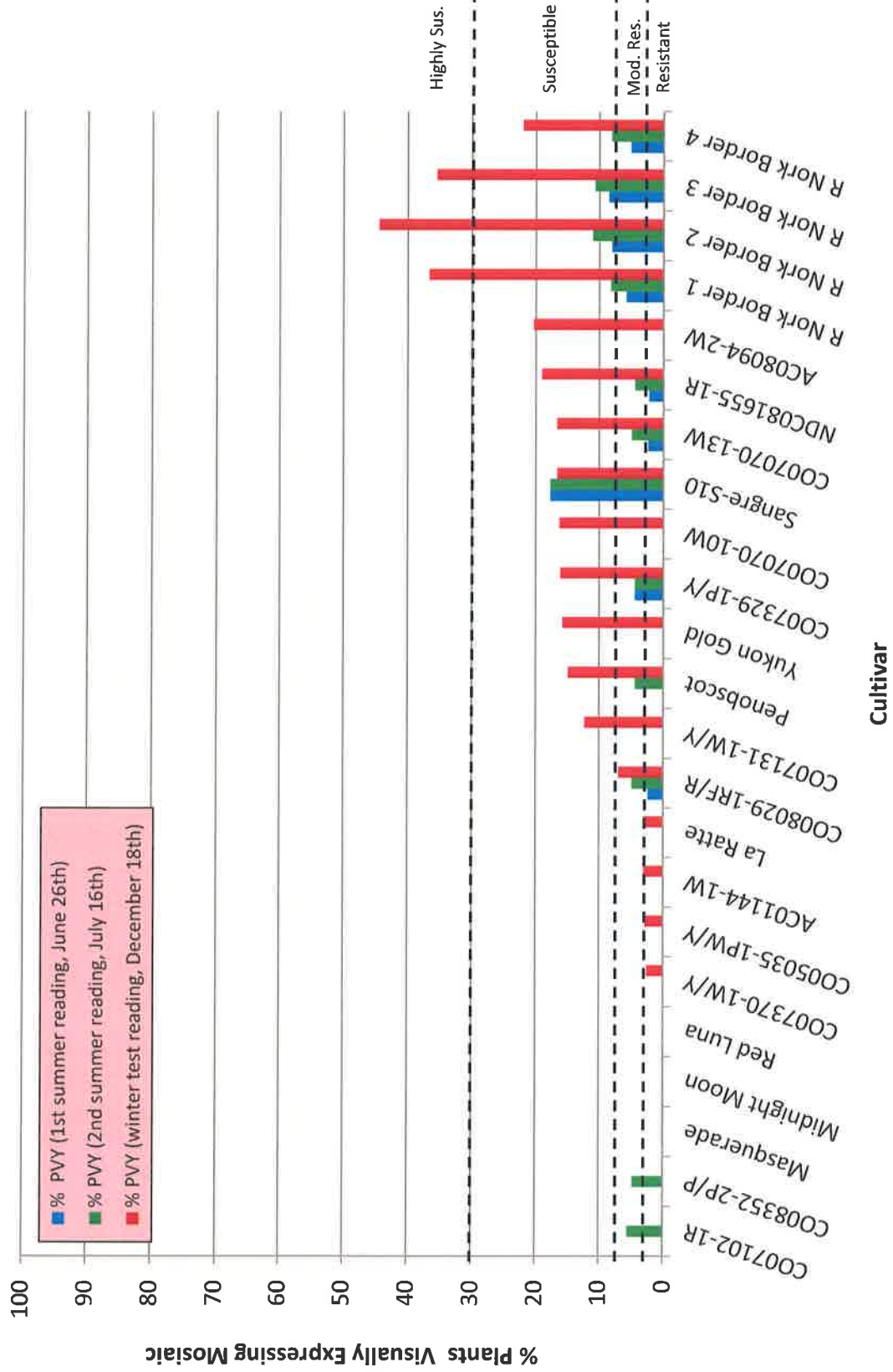
^eVisual symptom expression (1-5; 1 = very difficult to see mosaic symptoms, 5 = easy to see mosaic symptoms). Where more than one rating is given, two or more strains of PVY are present in the sample. These ratings were determined at the winter test plots in Hawaii. Due to environmental differences, visual symptom expression may be different in the SLV.

Means followed by the same letters are not significantly different at P=0.05.

2015 Evaluation of Potato Cultivars for PVY Susceptibility, San Luis Valley, CO (Russets)



2015 Evaluation of Potato Cultivars for PVY Susceptibility, San Luis Valley, CO (Specialties)



2015 Bacterial Ring Rot Clonal Evaluation

There were a total of 43 different cultivars evaluated for bacterial ring rot expression in 2015. Overall, new clones from the breeding program expressed ring rot symptoms in the foliage prior to the 90 Days After Planting (DAP) threshold. Ninety DAP is the standard for determining whether or not a given seed lot contains any plants that are infected with ring rot. This trial confirms that new potato clones from the breeding program, when grown under SLV conditions, will express ring rot within the 90 day timeframe.

EVALUATION OF ADVANCED CLONES FOR SYMPTOM EXPRESSION TO BACTERIAL RING ROT, 2015

- Researchers:** Andrew J. Houser & Robert D. Davidson (advisory role), Colorado State University
- Location:** San Luis Valley Research Center, Center, CO
- Objective:** To evaluate the symptom expression of advanced potato clones to bacterial ring rot, caused by *Clavibacter michigenensis* ssp. *Sepedonicus* (Cms).
- Seed:** Fourteen potatoes (seven were inoculated with Cms and seven were uninoculated) were evaluated per cultivar per replication.
- Inoculation Protocol:** Twenty one cut seed pieces per clone were placed in a Cms solution for five minutes on May 11th, 2015.
- Cultivars:**
- | | |
|---------------------|------------------------|
| 1. AC01144-1W | 23. A03921-2 |
| 2. AC08094-2W | 24. A06021-1T |
| 3. CO08029-1RF/R | 25. A06914-3CR |
| 4. CO08065-2RU | 26. AO03123-2 |
| 5. CO08155-2RU/Y | 27. AOR06070-1KF |
| 6. CO08231-1RU | 28. POR06V12-3 |
| 7. CO08352-2P/P | 29. NDA050237B-1R |
| 8. NDC081655-1R | 30. A05180-3PY |
| 9. CO07015-4RU | 31. COA07365-4RY |
| 10. CO07049-1RU | 32. A05182-7Y |
| 11. CO07070-10W | 33. NDA081451CB-1CY |
| 12. CO07070-13W | 34. Pacific Russet |
| 13. CO07102-1R | 35. CO86030-1RU |
| 14. CO07131-1W/Y | 36. CO86153-2RU |
| 15. CO07329-1P/Y | 37. WNC230-14RU |
| 16. CO07370-1W/Y | 38. Centennial Russet |
| 17. AC05039-2RU | 39. Russet Burbank |
| 18. CO05028-4P/PY | 40. Russet Norkotah-S3 |
| 19. CO05028-11P/RWP | 41. Sangre-S10 |
| 20. CO05035-1PW/Y | 42. Ute Russet |
| 21. AC05175-3P/Y | 43. Katadin |
| 22. A03141-6 | |
- Plant Date:** May 12, 2015 (by hand)
- Plot Design:** Randomized complete block
- Plot Size:** 1-14 foot row per trt per replication (7 ft are inoculated with Cms, 7 ft are uninoculated).
- Plant Spacing:** 12 inches
- Row Spacing:** 34 inches
- Replications:** Three
- Irrigation:** Solid set sprinkler, rate based on ET
- Fertilizer:** 80N-60P-0K-25S-2.5Z, preplant
- Herbicide:** Dual Magnum @ 1.25 pt/A + Sencor @ 0.17 lb/A + Eptam @ 4.0 pt/A + Matrix @ 1.5 oz/A
- Insecticide:** None
- Fungicide:** None
- Vine Killer:** Vines allowed to die naturally.
- Harvest:** September 30, 2015 (by hand)
- Symptoms:** ED = Early Dwarf, R = Rossette, IVC = Interveinal Chlorosis, IVN = Interveinal Necrosis, MN = Marginal Necrosis, W = Wilt
- Data Collection:** Plants were evaluated for ring rot symptom expression on the following dates: July 13 (62 DAP), July 31 (80 DAP), August 7 (87 DAP), August 14 (94 DAP), August 21 (101 DAP), August 27 (107 DAP), September 4 (115 DAP). A sample of 10 tubers collected from symptomatic plants were harvested and evaluated for ring rot tuber symptoms on September 30, 2015.

Table 1. Clonal Evaluation for Foliar Ring Rot Symptom Expression, Colorado State University, SLV Research Center, Center, CO, 2015.

Treatment	DAP to 1st symptom ^a		# Reps Positive ^b		# Plants Positive ^c		% Plants Positive ^d		DAP 50% or more Positive ^e		Total # Reps Positive ^f		% Plants Positive at 101 DAP ^g		Summary of Symptoms ^h	
	62	2	2	3	3	14.3	3	14.3	94	3	3	71.4	All	71.4	All	
1. AC01144-1W	62	2	2	3	3	14.3	3	14.3	94	3	3	71.4	All	71.4	All	
2. AC08094-2W	62	1	1	6	6	28.6	6	28.6	87	3	3	71.4	All	71.4	All	
3. CO08029-1RF/R	62	1	1	2	2	9.5	2	9.5	101	3	3	52.4	All	52.4	All	
4. CO08065-2RU	62	3	3	5	5	23.8	5	23.8	87	3	3	66.7	All	66.7	All	
5. CO08155-2RU/Y	62	3	3	9	9	42.9	9	42.9	80	3	3	100.0	All	100.0	All	
6. CO08231-1RU	62	2	2	2	2	10.0	2	10.0	94	3	3	66.7	All	66.7	All	
7. CO08352-2P/P	62	3	3	7	7	33.3	7	33.3	80	3	3	71.4	All	71.4	All	
8. NDC081655-1R	62	3	3	10	10	50.0	10	50.0	62	3	3	75.0	All	75.0	All	
9. CO07015-4RU	62	2	2	4	4	19.0	4	19.0	87	3	3	61.9	All	61.9	All	
10. CO07049-1RU	62	2	2	10	10	47.6	10	47.6	87	2	2	71.4	All	71.4	All	
11. CO07070-10W	62	3	3	9	9	45.0	9	45.0	80	3	3	100.0	All	100.0	All	
12. CO07070-13W	62	2	2	2	2	10.0	2	10.0	94	3	3	65.0	All	65.0	All	
13. CO07102-1R	62	2	2	3	3	18.8	3	18.8	94	3	3	78.9	All	78.9	All	
14. CO07131-1W/Y	80	4	4	4	4	25.0	4	25.0	87	3	3	62.5	All	62.5	All	
15. CO07329-1P/Y	62	2	2	5	5	25.0	5	25.0	80	3	3	65.0	All	65.0	All	
16. CO07370-1W/Y	62	2	2	4	4	19.0	4	19.0	107	3	3	47.6	All	47.6	All	
17. AC05039-2RU	62	2	2	4	4	19.0	4	19.0	94	3	3	66.7	All	66.7	All	
18. CO05028-4P/PY	80	7	7	7	7	33.3	7	33.3	94	3	3	71.4	All	71.4	All	
19. CO05028-11P/RWP	62	1	1	2	2	9.5	2	9.5	94	3	3	57.1	All	57.1	All	
20. CO05035-1PW/Y	62	2	2	6	6	28.6	6	28.6	94	3	3	66.7	All	66.7	All	
21. AC05175-3P/Y	80	3	3	3	3	14.3	3	14.3	-	-	-	47.6	All	47.6	All	
22. A03141-6	62	1	1	2	2	10.0	2	10.0	101	3	3	50.0	All	50.0	All	
23. A03921-2	62	2	2	4	4	20.0	4	20.0	80	3	3	75.0	All	75.0	All	
24. A06021-1T	62	2	2	6	6	28.6	6	28.6	87	3	3	60.0	All	60.0	IVC,ED,R,W	
25. A06914-3CR	62	2	2	2	2	10.0	2	10.0	94	3	3	90.5	All	90.5	All	
26. A003123-2	62	2	2	2	2	9.5	2	9.5	-	-	-	28.6	All	28.6	All	
27. AOR06070-1KF	87	1	1	1	1	4.8	1	4.8	80	3	3	100.0	All	100.0	All	
28. POR06V12-3	62	3	3	10	10	47.6	10	47.6	80	3	3	57.1	All	57.1	All	
29. NDA050237B-1R	62	3	3	7	7	33.3	7	33.3	101	3	3	76.2	All	76.2	ED,R,W	
30. A05180-3PY	62	3	3	7	7	33.3	7	33.3	87	3	3	71.4	All	71.4	IVC,ED,R,W	
31. COA07365-4RY	62	2	2	4	4	19.0	4	19.0	87	3	3	28.6	All	28.6	All	
32. A05182-7Y	62	3	3	11	11	52.4	11	52.4	62	3	3	76.2	All	76.2	All	
33. NDA081451CB-1CY	62	1	1	1	1	4.8	1	4.8	-	-	-	76.2	All	76.2	All	
34. Pacific Russet	62	3	3	8	8	38.1	8	38.1	80	3	3	100.0	All	100.0	All	
35. CO86030-1RU	62	2	2	4	4	20.0	4	20.0	94	3	3	42.9	All	42.9	All	
36. CO86153-2RU	62	3	3	9	9	42.9	9	42.9	80	3	3	76.2	All	76.2	All	
37. WNC230-14RU	62	1	1	4	4	19.0	4	19.0	-	-	-	94	All	94	All	
38. Centennial Russet	62	1	1	2	2	9.5	2	9.5	94	3	3	62	All	62	All	
39. Russet Burbank	62	3	3	13	13	61.9	13	61.9	62	3	3	100.0	All	100.0	All	
40. Russet Norkotah-S3	62	3	3	16	16	76.2	16	76.2	62	3	3	47.6	All	47.6	All	
41. Sangre-S10	62	1	1	2	2	9.5	2	9.5	115	3	3	42.9	All	42.9	All	
42. Ute Russet	62	2	2	6	6	28.6	6	28.6	107	3	3	42.1	All	42.1	All	
43. Katadin	62	2	2	5	5	26.3	5	26.3	-	-	-	-	-	-	-	

^aNumber of days after planting (DAP) when the first foliar ring rot symptoms were observed.

^bNumber of replications that had plants expressing symptoms when symptoms were first observed.

^cTotal number of plants expressing symptoms when symptoms were first observed.

^dTotal percent of plants expressing symptoms when symptoms were first observed.

^eNumber of DAP when the >50% of the inoculated plants were expressing foliar ring rot symptoms.

^fNumber of replications that had >50% inoculated plants expressing symptoms when symptoms were first observed.

^gTotal percent of plants expressing symptoms at 101 DAP.

^hAll foliar ring rot symptoms that were observed throughout the 2015 growing season.

Table 2. Clonal Evaluation for Ring Rot Symptom Expression in Potato Tubers, Colorado State University, SLV Research Center, Center, CO, 2015.

Clone	# reps positive ^a	# tubers positive ^b	% tubers positive ^c	External (E) or Internal (I) Symptoms ^d
1. AC01144-1W	-	-	-	-
2. AC08094-2W	-	-	-	-
3. CO08029-1RF/R	1	1	5.0	both
4. CO08065-2RU	1	2	10.0	E & I
5. CO08155-2RU/Y	1	1	5.0	both
6. CO08231-1RU	1	1	5.0	E
7. CO08352-2P/P	-	-	-	-
8. NDC081655-1R	-	-	-	-
9. CO07015-4RU	1	1	5.0	both
10. CO07049-1RU	-	-	-	-
11. CO07070-10W	2	5	25.0	both
12. CO07070-13W	1	2	10.0	both
13. CO07102-1R	-	-	-	-
14. CO07131-1W/Y	-	-	-	-
15. CO07329-1P/Y	-	-	-	-
16. CO07370-1W/Y	1	3	15.0	both
17. AC05039-2RU	-	-	-	-
18. CO05028-4P/PY	-	-	-	-
19. CO05028-11P/RWP	-	-	-	-
20. CO05035-1PW/Y	2	2	10.0	both
21. AC05175-3P/Y	1	1	5.0	both
22. A03141-6	-	-	-	-
23. A03921-2	-	-	-	-
24. A06021-1T	-	-	-	-
25. A06914-3CR	-	-	-	-
26. AO03123-2	1	1	5.0	both
27. AOR06070-1KF	-	-	-	-
28. POR06V12-3	-	-	-	-
29. NDA050237B-1R	-	-	-	-
30. A05180-3PY	-	-	-	-
31. COA07365-4RY	-	-	-	-
32. A05182-7Y	-	-	-	-
33. NDA081451CB-1CY	-	-	-	-
34. Pacific Russet	-	-	-	-
35. CO86030-1RU	-	-	-	-
36. CO86153-2RU	1	1	5.0	internal
37. WNC230-14RU	-	-	-	-
38. Centennial Russet	1	1	5.0	external
39. Russet Burbank	1	1	5.0	both
40. Russet Norkotah-S3	1	1	5.0	both
41. Sangre-S10	-	-	-	-
42. Ute Russet	-	-	-	-
43. Katadin	-	-	-	-

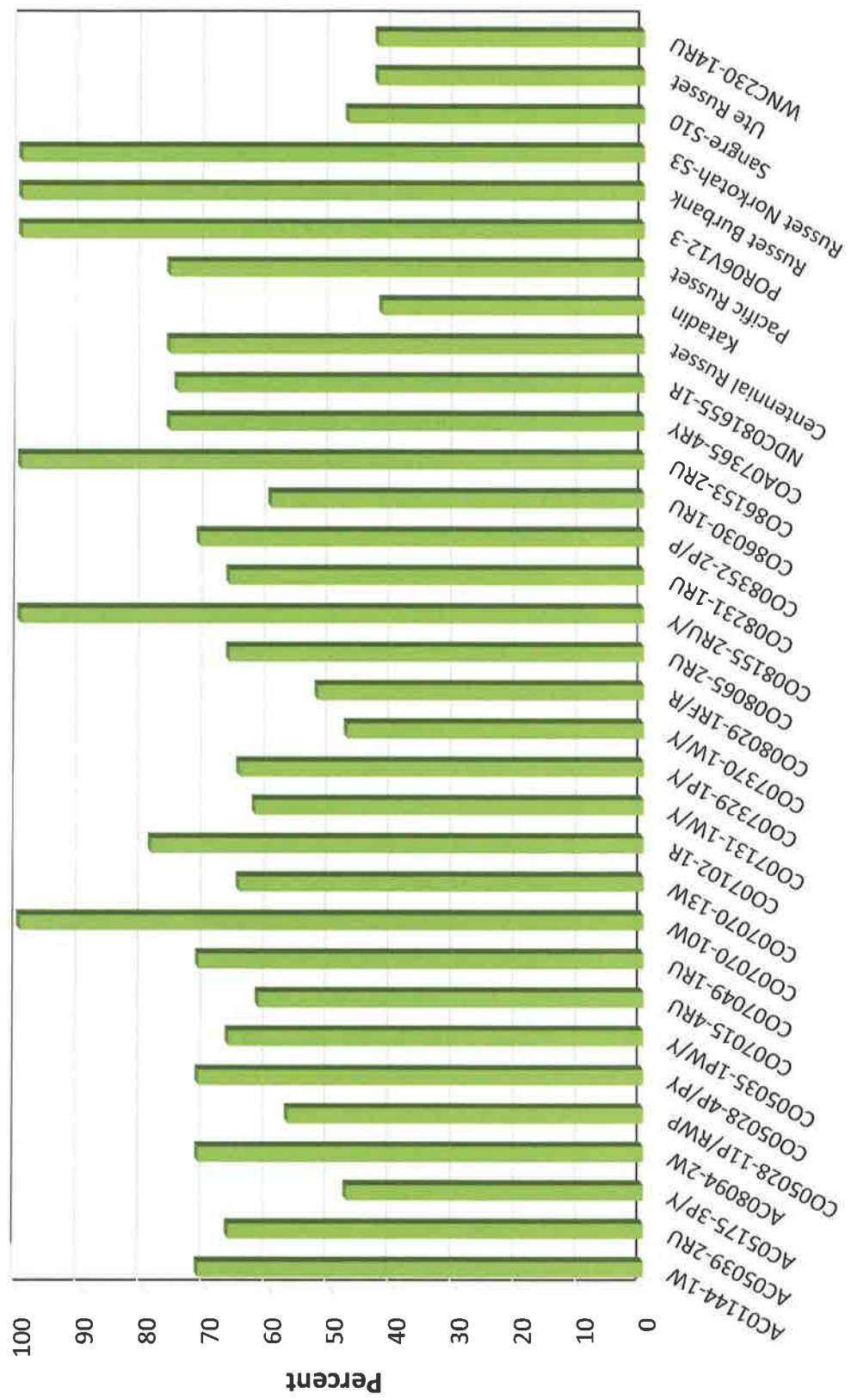
^aNumber of replications that had tubers expressing ring rot symptoms at harvest.

^bNumber of tubers that were expressing ring rot symptoms at harvest, sum of two replications.

^cPercent tubers that were expressing ring rot symptoms at harvest, sum of two replications.

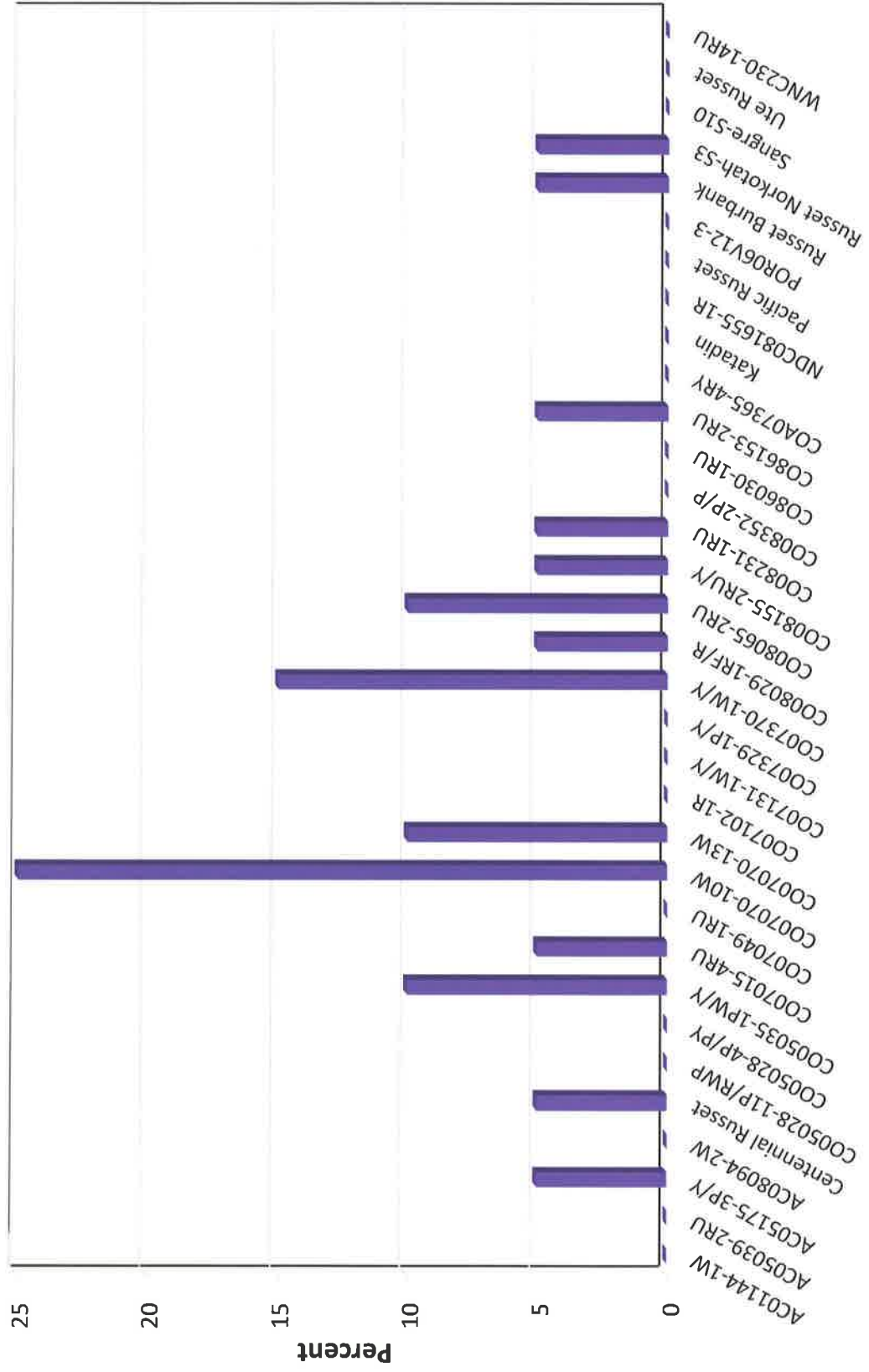
^dTuber symptoms that were visible at harvest; External tuber symptoms, Internal tubers symptoms, or both.

2015 Bacterial Ring Rot Trial - Average Percent of Plants Visually Expressing Ring Rot Symptoms at 101 DAP (San Luis Valley, CO)



Potato Cultivar

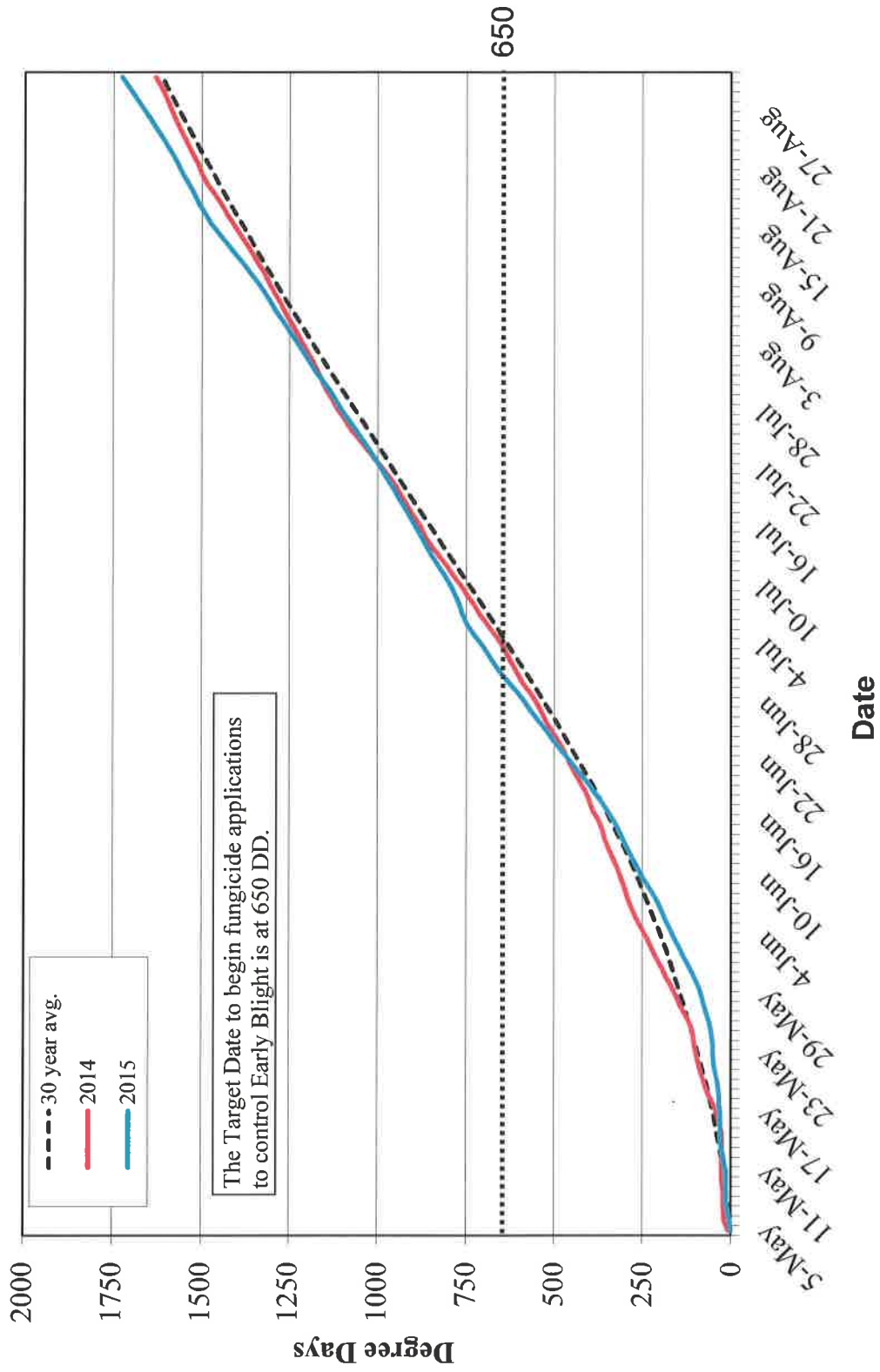
2015 Bacterial Ring Rot Trial - Average Percent of Tubers with Ring Rot Symptoms at Harvest (San Luis Valley, CO)



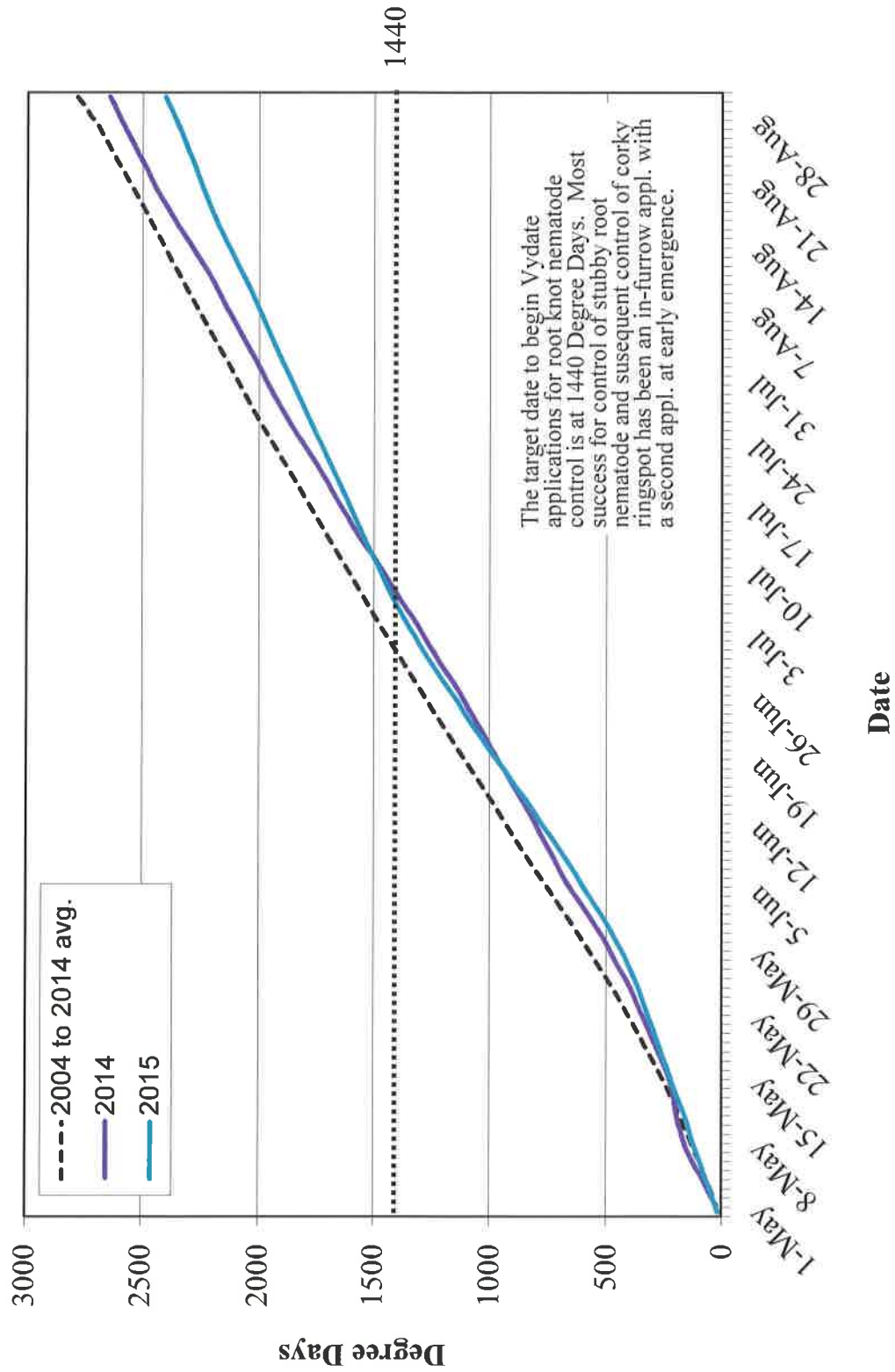
2015 Early Blight, Root-Knot Nematode, and Late Blight Degree Day Reporting

For early blight, the threshold to apply fungicides was reached on July 1st, which was ahead of the 30 year average and three days ahead of the 2014 degree day threshold. For Root-Knot Nematode management, the 1440 DD threshold was reached on July 9th in 2015. This was six days later than the running 10 year average and was reached on the same day as 2014. For late blight, monitoring was continued in 2015 in the Blanca, Hooper, and Sargent areas. An additional monitoring station was set up at the SLV Research Center as well. Conditions favorable for late blight were reached in early July for Sargent, Hooper and the SLVRC. Due to technical issues with the monitoring station at the Blanca site, data collection at this location did not start until July 9th. This is earlier than findings from previous years and should continue to be monitored in 2016.

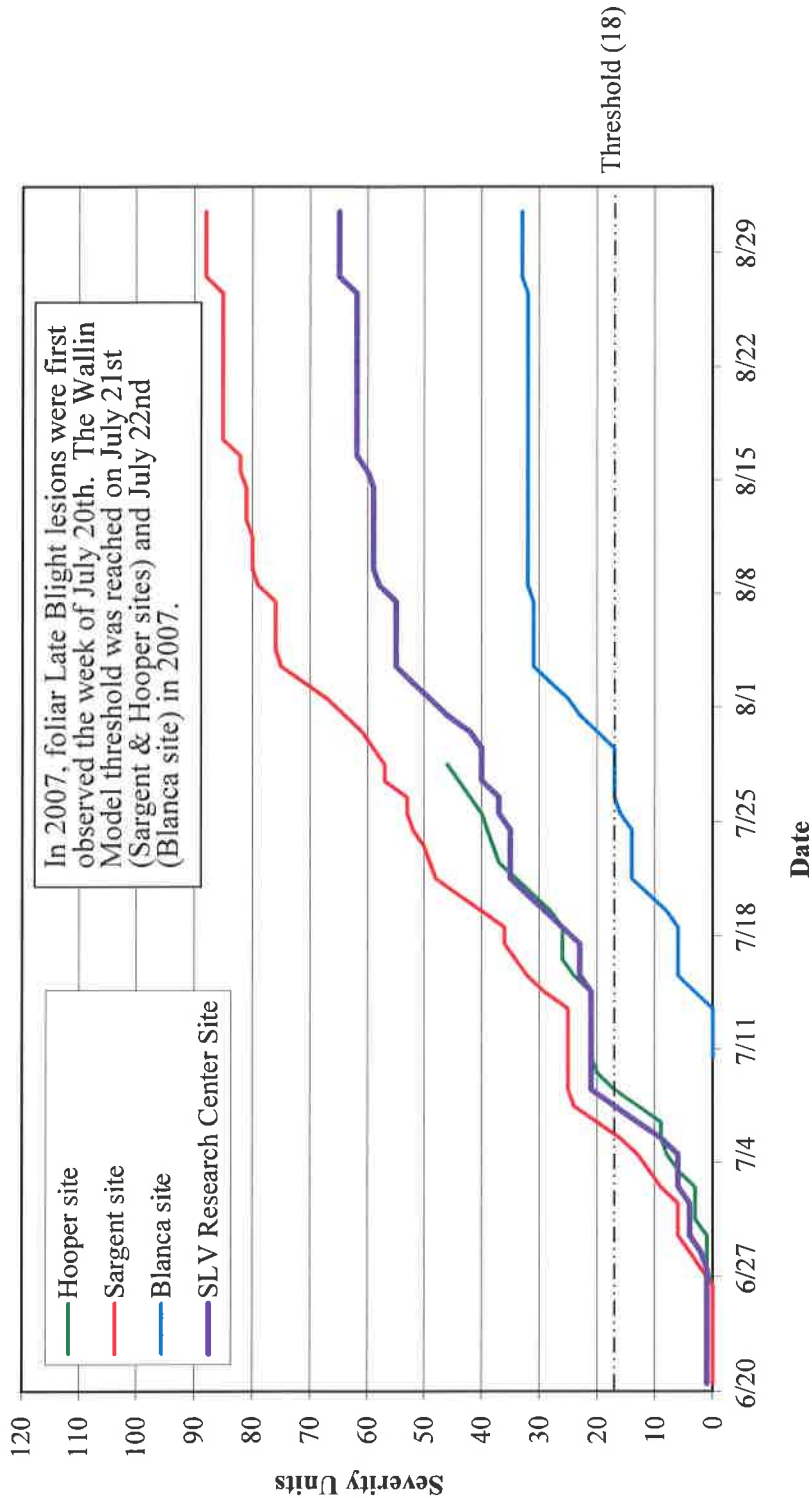
**Early Blight Degree Days for the San Luis Valley, 2014 & 2015
 Temperature Data Collected from the CoAgMet Station Located at the SLV Research Center**



**Root Knot Nematode Degree Days for the San Luis Valley, 2014 & 2015
Soil Temp. Data Collected from the Watchdog Station at the SLV Research Center, 8 in. depth**



Potato Late Blight Severity Values - Wallin Model, San Luis Valley, Colorado, 2015



Footnote:

- The Sargent weather station began collecting data on June 18, 2015. Conditions favorable for Late Blight were reached on July 6th.
- The Hooper weather station began collecting data on June 19, 2015. Conditions favorable for Late Blight were reached on July 8th.
- The Blanca weather station began collecting data on July 9, 2015. Conditions favorable for Late Blight were reached on July 30th, due to a late starting date.
- The San Luis Valley Research Center station began collecting data on June 16, 2015. Conditions favorable for Late Blight were reached on July 6th.