The Evaluation of Ringrot Symptom Development in Selected Potato Clones

Summary of 1983 Results and Research Proposal for 1984

G.D. Franc and M.D. Harrison

Summary of 1983 Results (see attached detailed report for additional information)

Clones WNC672-2, WNC285-18, BC9289-1, WNC521-12, AC71861-4, Sangre, WNC230-14, Centennial and Russet Burbank were inoculated with Corynebacterium sepedonicum and evaluated for foliar and tuber ringrot symptom development in the San Luis Valley.

Foliar symptoms were evident in all clones except WNC285-18, BC9289-1 and WNC230-14 on July 19. However, all clones had foliar symptoms evident on August 11.

All clones produced tubers with surface cracking typical of ringrot infection with the exception of BC9289-1 in which tubers had to be cut open before symptoms could be observed. Few tubers with symptoms were observed for clones WNC285-18 and BC9289-1. Although clones WNC521-12 and WNC230-14 had more infected tubers evident than clones WNC285-18 and BC9289-1, fewer tubers with symptoms were found than for the remainder of the clones.

Research Proposal for 1984

Seven or eight promising numbered clones and new varieties will be inoculated with the ringrot bacterium and planted in replicate plots to determine their reaction to ringrot infection in the San Luis Valley. Varieties with known ringrot reactions, including Russet Burbank (early dwarf reaction), Sangre (normal reaction) and WNC230-14 (resistant reaction) will be included as controls. Data will be collected on the effect of inoculation on plant

stands, the time of earliest symptom expression and types of symptoms expressed for both foliage and tubers.

Proposed numbered clones and new varieties to be included in the test are:

1. AC77652-1
2. TC2-1
3. WNC567-1
4. Nooksack
5. WNC672-2
6. WNC285-18
7. A72685-2
8. WNC521-12 (possibly if space and resources allow).

Proposed Budget

Plot Maintenance and Supplies	$600.00
Labor	450.00
Travel	500.00
Supplies	100.00
Total	$1650.00

The Evaluation of Ringrot Symptom Development in Selected Potato Clones

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Abstract

Clones WNC672-2, WNC285-18, BC9289-1, WNC521-12, AC71861-4, Sangre, WNC230-14, Centennial and Russet Burbank were inoculated with Corynebacterium sepedonicum and evaluated for foliar and tuber ringrot symptom development in the San Luis Valley, CO.

Foliar symptoms were evident for all clones on July 19 except for clones WNC285-18, BC9289-1 and WNC230-14. However, all clones had foliar symptoms evident on August 11.

All clones developed tubers with surface cracking typical of ringrot infection with the exception of BC9289-1 in which tubers had to be cut open before symptoms could be observed. Few tubers with symptoms were observed for clones WNC285-18 and BC9289-1. Although clones WNC521-12 and WNC230-14 had more infected tubers evident than for clones WNC285-18 and BC9289-1, fewer tubers with symptoms were found than for the remainder of the clones.

Materials and Methods

Seed potatoes for clones WNC672-2, WNC285-18, BC9289-1, WNC521-12, AC71861-4, Sangre, WNC230-14, Centennial and Russet Burbank were obtained from the San Luis Valley Research Center near Center, CO.

The experiment was done in a field plot ca 81 ft long by 12 rows wide. The clones were inoculated and planted on May 18, 1983 into pre-irrigated soil. Rows were opened immediately prior to planting and pre-plant fertilizer was deposited.

Clones were inoculated by placing cut seedpieces into either sterile water (treatment A) or sterile water to which macerated tuber tissue had been added (treatment B). The macerate was prepared from infected tubers with evident ringrot symptoms. Infected tubers were provided by Dr. Franklin Manzer. Additional ringrot inoculum was added to the sterile water plus tuber macerate by washing Corynebacterium sepedonicum (ringrot bacterium isolate Cs43) cells from spread plate cultures grown on nutrient-dextrose agar. All treatment A seedpieces were planted prior to the treatment B seedpieces. Seedpieces were covered by soil within 5 min after planting.

The field plot was planted in a randomized complete block design consisting of nine clones, two treatments per clone and three replications. Individual treatment plots consisted of seven treated seedpieces (planted at 1 ft spacing) followed by three Red McClure seedpieces. Individual treatment plots were 9 ft long. The field plot was weeded by hand and furrow-irrigated throughout the growing season. The field plot plan used is illustrated in Figure 1.

Treatment plots were observed periodically throughout the growing season. A stand count was made on June 14. At this time and on June 25 some frost damage was evident on the potato plants. Plants that developed typical symptoms in the field were flagged at the time of observation. On August 25 and September 14 tubers were also evaluated for visual symptom development.

Results

The stand counts determined on June 14 are shown in Table 1. An ideal stand of 7 plants only occurred for clones BC9289-1 (water only) and AC71861-4 (water + C. sepedonicum). Although some variation in

	← 12 rows →						↓ ↑ 9 feet
	8A	7B	1B	6A	9A	1A	
Rep. 1	5B	9B	3A	4A	2B	8B	
	4B	6B	3B	5A	2A	7A	
	7B	1B	8A	5B	8B	5A	
Rep. 2	6B	3B	2A	4A	6A	2B	
	1A	9A	3A	9B	7A	4B	
	1A	6A	7B	8B	5B	2A	
Rep. 3	4B	1B	2B	9A	4A	8A	
	6B	9B	7A	3A	5A	3B	

Figure 1. Field plot plan used for the evaluation of foliar ringrot symptom development in selected potato clones, Center, CO, 1983. Clones tested were: 1) WNC672-2, 2) WNC285-18, 3) BC9289-1, 4) WNC521-12, 5) AC71861-4, 6) Sangre, 7) WNC230-14, 8) Centennial and 9) Russett Burbank. Each 9 ft plot consisted of seven treated seedpieces followed by three Red McClure spacers. Treatments were inoculation with: A) water alone or B) water containing Corynebacterium sepedonicum (ringrot bacterium).

stand counts was seen the stand effects were due to the clones themselves rather than inoculation treatment. Evidence for this is the average stand for all clones was 6.1 plants regardless of inoculation treatment.

Data for the development of foliar symptoms are shown in Table 2. All clones except WNC285-18, BC9289-1 and WNC230-14 had foliar ringrot symptoms evident on July 19. The symptoms in Centennial, although evident, were considered weak because very few leaves showed strong symptoms at this time. The early dwarfing symptom in Russet Burbank was visible on July 19 and plants flagged at this time were dead by August 11. By August 11 the clones, previously symptomless on July 19, all had at least one plant with foliar ringrot symptoms evident. All C. sepedonicum inoculated clones (treatment B) had a positive stem squeeze for at least one plant during mid to late August.

All clones, except perhaps BC9289-1, had tubers with typical ringrot symptoms on September 14 (Table 3). Typical symptoms were visible tuber cracking and vascular squeeze after tubers were cut. Clone BC9289-1 had no tubers with tuber cracking evident and infected tubers were evident only after cutting. Clone WNC285-18 had few tubers with typical ringrot symptoms and these tubers were found under flagged plants only.

Discussion

The seedpieces inoculated with C. sepedonicum were exposed to more concentrated inoculum than in previous years since both macerated tuber tissue from infected tubers and cultured C. sepedonicum cells were used as a combined inoculum source. Previously, only macerated tuber tissue had been used. However, marked differences in symptom development were not evident for 1983 when compared to previous years.

Table 1. Stand count data for ringrot clone screening test; Center, CO, June 14, 1983.

Clone tested	Seedpiece inoculation treatment[1,2]	
	Water only	Water + C. sepedonicum
1) WNC672-2	6.0	5.3
2) WNC285-18	4.3	4.7
3) BC9289-1	7.0	6.3
4) WNC521-12	6.3	6.0
5) AC71861-4	6.0	7.0
6) Sangre	6.7	6.0
7) WNC230-14	6.7	6.7
8) Centennial	5.3	6.0
9) Russet Burbank	6.7	6.7
Average stand	6.1	6.1

[1] Seven seedpieces were treated and planted for each replication on May 18, 1983. Each datum entry is the average of three replications.

[2] Cut seedpieces were inoculated by placing into water only or water to which macerated tuber tissue prepared from ringrot had been added. Culture medium on which C. sepedonicum isolate Cs43 was growing was also added to the prepared inoculum.

Table 2. The development of typical foliar ringrot symptoms in inoculated potato clones, Center, CO, 1983[1].

Clone tested	Observations for the presence (+) or absence (-) of foliar ringrot symptoms in the field:		
	July 19	August 11	Symptoms observed (August 11)[3]
1) WNC672-2	+	+	IVC, IVN, W
2) WNC285-18	-	+ W[2]	IVC
3) BC9289-1	-	+ W[2]	IVC, W
4) WNC521-12	+	+	IVC, IVN, MN
5) AC71861-4	+	+	IVC, GC, GN, W
6) Sangre	+	+	IVC, IVN, GC, W[4]
7) WNC230-14	-	+	IVC[5]
8) Centennial	+ W[2]	+	IVC, GC, W[6]
9) Russet Burbank	+	+	IVC, GC, GN, W, ED

[1] Cut seedpieces (7 seedpieces x 3 replications) for each clone were inoculated with pathogenic Corynebacterium sepedonicum cells. Seedpieces inoculated with sterile water only were used to compare plants developing foliar ringrot symptoms.

[2] Foliar symptoms designated as "+W" were considered weak, although definitely present, because symptoms were not markedly distinct or because only a limited number of plants displayed foliar symptoms.

[3] Designations used are: IVC: interveinal chlorosis; IVN: interveinal necrosis; GC: general chlorosis; GN: general necrosis; MN: marginal necrosis of leaflets; W: wilt; ED: early dwarfing.

[4] Interveinal necrosis symptoms were much more visible on July 19 than on August 11.

[5] A positive stem squeeze was evident for plants with visible foliar symptoms as well as for some plants without symptoms.

[6] Interveinal chlorosis evident only on a limited number of leaves.

Table 3. The development of typical ringrot symptoms for tubers harvested from inoculated potato clones, Center, CO, 1983.

Clone tested	Presence (+) or absence (-) of tuber ringrot symptoms (September 14, 1983)[1,2]
1) WNC672-2	+ 2
2) WNC285-18	+ 1[3]
3) BC9289-1	+ 1[4]
4) WNC521-12	+ 2[5]
5) AC71861-4	+ 3
6) Sangre	+ 3
7) WNC230-14	+ 2[6]
8) Centennial	+ 3
9) Russet Burbank	+ 3

[1] Typical ringrot tuber symptoms observed were cracking of the tuber surface and a vascular squeeze of cut tubers.

[2] Tuber symptom development was rated on a scale of +1 to +3. Many tubers with obvious symptoms were rated as "+3." Few tubers with ringrot symptoms evident (symptom development weak) were rated as "+1."

[3] Few tubers with typical symptoms were found. Symptomatic tubers were only found under plants previously displaying foliar symptoms.

[4] No tuber surface cracking evident. Tubers with symptoms were found only after cutting open.

[5] Tubers with symptoms were only found under plants previously displaying foliar symptoms.

[6] Tubers were found under inoculated plants both with and without previous foliar symptoms.

Most clones developed foliar symptoms at approximately the same time. Symptom development in clones WNC285-18, BC9289-1, and WNC230-14 required longer time. Early dwarfing symptoms were evident in Russet Burbank on July 19 and many of these plants were dead by August 11 unlike for the other clones. Therefore, Russet Burbank early dwarfing symptoms were probably visible before July 19. Infected Russet Burbank plants developed much more obvious interveinal chlorosis symptoms in 1983 than in the previous three years as well as general wilting, chlorosis, and necrosis. Other ringrot plots in the San Luis Valley showed that ringrot symptom expression was very strong in 1983.

Symptoms for Sangre were extensive wilt with general chlorosis in many plants with strong interveinal chlorosis and necrosis evident in fewer plants. Tuber symptoms were very evident and many were extensively decayed by September 14. It was assumed decay was due to ringrot since water-inoculated plots were not similarly decayed.

A limited number of Centennial plants developed foliar interveinal chlorosis symptoms typical of ringrot. Infected plants more commonly had leaves on single stems wilted or flagging of stems evident with much of the plant appearing healthy. The same observation was made in 1983 in other ringrot plots at the same field location inoculated solely with the Cs43 ringrot isolate. Since the clone testing plots received mixed inoculum (isolate Cs43 plus macerate from infected tubers) it does not appear to be an effect of the inoculum source on symptom expression but more likely that symptom expression in Centennial can be very subtle under the same conditions it is quite evident in other clones. Many typical tuber symptoms were found for Centennial indicating many plants had been infected during the course of the growing season.

Symptom expression (interveinal chlorosis) was observed on August 11, but not July 19, for a limited number of plants for clone WNC230-14 in which symptoms are commonly latent. Positive stem squeezes were observed for plants with typical symptoms as well as for plants appearing healthy. Typical tuber symptoms were observed under plants both with and without foliar symptoms evident during the growing season.

Clones WNC285-18 and BC9289-1 also appeared healthy on July 19 and had limited foliar symptoms evident on August 11. Clone WNC285-18 had few tubers with typical symptoms and these were only found under flagged plants. Tubers with surface cracking were not found for BC9289-1 and symptoms were evident only after cutting tubers open.

Generally, clones with delayed foliar symptoms also had fewer tubers with typical symptoms evident.