

Research Summary for 1985

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- I) Yield comparisons in the San Luis Valley between leafroll infected plants, plants adjacent to those infected plants and healthy plants nearby.

In 1983, 84, and 85 Centennial Russet and Russet Burbank fields with known infections of potato leafroll virus were sampled. Overall tuber weights per hill and an estimated weight per tuber were taken from the leafroll infected plants, the plants adjacent to these and healthy plants nearby. Several factors have become evident through these studies and will be discussed in relation to Tables 1, 2, and 3.

Table 1: Average number of tubers per plant

	<u>CR (83)</u>	<u>(84)</u>	<u>(85)</u>	<u>(85)</u>	<u>RB (83)</u>	<u>(85)</u>
PLRV plants	6.8	6.3	8.3	5.6	8.5	9.0
Adjacent plants	8.3	10.5	9.1	7.5	7.9	9.9
Healthy plants	9.7	12.0	12.7	9.0	9.3	11.5

Table 2: Average weight per plant (pounds)

	<u>CR (83)</u>	<u>(84)</u>	<u>(85)</u>	<u>(85)</u>	<u>RB (83)</u>	<u>(85)</u>
PLRV plants	1.2	1.5	1.6	1.0	1.4	1.4
Adjacent plants	2.6	2.9	3.1	2.4	3.5	3.6
Healthy plants	2.9	3.3	4.0	2.7	4.0	4.3

Table 3: Percentage of tubers 6 ounce and over (Average/plant)

	<u>CR (83)</u>	<u>(84)</u>	<u>(85)</u>	<u>(85)</u>	<u>RB (83)</u>	<u>(85)</u>
PLRV plants	4%	12%	0%	4%	10%	5%
Healthy plants	45%	31%	37%	35%	53%	43%

There are substantial yield reductions occurring in the plants infected with leafroll versus the healthy plants (in the range of 55-65% per plant). Tubers in the 2 or 3 ounce range are two to three times more likely to occur under a leafroll infected plant than under a healthy plant. Also, there is a conspicuous absence of tubers 6 ounce and over under the leafroll infected plants. These tubers can account for 30 to 50% of the total yield on a healthy plant. Thus, on a per plant basis, a leafroll infected plant has from 20-40% fewer tubers in the 6 ounce and over range than the healthy plant.

There is a difference between adjacent plant yields and healthy plant yields with the adjacent plants yielding an average of 14% lower than the healthy plants. This relationship appears to hold true from year to year and would indicate that these adjacent plants do not help to make up the yield losses suffered due to leafroll as in the case of adjacent plants next to a blank space.

If a field yields well, the loss due to leafroll may be higher on a per plant basis (due to the larger difference between the infected plant yield versus the healthy plant yield), but the overall yield loss on the field may be proportionately smaller. Example: In 1983 and 1984 the two Centennial Russet fields sampled had approximately the same overall total weight loss per plant at 79%. The total weight lost in 1984 was higher at 2.6# per plant than in 1983 at 2.3# per plant. However, the 1983 field yield was approximately 385 cwt./acre while the 1984 field yield was approximately 400 cwt./acre. Stands and other disease factors were similar between fields.

Lastly, in terms of total loss, a rule of thumb for the San Luis Valley is that a 1% leafroll infection in the field will account for about a 1% yield loss. This rule of thumb takes into account both the loss due to leafroll infected plants and the loss associated with the adjacent plants. While many growers do not feel that a 1% leafroll infection poses a serious economic yield loss, it does pose a serious contamination threat in the field. Also, if the potatoes are saved as dropseed for plant back the following year, the grower faces a 3 fold increase in leafroll without any additional vector spread. This kind of process can quickly escalate a relatively minor problem into a serious economic reality.

II) Studies on aphid preference versus cultivar (Russet Burbank and Centennial Russet), aphid vector present and the timing of the leafroll spread.

In 1984 and 85 plots were designed to examine the possibility that Centennial Russet demonstrates more resistance to leafroll infection than does Russet Burbank. These plots consisted of groups of 5 plants of each cultivar alternated in the row so that a checkerboard pattern existed (see Figure 1). Known leafroll source plants were placed in a row down the middle of the plot to provide an inoculum source for the vectors. If the Centennial Russet plants show a higher resistance to leafroll spread than the Russet Burbank plants then the amount of leafroll in the nearest rows should be higher in the Russet Burbank plants than the Centennial Russet plants.

Figure 1: Plot design

RB	CR	RB	CR	etc.
CR	RB	CR	RB	etc.
RB	CR	RB	CR	etc.
**	**	**	**	PLRV source plants
CR	RB	CR	RB	etc.
RB	CR	RB	CR	etc.
CR	RB	CR	RB	etc.

Both the 1984 and 1985 plots showed a dramatic difference in the amount of leafroll spread. In 1984 Russet Burbank showed a leafroll spread to 14 individual plants as compared with one for Centennial Russet. In 1985 Russet Burbank showed a leafroll spread to 46 individual plants as compared with 9 for Centennial Russet. Most of this spread occurred around the groups of Centennial Russet plants as seen in Figure 2. This is a strong indication that Centennial Russet is not as susceptible to leafroll spread as the Russet Burbank under these field conditions.

Figure 2: Number of plants positive for leafroll within each 5 plant set

RB(0)	CR(0)	RB(1)	CR(0)	etc.
CR(0)	RB(2)	CR(0)	RB(0)	etc.
RB(2)	CR(0)	RB(3)	CR(0)	etc.
**	**	**	**	PLRV source plants
				etc.

Also in 1984 and 85 a project utilizing four blocks of potatoes containing smaller blocks of 25 plants each of the cultivars Centennial Russet and Russet Burbank were examined. Each of the smaller blocks contained either a source plant infected with leafroll or a healthy plant in the center of the block. The larger blocks were harvested at weekly intervals starting the first week of August and continuing until the last week of August. Four tubers per plant were individually harvested and identified. These tubers were then planted in Oceanside and evaluated for leafroll infection. Aphid counts were taken from each individual plant in each block of 25 at the time of kill down. Aphid species were identified (see Table 1) and the relative aphid counts per cultivar were established (see Table 2).

Table 1: Identification of aphid vectors collected at each harvest date

<u>Vector</u>	<u>8/9/84</u>	<u>8/16/84</u>	<u>8/23/84</u>	<u>8/31/84</u>
Green Peach Aphid	18(1%)	15(1%)	1(1%)	--
Potato Aphid	1305(99%)	1274(99%)	89(99%)	--
Total Aphids	1323	1289	90	--
	<u>7/30/85</u>	<u>8/8/85</u>	<u>8/15/85</u>	<u>8/22/85</u>
Green Peach Aphid	171(57%)	526(47%)	52(77%)	6(25%)
Potato Aphid	127(43%)	587(53%)	16(23%)	18(75%)
Total Aphids	298	1113	68	24

Table 2: Mean aphid numbers per plant (Includes all plants within all replications of each cultivar for each harvest date)

<u>Cultivar</u>	<u>8/9/84</u>	<u>8/16/84</u>	<u>8/23/84</u>	<u>8/31/84</u>
Centennial Russet	124	146	7	1
Russet Burbank	173	161	51	1
	<u>7/30/85</u>	<u>8/8/85</u>	<u>8/15/85</u>	<u>8/22/85</u>
Centennial Russet	4	3	55	13
Russet Burbank	4	14	118	11

Readings were taken on the plots grown in Oceanside, Ca. Several important considerations have surfaced as a result of these tests and will be discussed accordingly.

A significant shift in the population of vectors inhabiting the potatoes from 1984 to 1985 was evident. In 1984 essentially 100% of the aphids recovered were potato aphids. In 1985 readings were much closer to a 50-50 split with the green peach aphid becoming the predominant species later in the season. Monitoring aphid species in this way can help establish the type of leafroll spread to be expected and the amount which may occur. Potato aphids tend to be much less efficient at transmitting leafroll than the green peach aphids and cannot carry the virus on their mouth parts and in their bodies for any length of time. Thus, they tend to be implicated

in virus spread occurring intrafield (within the field) rather than interfield (from field to field). Green peach aphid, on the other hand, is an excellent transmitter of leafroll and can carry the virus in the body usually for its individual lifetime. These aphids can spread leafroll both intra and interfield quite easily.

In 1984 the leafroll readings showed that a large majority of the leafroll spread taking place occurred in the plots with a leafroll source plant present. This is consistent with an intrafield type of spread. Also, the plants were infected early in the season (before the first week of August harvest) and the plots showed little change throughout the season, indicating that most of the spread occurred at the earlier time period. The last harvest date indicated more of the non-specific type of leafroll spread (leafroll infected plants in those blocks without a leafroll source plant present) which would be consistent with an interfield type of spread. While we know that both inter and intrafield spread occur in the San Luis Valley, data from 1984 might indicate that serious leafroll spread is taking place in the fields much earlier than anticipated. In order to harvest infected tubers, the virus spread would probably have had to take place 8 days to two weeks earlier than the date of harvest (sometime in mid-July). In many cases, this is prior to the start of grower spray programs for aphid control. There is also an indication that identifying the aphid vector may not be as critical as was previously thought in determining whether or not to spray. Unchecked potato aphids in a field with leafroll source plants present may be just as destructive in terms of leafroll spread as green peach aphids late in the season.

In 1985 the aphid populations peaked one to two weeks later than in 1984 with mid-August showing the highest levels in 1985 versus late July to early August in 1984. This was demonstrated also in the leafroll infection which took place in the plots. Essentially no infection of leafroll was evident in the first two weeks of August. However, by the third week and into the fourth week of August, there was leafroll spread occurring around the leafroll source plants in those plots which had them. The plots without the leafroll source plants showed little or no spread indicating very little interplot spread. Overall the amount of leafroll spread in the plots in 1985 was much less than the amount seen in 1984. This does lead to some interesting questions regarding the attempts to delay aphid populations until the natural maturation factor in potatoes can play a role in susceptibility to leafroll infection and the prospect for better monitoring systems to better predict when aphid populations will peak.

In both 1984 and 1985 Russet Burbank showed up to 8 times more leafroll spread than did Centennial Russet, especially early in the season. This is more substantial evidence that Centennial Russet is more resistant to leafroll spread than Russet Burbank. Also during both 1984 and 1985 there was a significantly lower number of total aphids per plant on the Centennial Russet than on the Russet Burbank plants at the peak of the aphid populations. This might indicate a host preference for Russet Burbank over Centennial Russet. These figures, however, would not explain why there is such an overwhelming difference in the amount of leafroll spread. More than likely, it is a combination of a host preference and a host resistance. Further studies are underway to try and confirm this.

III) Eight clones were evaluated in 1985 for leafroll symptomology. They were infected with leafroll using viruliferous aphids. The daughter tubers produced from these plants were grown in Oceanside, Ca. and compared with healthy plants of the same clone. Pictures were taken of each individual leafroll reaction and ratings were given to each clone (Table 1). These samples will also be grown in the San Luis Valley in 1986 and compared with the reactions seen in California.

Table 1: Clonal evaluation for leafroll expression (0-3 with 3 being the strongest leafroll symptoms as compared with the controls).

<u>Clone #</u>		<u>Reaction and rating</u>
AC77149-2	0	The infected plants were smaller than their healthy counterparts.
AC77513-1	3	Severe rolling of the lower leaves.
AC77652-1	0	Stand loss evident in the infected plants.
A72685-1	3	Intense color change and severe lower leaf rolling.
A74133-1	3	" " " " " " " "
A74212-1	3	" " " " " " " "
BC9668-1	0	The infected plants were smaller than their healthy counterparts.
WNC230-14	0	" " " " " " " "

Also, a natural in-field spread experiment was conducted with the above eight clones and several other cultivars known to have varying resistance levels to leafroll. This consisted of planting four plants each of all of the clones and cultivars in a row and placing a leafroll source plant (Russet Burbank) between each set of four plants. Plant to plant transmission within a row with a leafroll source plant has been shown to be an effective method for in-field spread. The results of this plot were not spectacular, but they did show two interesting items. The first was that all of the clones which did show a leafroll reaction in the clonal evaluation except A72685-1 showed some leafroll spread. This may be a preliminary indication that the clone A72685-1 may have some resistance to leafroll spread and should be followed further. The second was that several of the WNC230-14 used in this plot showed what appeared to be very mild (0-1 rating) leafroll symptoms. The plants were smaller than the healthy controls, had some mild color change, and did have some mild lower leaf rolling. ELISA testing will be done to determine if these plants were indeed infected with leafroll, but in any event, the reaction was extremely mild at best.