IMPROVEMENT OF POTATO PERFORMANCE BY SEED SELECTION BASED ON LABORATORY ANALYSIS FOR SOFT ROTTING BACTERIA

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A joint project between Colorado State University and Ore-Ida Foods, Inc. was begun in 1974. The project had two major purposes: 1) to determine the cause or causes of decay losses in the field and in storage and 2) to devise ways to reduce losses.

During the 1974 through 1976 growing seasons, Ore-Ida personnel collected representative samples of decaying seedpieces and tubers from fields and storages. These were shipped by air to Colorado State University where causes of the decay were diagnosed by visual examination and laboratory isolations for pathogenic fungi and bacteria. The results of these evaluations are shown in Tables 1, 2 and 3.

Table 1. Causes of seedpiece decay in Russet Burbank potatoes.

	Primary cause of decay			
Season	Bacterial soft rot %	Fusarium dry rot %	Both soft rot[3/] and dry rot %	Total soft rot incidence %
1974 [1/]	100.0	0.0	0.0	100.0
1976[2/]	53.0	22.3	24.7	77.7

1/ Very small sample
2/ 236 seedpieces from 21 sources
3/ Not possible to determine which was the primary cause of decay

Table 2. Causes of losses in Russet Burbank potatoes in the field at harvest time.

	Primary causes of losses			
Season	Bacterial soft rot %	Fusarium dry rot %	Water Rot[1/] %	Other[2/] %
1974	69.1	0.0	30.9	0.0
1976	44.9	3.8	26.2	25.1

1/ Leak and pink rot
2/ Includes animal damage, jelly end rot, etc.

Table 3. Causes of losses in Russet Burbank potatoes in storage.

Season	Bacterial soft rot %	Fusarium dry rot %	Both soft rot and dry rot %	Total soft rot incidence %	Other[1/] %
	Primary cause of losses				
1974	70.0	8.8	----	70.0	18.9
1975	25.0	25.0	44.2	69.2	5.8
1976	39.4	17.5	18.4	57.8	23.8

1/ Includes water rot (leak and pink rot), animal damage, jelly end rot and miscellaneous causes.

The data show that bacterial soft rot was the dominant cause of decay in both the field and in storage. Fusarium dry rot was the second most important problem in storage where it was often a primary cause of decay. Fusarium infection was often closely associated with bacterial soft rot. In the field (seedpiece decay and decay at harvest) Fusarium decay was much less commen than soft rot. Erwinia was the predominant bacterium associated with soft rotting tubers or seedpieces. This organism represented 95+% of the bacteria isolated from soft rotting tissues. Pseudomonas spp. accounted for the remainder.

Based upon these results it was concluded that bacterial soft rot was the cause of most of the losses at all stages of crop production acting along in many cases and in association with Fusarium in others.

Since previous work had shown the importance of the seed tuber as the major source of bacterial inoculum an attempt was made, starting in 1975, to determine the relationship of the levels of bacterial contamination of potato seedlots to subsequent losses in the field and storage.

Samples of 30-40 tubers from each of several different seed lots were collected by Ore-Ida personnel and shipped to Colorado State University. The levels of contamination by soft rotting bacteria were determined in the laboratory by wrapping the tubers in saran wrap and incubating them for 3-4 days using the method of Deboer and Kelman. The extent of bacterial decay and its cause was determined by counting the number of soft rot pockets on each tuber and by isolating and identifying the bacteria associated with the decay. These data were used to develop an arbitrary formula which considered three factors; 1) the percentage of contaminated tubers in a seed lot, 2) the level of contamination (estimated by the number of individual soft rot pockets per tuber), and 3) the amount of Erwinia contamination, to calculate a numerical rotting potential for a given seedlot. The formula used to calculate the rotting potential was as follows:

$$\text{Rotting potential} = \frac{\text{\% of tubers in a seed lot which develop soft rot symptoms} \times \text{average number of soft rot pockets per tuber in the sample} \times \text{\% of tubers in the sample which yield Erwinia}}{100}$$

The assayed seed lots were planted in several commercial fields and evaluated for seedpiece decay and blackleg incidence by Ore-Ida personnel during the season. The amount of tuber decay was also determined at harvest time and during the storage period. The laboratory and field data were subjected to regression analysis to determine how well the laboratory rotting potential estimates related to subsequent performance of the seed lots in terms of the amounts of seedpiece decay, blackleg and tuber decay in the field and in storage.

The results are shown in Figures 1 through 4.

The data show that there was a very close linear relationship between the rotting potentials calculated for the seed lots and the degree of seedpiece decay, blackleg expression, tuber decay at harvest and storage decay.

Conclusion

The results of the study have strongly suggested that the level of contamination of seed lots by soft rotting bacteria is closely related to the performance of the crop produced by that seed lot from planting to storage. If this is true it should be possible by laboratory assays before planting to select seed lots which have lower levels of contamination and thus greater potential for superior performance. It must, however, be recognized that spread of contamination or increased contamination of seed lots during cutting and handling after the assays are completed, environmental conditions and probably other factors may contribute to the success or failure of this kind of program.

Reference

Deboer, S. H. and A. Kelman. 1975. Evaluation of procedures for detection of pectolytic Erwinia spp. on potato tubers. Amer. Potato J. 52: 117-123.

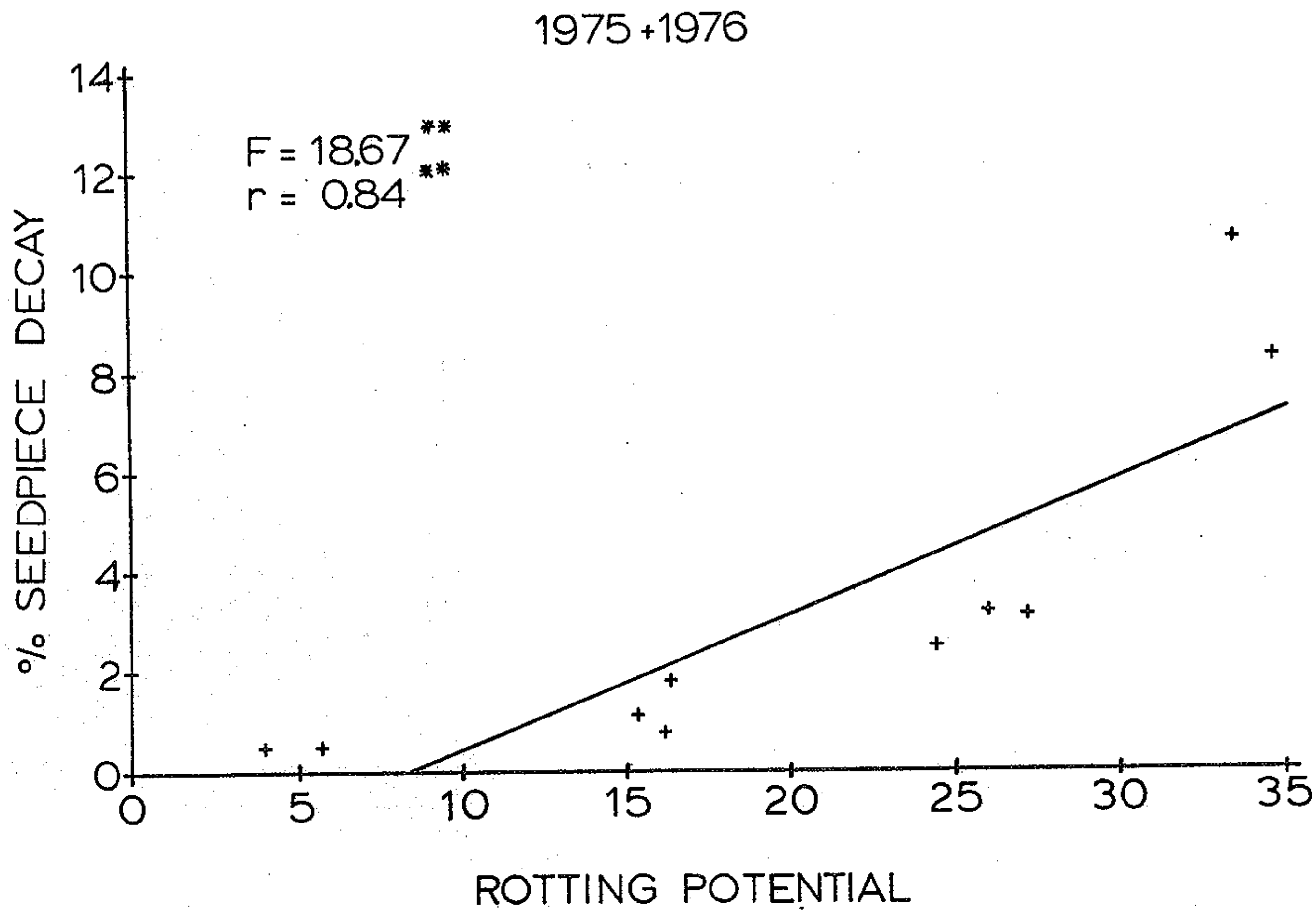

Figure 1. The relationship between seed lot rotting potential and the amount of seedpiece decay in the subsequent crop (combined 1975-1976 data).

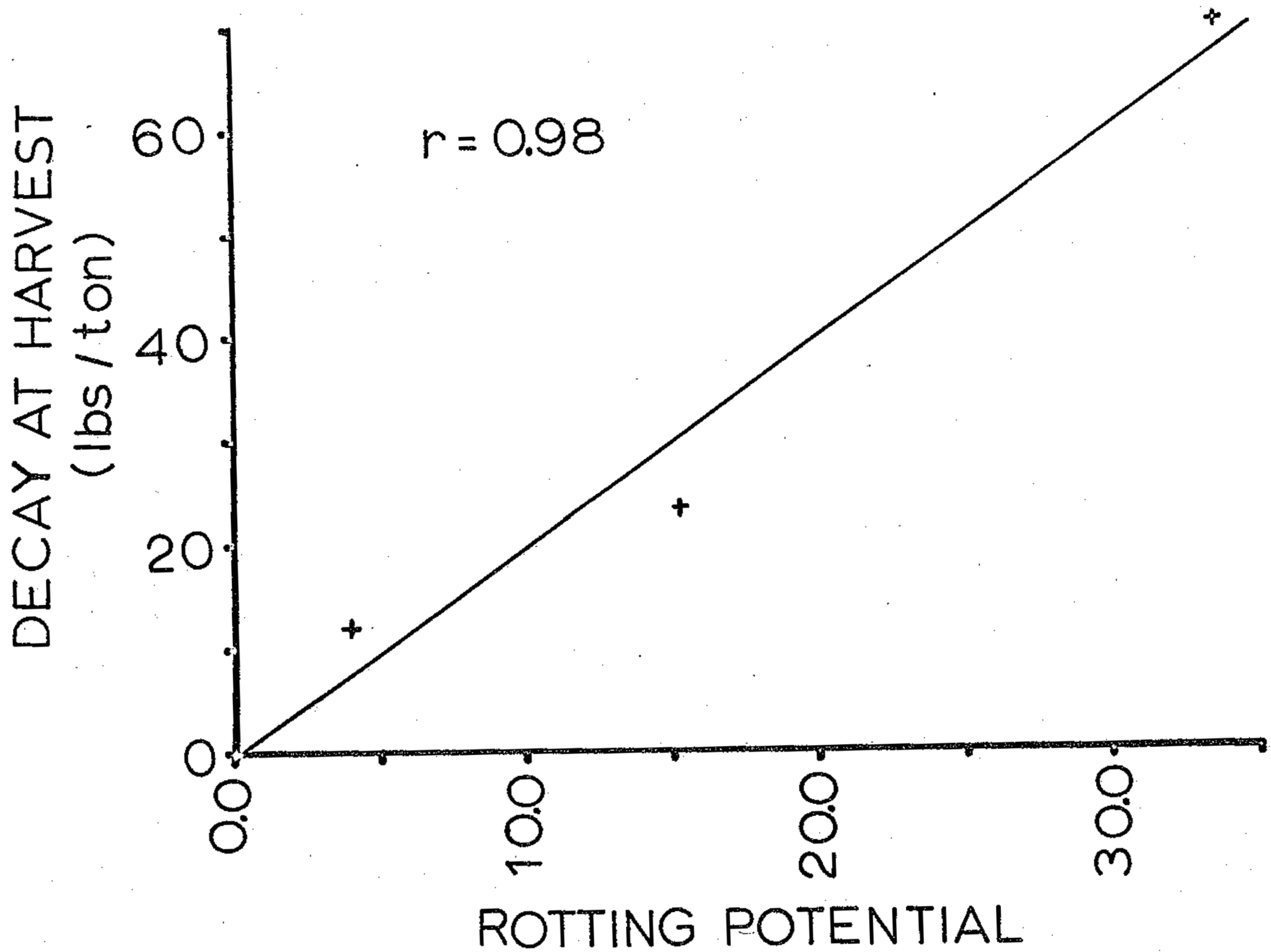

Figure 2. The relationship between seed lot rotting potential and the amount of decay in the subsequent potato crop at harvest time, 1975.

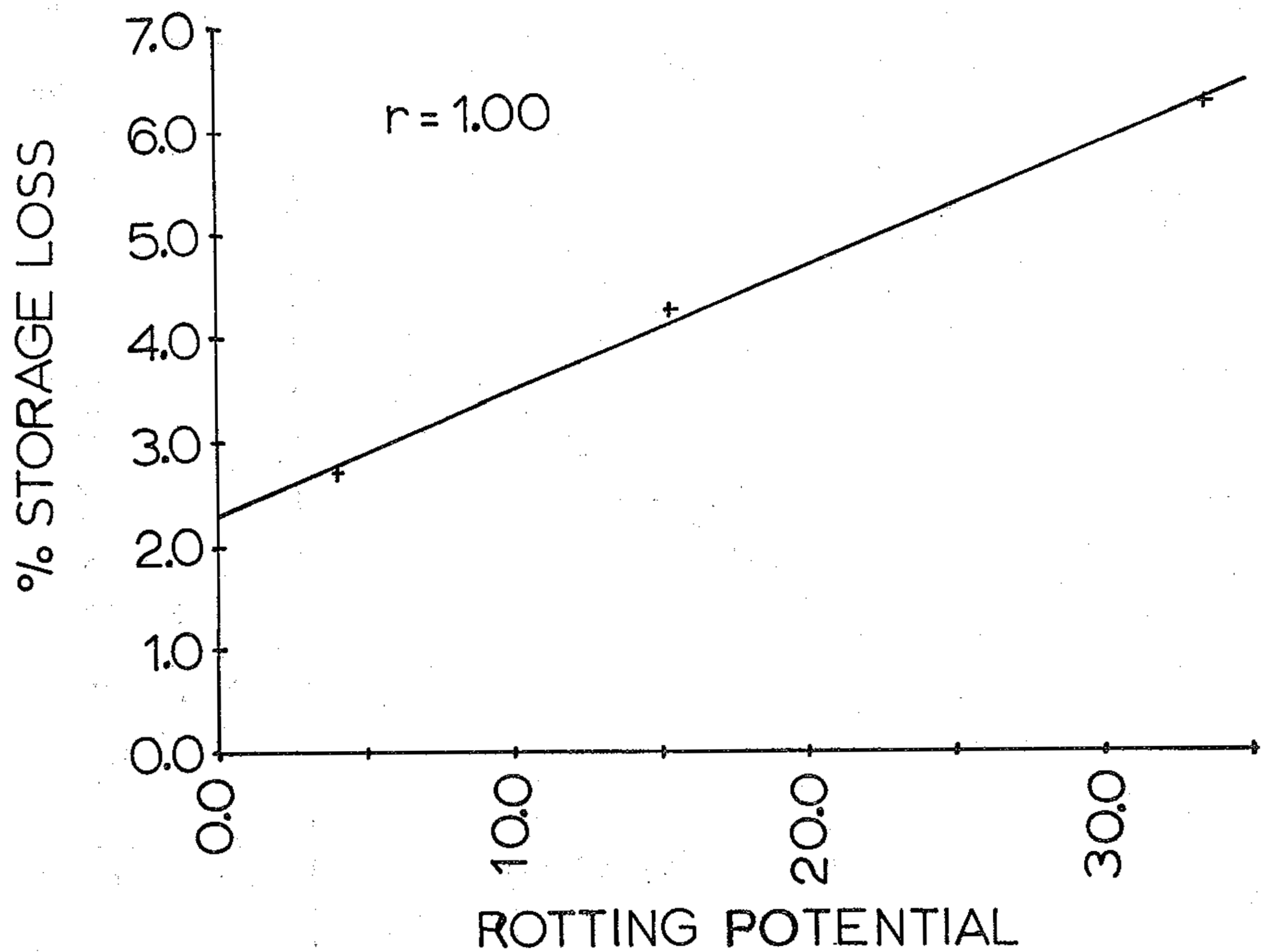

Figure 3. The relationship between seed lot rotting potential and the amount of decay in the subsequent potato crop in storage, 1975.

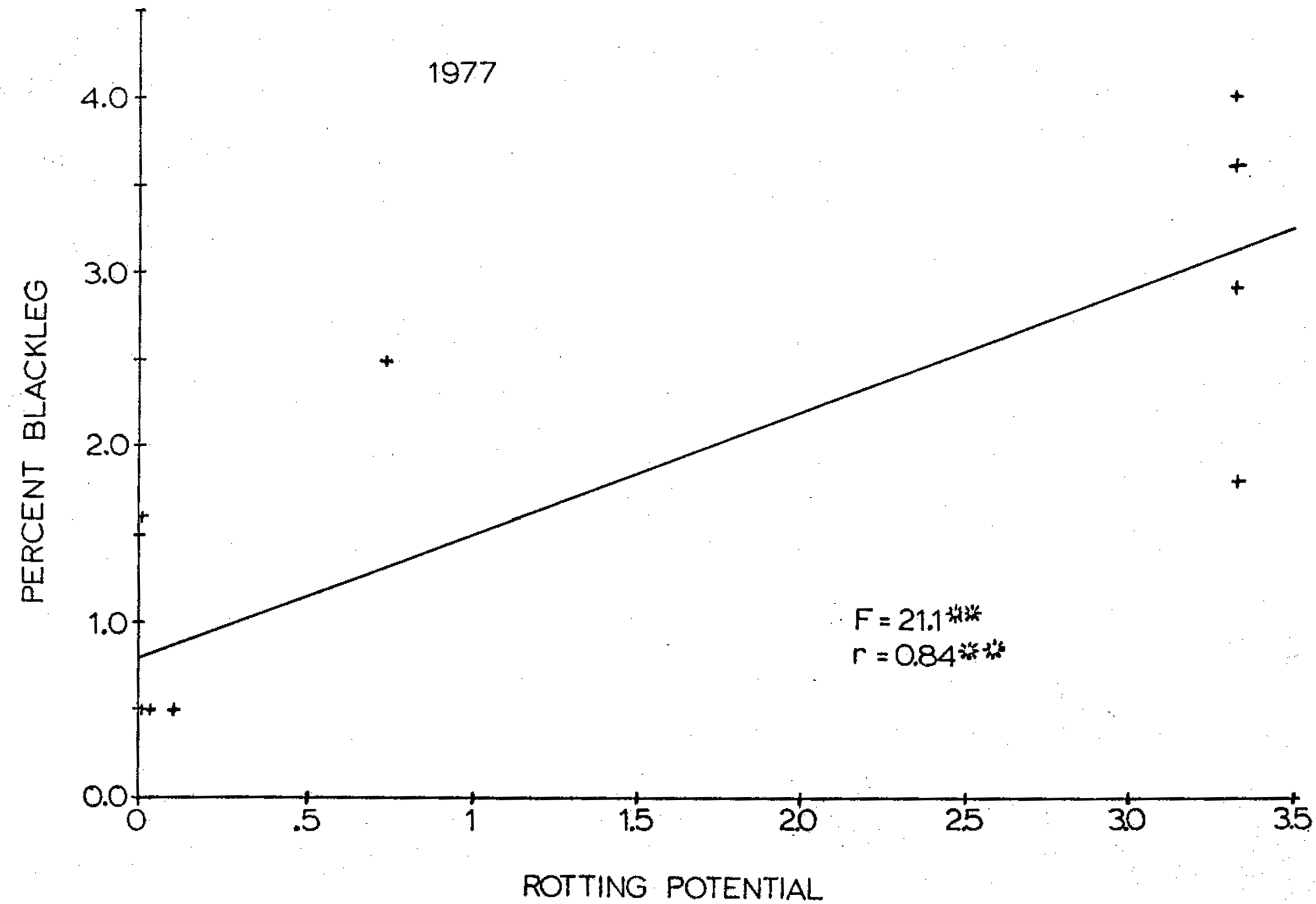

Figure 4. The relationship between seed lot rotting potential and the amount of typical blackleg in the subsequent crop, 1977.