Fungicide Spray Strategies for the New Late Blight Resistant Potato, A90586-11

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Over the past several years, there have been many recommendations on cultural and chemical practices for managing late blight on potato. During the same period of time, many members of the Tri-State Potato Variety Development Program have focused on host resistance as a means of controlling this serious disease. Since the mid 1990s, the Tri-State Program has submitted various breeding materials to WSU-Mount Vernon annually, and to other locations, in order to have them evaluated in the field for resistance to late blight. WSU-Mount Vernon has proven to be an ideal location for these screening efforts because of i) the mild, marine climate which is favorable for disease development, ii) disease incidence that is initiated either early, mid or late season depending on the environmental conditions of a given year, and iii) persistence of complex virulences in the region's *Phytophthora infestans* population (Derie, M. L. and Inglis, D. A. 2001. Phytopathology 91: 606-612).

Germplasm evaluations over time against complex races of a plant pathogen are highly desirable because they increase the likelihood of selecting a type of resistance that may be partial but can be long lasting–the plant still develops the disease, but the disease develops slowly because lesions may be smaller, develop over a longer period of time, or produce fewer spores. This type of resistance appears to be controlled by many genes, and is difficult to breed in combination with the many yield and processing attributes desired in new potato varieties (Brown, C., Grunwald, N., Lozoya-Saldana, H. 2002. Potato Progress Vol. II, No. 5). One entry that has stood out each year in late blight evaluations at WSU-Mount Vernon, and other locations, is A90586-11. This clone was developed at Aberdeen, ID, and is the result of a cross between Ranger Russet and a Polish potato. In years of either low disease pressure (2001), intermediate disease pressure (1996 and 1997), or high disease pressure (1998 and 2000) at WSU-Mount Vernon, the level of late blight on A90586-11 has always been about 50% of Russet Burbank, the susceptible control (see Figure 1).

One possible outcome of using a new potato variety with improved but not complete resistance to late blight is continued reliance on standard late blight management practices. By accepting some low level of disease susceptibility, in order to retain acceptable yield and processing characters in a variety, the cultural and chemical tactics that have been recommended to control late blight remain important. During the 2002 field season we were interested in determining whether the improved level of foliar resistance in A90586-11 could be integrated into a late blight management program where the intervals between fungicide applications were extended in order to reduce the number of applications per season by half. Because A90586-11 has yield comparable or better than Russet Burbank and acceptable processing attributes, it is a good candidate for a reduced fungicide spray strategy.

Three foliar fungicide spray programs (organic, conventional, and reduced) and no fungicide spray program, were compared on both A90586-11 and Russet Burbank at WSU-Mount Vernon in 2002. The field trial consisted of six-row plots (38 in row spacing) planted to 25 seed pieces; each plot consisted of two outside border/spreader rows of White Rose, two paired rows of A90586-11 and two paired rows of Russet Burbank. Plots were arranged in randomized complete blocks, separated by 15 ft alleys, and replicated four times. Disease resulted from naturally-occurring inoculum of the US-8 genotype of *P. infestans*. Plots were rated weekly for percent blighted foliage, July 11 to September 6 when the vines were chopped and killed with Diquat herbicide. Harvest was on September 23. Tubers were shipped to WSU-Othello where they were stored until being graded on October 21. At WSU-Mount Vernon, total rainfall May 23 to September 6 was 4.2 inches with 90 % occurring before Jul 28; rainfall was 0.35 inches during August and 0.08 inches from September 1-6. Supplemental irrigation with drip tape delivered an additional 4.5 in., July 15 to August 23. The average maximum and minimum temperatures, May 23 to September 6, were 71.8 and 51.4 ^{o}F. The full yield potential of A90586-11 or Russet Burbank was not observed in this trial because plants were grown under westside conditions favorable to late blight, and harvested at 123 days.

Figure 2 summarizes fungicide application dates, fungicides, and fungicide costs. In this study, a reduced number of fungicide applications rather than a reduction in fungicide rates was chosen in order to reduce the number, and consequently, the costs associated with fungicide applications. Also, the first fungicide application coincided with the first report of late blight in the area. The importance of applying protective fungicides early in order to prevent infections and assure good distribution of fungicide within the canopy has been emphasized many times in previous reports.

Based on percent foliar late blight in the plots over time, area under disease progress curve (AUDPC) values were generated, and statistically analyzed. AUDPC values were lower for A90586-11 than for Russet Burbank (see Figure 3). However, on both potatoes there was significantly more disease (higher AUDPC value) for the treatment with no spray compared to the treatments with fungicide sprays. [Note: for all statistical analyses in this study, numbers within a column followed by the same letter are not significantly different as determined by least significant difference test (P= 0.05)].

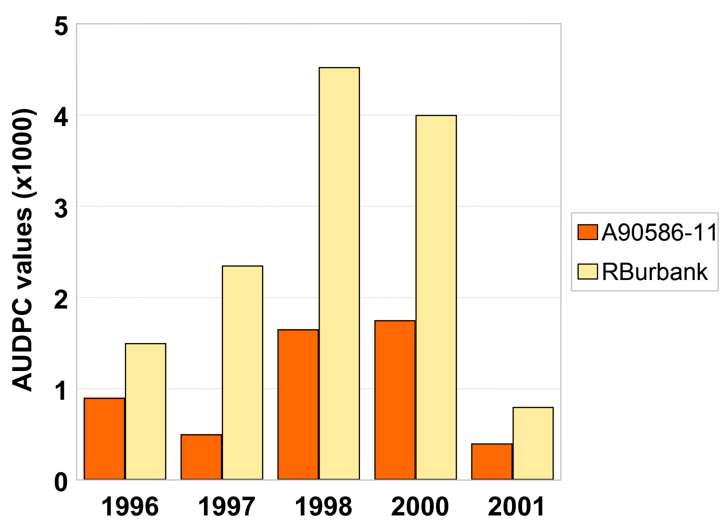
The yields of all U.S. No. 1's < 4 oz (Figure 4), U.S. No. 1's 6-10 oz (Figure 5), U.S. No. 2's + culls (Figure 6), and of U.S. No. 1's + U.S. No. 2's + culls (Figure 7) were not significantly different among spray treatments for A90586-11, but were significantly different among spray treatments for Russet Burbank. In the case of U.S. No. 1's > 4 oz for Russet Burbank, the organic, conventional and reduced spray programs had yields that were statistically the same but significantly better than no spray. The organic spray program on Russet Burbank had significantly more U.S. No. 1's at 6-10 oz than the other spray treatments, and the conventional spray program on Russet Burbank had significantly more U.S. No. 2's + culls than the other spray treatments. The increased yield in the 6-10 oz size class for Russet Burbank on the organic spray program is as yet unexplained. The total yield for A90586-11 was nearly the same among spray treatments, including the reduced sprays treatment. However, the total yield for Russet Burbank was lower for the reduced sprays treatment compared to the other spray treatments.

Data from this study were analyzed for economic returns based on contract assumptions (Figure 8) developed by Dr. Tom Schotzko, WSU-Pullman. On A90586-11 gross returns minus fungicide costs on a per acre basis (Figure 9) were statistically the same for all spray treatments, and ranged from $1850 (for the organic spray program) to $2106 (for the reduced sprays program). In contrast, gross returns minus fungicide costs on Russet Burbank, although less than for A90586-11, were significantly better for the organic and reduced spray programs compared to no spray program, and ranged from $1038 (for no sprays) to $1621 (for the organic spray treatment program). Due to application costs, the conventional program on Russet Burbank was not significantly different from the no spray program.

Since late blight can be an explosive disease, depending on the weather, and the risk of late blight tuber rot always exists, it will be important to maintain some type of late blight spray program when A90586-11 is planted since it is not completely resistant. This study shows that both an organic program and a reduced sprays program would be comparable to a conventional spray program for managing late blight and maximizing yield potential on A90586-11. In fact, the highest net return ($2106) of the study was achieved for the reduced sprays program on A90586-11.

A90586-11, continues to be of interest to potato breeders and growers alike. All evidence to date suggests that its improved late blight resistance is a long lasting type of resistance that promises to reduce fungicide use. Not only does it have an improved level of foliar resistance to late blight compared to other processing potatoes, its yield and specific gravity are as good or better than Russet Burbank. Drawbacks include greening of the tubers and vulnerability to blackspot bruise. Exposed green tubers are especially susceptible to late blight tuber rot (L. Porter and D. Johnson, unpublished), and would need to be managed accordingly. A newspaper article in the Nov 25, 2001 edition of the *Spokesman Review*, titled “Fungus-resistant potato may save farmers a bundle”, focused on its development in the Tri-State Potato Breeding program. A90586-11 is anticipated to be released as a variety, depending on industry feedback, during 2003-2004.

Figure 1. Foliar infection on A90586-11 at Mount Vernon



Kocide 2000
3 lb/acre
$2.90 per pound

Dithane Rainshield
2 lb/acre
$3.00 per pound

None	--	--	--	--	--	--
Organic	7/23	7/31	8/7	8/14	8/21	8/28
Conven.	7/23	7/31	8/7	8/14	8/21	8/28
Reduced	7/23	--	8/7	--	--	8/28

Figure 2. Fungicide application dates. All sprays delivered by ground rig in 50 gpa at 38 psi; spray boom with flat fan nozzles & 8002 tips; custom application costs estimated at $9.00 per acre.

Figure 3. Area under disease progress curve values.

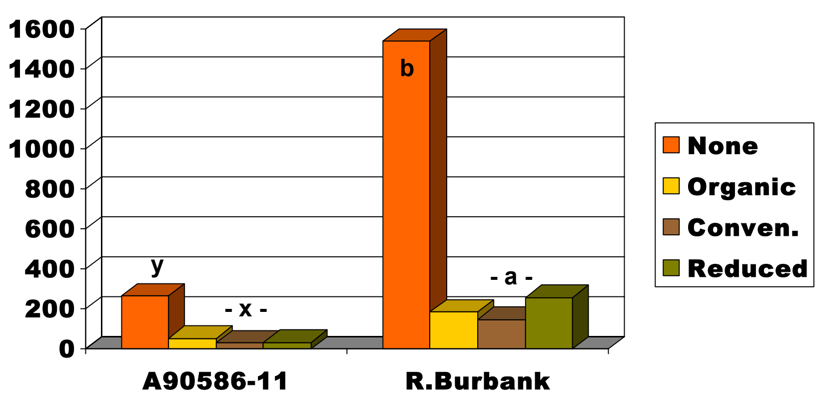


Figure 4. Yield (cwt/a) of all U.S. No. 1's >4 oz.

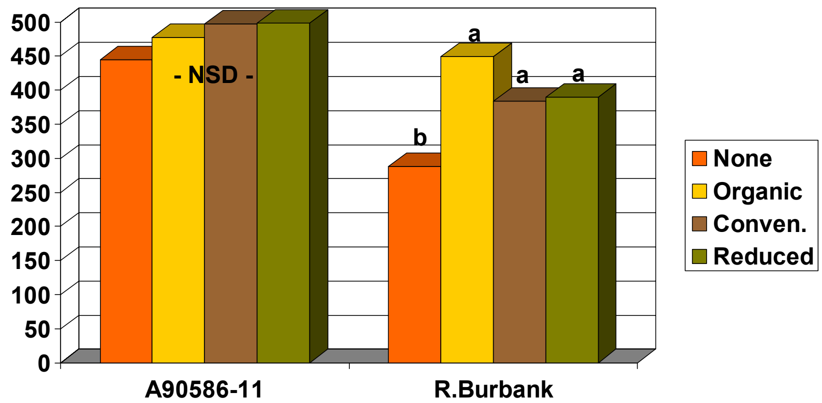


Figure 5. Yield (cwt/a) of U.S. No. 1's 6-10 oz.

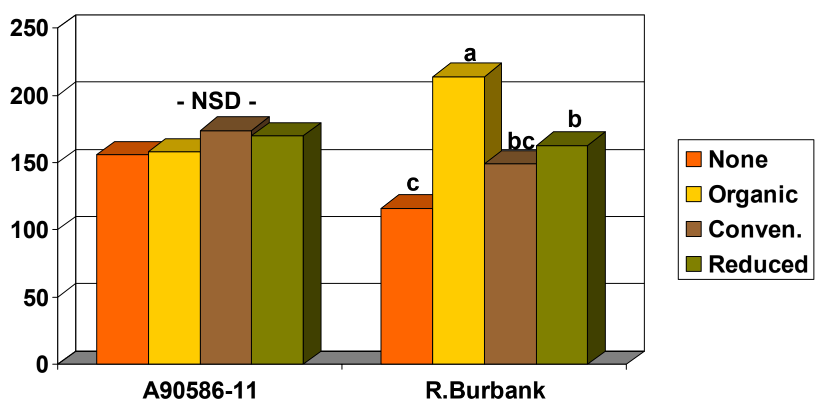


Figure 6. Yield (cwt/a) of U.S. No. 2's + culls.

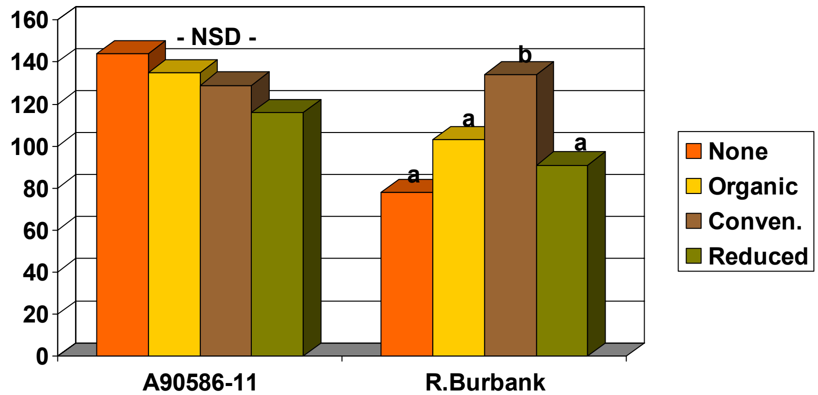


Figure 7. Total yield (cwt/a): No. 1's + No. 2's + culls.

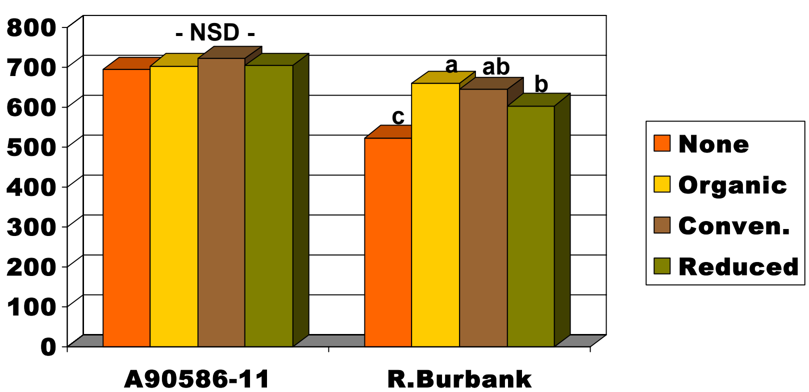


Figure 8. Contract assumptions (T. Schotzko)

- $80 per ton base price
- Clause for 6 oz and larger w/50% = $0.60 for each percentage point above (negative $0.60 below)
- No reject point of 45% 6 oz and larger
- Returns $20 per ton for processing culls up to 10%
- Above 10% processing culls at $0 per ton
- No % U.S. No. 1 incentive or any small size disincentives; no clauses for specific gravity or internal defects
- No bonus for organic production

Figure 9. Gross returns minus fungicide costs ($).