Final Report to WSDA

Assuring Washington cranberry growers access to genetically pure and uniform germplasm

Submitted by
Pacific Coast Cranberry Research Foundation

Project Title: Assuring Washington cranberry growers access to genetically pure and uniform germplasm

Project Summary: The Washington cranberry industry has been plagued by low-producing beds, caused in large part by growing cranberry varieties that have not been true to type. These off-type selections of major varieties have contaminated the entire Washington cranberry industry. Growers propagating from these beds cause further increases in off-types and reduced production. To assess which, if any, Pilgrim beds are clean enough to propagate from, we sampled DNA of all major Pilgrim beds in the state. A few of the original plantings were clean enough (85%) that if mowed would be a good vine source. Most beds, however, were not. This was remedied by establishing propagation beds of pure Stevens and Pilgrim. These will serve as a source for growers to obtain cutting vines of pure Pilgrim and Stevens to use to establish their own propagation beds.

Project Approach:

Goal 1: Assessing the genetic variability and trueness to type of Washington Pilgrim beds.

Procedures: 122 vine samples were collected by WSU researchers from 17 grower beds that were indentified, based on yield and source, as likely Pilgrim germplasm. Additional criteria for bed selection included a) determining the purity of the source vines for the original Pilgrim beds planted in the state, b) assessing if runners on Pilgrim beds are likely to be off-type, hence with subsequent plantings of prunings resulting in non- "Pilgrim" beds, and c) following the change in beds planted from prunings with each subsequent planting. Following the collections, samples were sent to Rutgers University for DNA identification.

Results: DNA analysis of Pilgrim purity is presented in Tables 1 to 3. None of the original plantings of Pilgrims was pure (Table 1). The highest level of purity was 85% and the lowest was 0%. The earlier 1980 plantings were the most contaminated.

Table 1. Purity of the original Pilgrim sources for cranberry plantings in Washington*

Grower	Location	Bed	Type of sample	# of samples tested	Source of vines	Date planted	% Pilgrim
Jubilee	Long Beach	c40	uprights	4	WI or BC	1980's	50%
Jubilee	Long Beach	c40	runners	4	WI or BC	1980's	0%
Allan	Grayland	b	uprights	4	Dillon, BC	1980	0%
William	Grayland	Larkin	uprights	3	Dillon, BC	1982	0%
Brewe	Long Beach	a1	uprights	3	Dillon, BC	1991	66%
Whannell	Long Beach	a10	uprights	20	Dillon, BC	1991	85%
McPhail	Long Beach	q3	uprights	20	Dillon, BC	1991	85%
Gray	Chinook	g8	uprights	9	Scott, WI	2000	88%

* Sites with obvious off-type Pilgrim were not sample

Six Pilgrim beds that contained significant runner density were sampled to determine if these runners were off-types compared to uprights (Table 2). In four of the beds where upright purity

ranged from 25 to 100%, none of the runners were Pilgrim. One bed contained no Pilgrim in its runner or upright populations and in one bed both samples were mixed.

Table 2. Comparative purity of Pilgrim uprights and runners off the same bed

Owner	Bed	Type and number of samples	Pilgrim Purity (%)	
			Uprights	Runners
Whannell	a11	grouped uprights 4 samples; grouped runners 1 sample	100%	0%
Whannell	a4	grouped uprights 4 samples; grouped runners 1 sample	0%	0%
Whannell	a5	grouped uprights 3 samples; grouped runners 2 samples	33%	50%
McPhail	s1	grouped uprights 4 samples; grouped runners 1 sample	25%	0%
Gray	g1	grouped uprights 1 sample; grouped runners 1 sample	100%	0%
Jubilee	c40	grouped uprights 4 samples; grouped runners 4 samples	50%	0%

Pilgrim purity was sampled from four of the original plantings in order to assess the change in purity over time, with each subsequent planting (Table 3). In almost every situation, purity declined significantly with subsequent plantings of prunings from the original source. There were, however, numerous sample anomalies, where purity increased over the original level (McPhail q3 to Wood), or where it went to zero and then increased (McPhail q3 to j/k to s1 to a8; Whannell a11 to a4 to a5). It is difficult to explain these results other than being caused by chance and the fact that only a few very random uprights or runners from a bed were sampled. A typical cranberry bed has over 10 million uprights per acre. Because of cost, only a few uprights per bed can be sampled and analyzed. By only taking a few samples there is a likelihood that the results will be non-representative.

Table 3. Change in Pilgrim purity with sequential planting of prunings

McPhail q3, 1991 Uprights 85% Pilgrim	McPhail j/k, 1997 0% Pilgrim	McPhail s1, 1998 Uprights 25% Pilgrim, Runners 0% Pilgrim	McPhail a8, 2000 Uprights 20% Pilgrim
	Sacks, 1998, Upright 40% Pilgrim		
	Wood, 1998, Upright 100% Pilgrim		
Jubilee c40, 1980's Uprights 50% Pilgrim Runners 0% Pilgrim	Jubilee c36, 2008 0% upright		
Whannell a10, 1991 Uprights 85% Pilgrim	Whannell a11, 1994 Uprights 100% Pilgrim, Runners 0% Pilgrim	Whannell a4, 2002 Uprights and Runners 0% Pilgrim	Whannell a5, 2007 Uprights 33% Pilgrim Runners 50 % Pilgrim
Allan b-1980 Uprights 0% Pilgrim	Williams 1982 Uprights 0% Pilgrim		

Goal 2: Establishment of genetically pure propagation beds

Procedures:

- A 1.5 acre producing cranberry bed at the Pacific Coast Cranberry Research Foundation farm was scalped, sanded, and treated with Basamid to kill residue perennial weed propagules.
- Growers and researchers throughout the US and Canada were contacted regarding finding, testing and procuring DNA-pure germplasm of Stevens and Pilgrim. Numerous sources were tested for purity. Two sources were found and germplasm obtained.
- DNA-certified pure Stevens and Pilgrim were propagated and planted within discrete sections of new beds at PCCRF.
- These DNA germplasm beds were fertilized, weeded, irrigated and maintained to maximize their growth and vigor. They will be ready for harvest for propagules for the industry by as early as winter 2010.
- These DNA germplasm beds were featured during WSU 2009 Cranberry Field Day.

Goals and Outcomes Achieved:

Goal 1: Assessing the genetic variability and trueness to type of Washington Pilgrim beds.

Goal 1 was accomplished. These results indicate very few grower beds are safe to propagate from. They indicate that there is a strong risk of ending up with off-types with poor production when using prunings, and that mowed vines would be a much more prudent choice. They further suggest that the farther down the planting sequence the less likely you are to obtain reasonably pure vines. The results, however, don't always indicate that off-type Pilgrim will be poor producers. Some beds with low purity were excellent producers. However, beds with high purity always had excellent production.

Goal 2: Establishment of genetically pure propagation beds.

Goal 2 was accomplished. Beds of pure Stevens and Pilgrim were established and will be maintained by PCCRF. These will be used as propagation beds to help the industry avoid the significant problems of off-types that has plagued its past. This in turn will improve the economic viability of the Washington industry for years to come.

Beneficiaries:

This project will benefit the long term viability of the cranberry growers in Washington. In the short term, growers will benefit from being able to make more informed choices on what beds are not pure enough to use for propagation and that they should minimize the use of prunings for new plantings. The long term benefit is that, over time, growers will have a source of vines that they can use to establish and maintain their own propagation beds and be assured of high-producing genetically pure cranberry varieties. Over the next 20 years, this will help assure the industry will remain competitive.

Lessons Learned

- It would have been very wise to assess the purity of our cultivars 15 years ago when this technology first became available and before the industry invested in a lot in renovation with off-type vines.

- Beds that look and performed like Pilgrim beds may not be.

- The use of prunings for establishing a new planting is a big risk, even on fairly pure beds.

- Each grower and the industry at large needs a long-term plan to assure a source of good vines for the future.

Contact Persons

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Additional Information

Plans are being made to release the results of the Pilgrim DNA assessment study in the next edition of WSU's cranberry newsletter "December 2009 Cranberry Vine". Propagation material from our DNA-certified germplasm beds will likely be available for use by the industry within 1 to 2 years.