

**Michigan Grape and Wine Industry Council  
Research and Education Advisory Committee**

**Interim Report on Research Activity**

Grant Number: 791N52000237

**Title: Influence of Training System Choice and Shoot Density on Yield, Yield Components and Fruit Composition of Cabernet Franc Grapevines.**

Principal Investigator: Dr. G.S. Howell

Effective Dates: October 1 2005 to September 30, 2006

The Michigan climate is renowned for annual freeze damage that can kill vines to the snow-line, spring frosts and poor fruit-set conditions that can reduce yields, and immense annual variability in heat units (growing degree days, GDD). However, when growing Cabernet Franc, there is a training system that best accommodates these climatic challenges. In addition, there is an optimum range of shoot density that can provide the grower the best chance to produce fruit capable of the current premium value per ton, within the constraints of the weather. We believe training systems with greater amounts of perennial wood will produce higher yields at similar shoot numbers, and will do so at comparable fruit composition values, and systems with greater portions of the fruit and renewal zone shaded will be less mature on any given ripening date as measured by sugar and acidity levels.

Given Cabernet Franc's demonstrated ability to produce fine wines in good seasons, we can develop means to culture vines to produce good wines every year from this cultivar.

In our work we have the following objectives,

- a) To select the single canopy system most effective at producing sustainable production of ripe Cabernet Franc grapes
- b) To select a canopy density that minimizes within canopy fruit and renewal zone shading while maintaining adequate leaf area for fruit and vine maturation
- c) To select a training-shoot density combination that reduces annual hand labor while keeping production and fruit quality goals

**Plot layout:**

Mature, bearing Cabernet Franc grapevines are in place at SWMREC. The vines are in a split-plot that uses Training systems as Main Plots and Shoot Densities as Sub-Plots. There are 6-Training systems ranging from Guyot, Low Cordon, Sylvoz, Hudson River Umbrella, Fan and Scott-Henry. Within each training system there are 4-shoot densities that include: a non-thinned Control, hand width spacing between the shoots, 10- and 15 shoots/ meter of row.

**Procedures for 2004 growing season:**

- a) Plots and training systems were in place.
- b) In the spring assessed bud mortality; wood damage due to winter cold.
- c) Shoot thinning has occurred in spring 2004; only 1-shoot per count node retained.
- d) Crop thinning on 29 July; remove the fruit on every 3<sup>rd</sup> shoot.
- e) At harvest we measured yield, yield components, fruit composition.

See attached tables for the 2004 growing season's data.

**Procedures for 2005 growing season:**

We will repeat all procedures as in the 2004growing season, however we will also do a point quadrant assessment of each training system x shoot density at veriason. We believe that the specific data which would tell us, which portion of the fruit and leafs are interior or exterior to the canopy, would be hugely beneficial in making sound decisions on which training system and shoot density are most effective under Michigan conditions.

**Budgetary Portion of the Grant Agreement:**

The budget for the project in on-track with that outlined in the proposal and there are no anticipated deviations on any one line item in excess of \$1000.

The following budget adjustments have been approved (6/25/05):

	Original	Revised
Salaries and Wages	\$3,000	\$1,250
Materials and Supplies	\$500	\$500
Travel	\$500	\$2,250
<b>TOTAL</b>	<b>\$4,000</b>	<b>\$4,000</b>

In the event of a budget adjustment, the grant administrator (Linda Jones) is required to sign-back this form, indicating approval from the Research and Education Advisory Committee.

Signed:

Principal Investigator \_\_\_\_\_ Date:  
\_\_\_\_\_

Grant Administrator \_\_\_\_\_ Date:  
\_\_\_\_\_  
(if necessary for budget adjustment)

Please return completed forms to Linda Jones at the Michigan Department of Agriculture via e-mail ([jonesL9@michigan.gov](mailto:jonesL9@michigan.gov)), FAX 517 335-0628 or postal mail P.O. Box 310071, Lansing 48909.

TABLE 1. Differences in yield for the duration of the Cabernet Franc training X crop level trial at SWMREC

			Yield (Kg/vine)				
			2000	2001	#2002	2003	##2004
<u>Training System</u>							
	Fan		6.41ab	0.70c	7.77ab	6.68ab	4.3b
	Guyot		6.69a	0.37c	6.02b	5.58b	4.6b
	LC		5.97ab	2.87ab	7.12ab	6.99ab	5.1ab
	Sylvoz		5.34b	1.59bc	9.18a	9.21ab	6.1a
	HRU		5.70ab	0.64c	7.57ab	9.79a	5.4ab
	SH		6.69a	4.46a	6.48b	8.73ab	4.8ab
			*	***	***	***	*
<u>Crop Level</u>	<u>Shoot Density a</u>	<u>Shoot Density b</u>					
2	Control	control	6.23	1.55		9.85a	5.66a
4	5 sht/m	Hand width	6.16	1.97	7.13ab	6.58b	4.87ab
6	10 sht/m	10 sht/m	5.92	1.83	7.80ab	7.32b	4.64b
8	15 sht/m	15 sht/m	6.22	1.75	8.24a	7.57b	5.11ab
			ns	ns	***	***	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 2. Differences in yield for the duration of the Cabernet Franc training X crop level trial at SWMREC

				Yield (kg/vine)				
				2000	2001	#2002	2003	##2004
Training System X Treatment								
Fan		a	b					
	2 t/a	control	control	5.86	0.52efg		8.67bc	6.18ab
	4 t/a	5 sht/m	Hand width	6.70	0.68defg	7.51abcde	4.99cd	4.76b
	6 t/a	10 sht/m	10 sht/m	5.72	0.64defg	8.01bcdef	6.13cd	2.57c
	8 t/a	15 sht/m	15 sht/m	7.35	0.98de	8.35cdef	6.92bcd	3.63bc
Guyot		a	b					
	2 t/a	control	control	5.77	0.33fg		5.31cd	3.56bc
	4 t/a	5 sht/m	Hand width	7.24	0.58efg	6.67abcd	4.70cd	4.68b
	6 t/a	10 sht/m	10 sht/m	7.54	0.29g	6.96abcde	5.27cd	4.70b
	8 t/a	15 sht/m	15 sht/m	6.20	0.29g	5.77abc	7.06bcd	5.58ab
LC		a	b					
	2 t/a	control	control	6.38	3.45bc		10.10ab	6.02ab
	4 t/a	5 sht/m	Hand width	5.40	2.43c	6.83abcd	5.22cd	4.79b
	6 t/a	10 sht/m	10 sht/m	6.70	2.23cd	6.51abcd	6.67bcd	4.54b
	8 t/a	15 sht/m	15 sht/m	5.40	3.38c	8.64cdef	5.97cd	4.99b
				ns	***	**	*	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 3. Differences in yield for the duration of the Cabernet Franc training X crop level trial at SWMREC

				Yield (Kg/vine)				
				2000	2001	#2002	2003	##2004
Training System X Treatment								
Sylvoz				a	b			
2 t/a	control	control		6.01	1.58de		11.96ab	7.58a
4 t/a	5 sht/m	Hand width		5.26	1.88de	9.13def	8.94bc	5.92ab
6 t/a	10 sht/m	10 sht/m		5.32	1.38de	9.71ef	7.11bcd	6.24ab
8 t/a	15 sht/m	15 sht/m		5.94	1.58de	10.48f	8.81bc	4.79b
HRU				a	b			
2 t/a	control	control		6.06	0.44fg		14.19a	5.83ab
4 t/a	5 sht/m	Hand width		5.24	0.79def	7.26abcde	7.45bcd	4.99b
6 t/a	10 sht/m	10 sht/m		5.61	0.36fg	8.47cdef	9.81b	4.65b
8 t/a	15 sht/m	15 sht/m		5.90	0.98de	7.72bcdef	7.74bcd	6.15ab
SH				a	b			
2 t/a	control	control		7.65	2.97c		8.67bc	4.90b
4 t/a	5 sht/m	Hand width		7.29	5.43a	5.41ab	7.99bcd	3.86bc
6 t/a	10 sht/m	10 sht/m		4.84	6.12a	7.18abcde	8.65bc	5.09b
8 t/a	15 sht/m	15 sht/m		6.99	3.34c	8.46cdef	8.53bc	5.44b
				ns	***	**	*	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 4. Differences in soluble solids for the duration of Cabernet Franc training X crop level trial at SWMREC  
Results are averages due to insufficient repetitions.

			Soluble Solids				
Treatment			2000	2001	#2002	2003	##2004
<u>Training System</u>							
	Fan		21.7	21.0	20.8b	21.2ab	19.95c
	Guyot		21.6	19.9	19.7c	21.8a	20.92b
	LC		20.4	19.6	20.1bc	20.9b	20.06c
	Sylvoz		19.6	18.9	21.0b	21.5a	21.75a
	HRU		21.6	20.0	20.4bc	20.1c	21.53a
	SH		20.6	20.2	22.2a	20.0c	21.22ab
			ns	ns	***	***	***
<u>Crop Level</u>	<u>Shoot Density a</u>	<u>Shoot Density b</u>					
2	control	control	20.6	20.2	20.5	20.1b	20.13b
4	5 sht/m	Hand width	21.1	20.9	21.3	20.9ab	21.32a
6	10 sht/m	10 sht/m	21.1	20.7	20.3	21.2a	20.98ab
8	15 sht/m	15 sht/m	20.8	20.4	20.6	21.3a	21.20a
			ns	ns	ns	**	**

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 5. Differences in soluble solids for the duration of Cabernet Franc training X crop level trial at SWMREC  
Results are averages due to insufficient repetitions.

				Soluble Solids				
				2000	2001	#2002	2003	##2004
Training System X Treatment								
Fan		a	b					
	2 t/a	control	control	21.8	20.9		21.0efg	21.01bc
	4 t/a	5 sht/m	Hand width	22.1	20.7	20.2	20.3gh	21.65ab
	6 t/a	10 sht/m	10 sht/m	21.4	20.6	20.2	21.9abcd	20.33c
8 t/a	15 sht/m	15 sht/m	21.6	21.0	20.5	21.7bcde	21.88ab	
Guyot		a	b					
	2 t/a	control	control	21.4	20.9		21.0efg	21.04bc
	4 t/a	5 sht/m	Hand width	21.9	20.8	20.0	22.1abc	21.50b
	6 t/a	10 sht/m	10 sht/m	21.1	21.0	20.1	22.4a	22.06ab
8 t/a	15 sht/m	15 sht/m	21.9	21.2	20.0	21.5cde	22.40a	
LC		a	b					
	2 t/a	control	control	19.6	18.9		19.6hi	19.56cd
	4 t/a	5 sht/m	Hand width	20.0	19.8	21.0	21.3def	21.65ab
	6 t/a	10 sht/m	10 sht/m	20.8	20.1	20.0	21.2ef	21.31b
8 t/a	15 sht/m	15 sht/m	18.1	19.0	20.1	21.7bcde	21.15b	
				ns	ns	ns	***	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 6. Differences in soluble solids for the duration of Cabernet Franc training X crop level trial at SWMREC  
Results are averages due to insufficient repetitions.

			Soluble Solids					
			2000	2001	#2002	2003	##2004	
Training System X Treatment								
Sylvoz		a	b					
	2 t/a	control	control	20.7	20.5		20.7fg	20.69bc
	4 t/a	5 sht/m	Hand width	20.4	20.6	21.1	22.4ab	21.33b
	6 t/a	10 sht/m	10 sht/m	20.3	20.0	20.0	21.8bcd	22.36a
8 t/a	15 sht/m	15 sht/m	20.9	21.0	19.9	21.3cdef	21.75ab	
HRU		a	b					
	2 t/a	control	control	18.2	19.5		19.2i	19.16d
	4 t/a	5 sht/m	Hand width	21.2	20.0	21.0	20.4gh	21.33b
	6 t/a	10 sht/m	10 sht/m	21.3	20.2	20.2	20.4gh	22.36a
8 t/a	15 sht/m	15 sht/m	20.7	20.2	20.0	20.3gh	21.75ab	
SH		a	b					
	2 t/a	control	control	21.9	20.6		19.2i	19.24d
	4 t/a	5 sht/m	Hand width	21.2	20.4	22.0	19.5i	21.48b
	6 t/a	10 sht/m	10 sht/m	21.8	20.6	21.0	19.2hi	19.46d
8 t/a	15 sht/m	15 sht/m	21.3	21.0	20.1	21.5cde	19.62cd	
			ns	ns	ns	***	*	

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 7. Differences in crop load for the duration of Cabernet Franc training X crop level trial at SWMREC

			Crop Load (yield / vine size)				
Treatment			1999	2000	2001	#2002	##2003
<u>Training System</u>							
	Fan		4.9ab	5.8ab	0.9	0.54c	5.80ab
	Guyot		2.6ab	4.2b	0.6	0.38c	5.05b
	LC		2.3ab	5.0ab	1.2	0.74c	6.47ab
	Sylvoz		3.5ab	3.5b	3.3	3.09b	10.09ab
	HRU		2.1b	3.1b	1.8	5.20a	11.55a
	SH		5.4a	8.3a	1.9	1.58bc	9.13ab
			**	***	ns	***	***
<u>Crop Level</u>	<u>Shoot Density a</u>	<u>Shoot Density b</u>					
2	control	control	3.4	5.0		1.91	9.56a
4	5 sht/m	Hand width	2.7	4.7	3.4	1.96	7.66b
6	10 sht/m	10 sht/m	3.7	4.6	3.6	1.78	7.66b
8	15 sht/m	15 sht/m	4.0	5.6	3.0	2.05	7.24b
			ns	ns	ns	ns	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 8. Differences in crop load for the duration of Cabernet Franc training X crop level trial at SWMREC

				Crop Load (yield / vine size)				
				1999	2000	2001	#2002	##2003
Training System X Treatment								
Fan		a	b					
	2 t/a	control	control	2.7	4.3d		0.40f	6.97bc
	4 t/a	5 sht/m	Hand width	2.6	4.7d	0.7a	0.60f	3.65c
	6 t/a	10 sht/m	10 sht/m	8.2	6.4bc	0.8a	0.42f	4.48c
8 t/a	15 sht/m	15 sht/m	6.2	7.7abc	1.5a	0.76f	7.14bc	
Guyot		a	b					
	2 t/a	control	control	1.9	2.9d		0.36f	4.09c
	4 t/a	5 sht/m	Hand width	2.8	4.7d	0.9a	0.54f	6.94bc
	6 t/a	10 sht/m	10 sht/m	2.9	4.3d	0.5a	0.31f	5.05c
8 t/a	15 sht/m	15 sht/m	3.0	5.0d	0.6a	0.31f	4.11c	
LC		a	b					
	2 t/a	control	control	2.9	6.0bcd		0.39f	7.76bc
	4 t/a	5 sht/m	Hand width	1.8	3.6d	0.9a	0.65f	5.72c
	6 t/a	10 sht/m	10 sht/m	2.3	5.2d	1.3a	0.61f	5.83c
8 t/a	15 sht/m	15 sht/m	2.1	5.2d	1.8a	1.33ef	6.57bc	
				ns	**	***	*	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 9. Differences in crop load for the duration of Cabernet Franc training X crop level trial at SWMREC

			Crop Load (yield / vine size)					
			1999	2000	2001	#2002	##2003	
Training System X Treatment								
Sylvoz		a	b					
	2 t/a	control	control	2.6	4.1d		3.43bcd	11.25b
	4 t/a	5 sht/m	Hand width	3.5	3.8d	3.7a	3.14cde	7.70bc
	6 t/a	10 sht/m	10 sht/m	3.2	3.4d	2.1a	2.08def	11.22b
8 t/a	15 sht/m	15 sht/m	5.5	4.8d	3.6a	3.71bcd	10.18bc	
HRU		a	b					
	2 t/a	control	control	2.4	3.4d		4.62abc	17.40a
	4 t/a	5 sht/m	Hand width	1.7	2.6d	12.3bc	5.46ab	9.65bc
	6 t/a	10 sht/m	10 sht/m	1.6	2.8d	15.8c	4.59abc	9.51bc
8 t/a	15 sht/m	15 sht/m	2.6	3.5d	8.7b	6.13a	9.64bc	
SH		a	b					
	2 t/a	control	control	8.3	10.3a		2.24def	9.39bc
	4 t/a	5 sht/m	Hand width	4.3	9.6ab	2.2a	1.40ef	10.13bc
	6 t/a	10 sht/m	10 sht/m	4.6	5.8cd	1.7a	1.11ef	9.68bc
8 t/a	15 sht/m	15 sht/m	4.4	7.8abc	2.3a	1.57def	5.31c	
			ns	**	***	*	*	

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 10. Differences in vine size for the duration of Cabernet Franc training X crop level trial at SWMREC

			Vine Size				
			1999	2000	2001	#2002	##2003
<u>Training System</u>							
	Fan		0.89abc	1.45bc	0.77ab	1.36a	1.30a
	Guyot		1.06ab	1.80ab	0.61ab	0.99b	1.17ab
	LC		0.81abc	1.28cd	0.60b	0.93b	1.19ab
	Sylvoz		0.77bc	1.46bc	0.95ab	1.00b	0.94ab
	HRU		1.23a	1.99a	0.48b	1.04b	0.90b
	SH		0.57c	0.94d	1.16a	1.20ab	1.13ab
			***	***	***	**	**
<u>Crop Level</u>	<u>Shoot Density a</u>	<u>Shoot Density b</u>					
2	control	control	0.99a	1.52ab		1.11	1.20a
4	5 sht/m	Hand width	0.92ab	1.62a	0.88	1.13	1.06ab
6	10 sht/m	10 sht/m	0.87ab	1.57a	0.75	1.09	1.01b
8	15 sht/m	15 sht/m	0.78b	1.23b	0.66	1.01	1.14ab
			**	**	ns	ns	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 11. Differences in vine size for the duration of Cabernet Franc training X crop level trial at SWMREC

				Vine Size				
				1999	2000	2001	#2002	##2003
Training System X Treatment								
FAN		a	b					
	2 t/a	control	control	1.09	1.48cdef		1.63a	1.48ab
	4 t/a	5 sht/m	Hand width	0.91	1.57bcd	0.99b	1.25abcd	1.48ab
	6 t/a	10 sht/m	10 sht/m	0.70	1.48cdef	0.73ab	1.25abcd	1.20ab
	8 t/a	15 sht/m	15 sht/m	0.86	1.27defg	0.65ab	1.32abc	1.09ab
Guyot		a	b					
	2 t/a	control	control	1.32	2.11ab		0.91cde	1.23ab
	4 t/a	5 sht/m	Hand width	0.95	1.75abc	0.64ab	1.02bcde	1.07ab
	6 t/a	10 sht/m	10 sht/m	1.11	1.91abc	0.66ab	1.07bcde	0.99b
	8 t/a	15 sht/m	15 sht/m	0.84	1.45def	0.45a	0.98bcde	1.38ab
LC		a	b					
	2 t/a	control	control	1.11	1.93abc		1.07bcde	1.36ab
	4 t/a	5 sht/m	Hand width	1.41	2.11ab	0.61ab	0.99bcde	1.04b
	6 t/a	10 sht/m	10 sht/m	1.34	2.18a	0.50a	0.86cde	1.25ab
	8 t/a	15 sht/m	15 sht/m	1.04	1.73abc	0.54a	0.77e	1.09ab
				**	***	***	*	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.

TABLE 12. Differences in vine size for the duration of Cabernet Franc training X crop level trial at SWMREC

				Vine Size				
				1999	2000	2001	#2002	##2003
Training System X Treatment								
Sylvoz				a	b			
2 t/a	control	control		0.91	1.16defg		1.04bcde	1.07ab
4 t/a	5 sht/m	Hand width		0.79	1.57bcd	0.70ab	0.84de	1.14ab
6 t/a	10 sht/m	10 sht/m		0.84	1.38defg	1.06b	1.07bcde	0.77b
8 t/a	15 sht/m	15 sht/m		0.68	1.02defg	0.95b	1.07bcde	0.79b
HRU				a	b			
2 t/a	control	control		0.50	0.82g		1.00bcde	0.83b
4 t/a	5 sht/m	Hand width		0.57	1.09defg	0.61ab	1.29abcd	0.86b
6 t/a	10 sht/m	10 sht/m		0.52	0.95efg	0.50a	1.00bcde	0.86b
8 t/a	15 sht/m	15 sht/m		0.68	0.91fg	0.32a	0.86cde	1.02b
SH				a	b			
2 t/a	control	control		0.99	1.58bcd		1.06bcde	1.24ab
4 t/a	5 sht/m	Hand width		0.89	1.63abc	1.82c	1.39ab	0.91b
6 t/a	10 sht/m	10 sht/m		0.57	1.52cde	1.08b	1.34abc	1.02b
8 t/a	15 sht/m	15 sht/m		0.59	1.09defg	1.07b	1.06bcde	1.48a
				ns	***	***	*	*

## Treatment was changed from shoot density a to shoot density b (number shoots per meter row) in 2004

# Treatment was changed from crop level to shoot density (number shoots per meter row) in 2002

F values significant at 5% (\*), 1% (\*\*), 0.1% (\*\*\*), or not significant (ns).

Mean Separation within columns using LSD Test.