Title: Demonstration & Verification of Best Management Practices for Winegrape Production in the Ozark Mountain Region

Viticulture Consortium - East
2006 Progress Report

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Objectives:

1) To conduct surveys to establish a benchmark and quantify progress in adopting grape best management practices and to identify constraints to implementation in AR and MO.
2) To demonstrate grape best management practices.
3) To disseminate grape management, pest and disease event information in a timely manner.
4) To produce a Wine Grape Integrated Production Systems Workbook for use in grower grape best management practices workshops.

Summary of Major Accomplishments and Results:

Objective 1) To conduct surveys to establish a benchmark and quantify progress in adopting grape best management practices and to identify constraints to implementation in AR and MO.

Results from the survey conducted in Fall 2005 regarding current grapevine canopy, insect, and disease management practices have been compiled and summarized. The summary is included as a separate appendix to this report. A manuscript is being prepared for submission to HortTechnology. Results will also be published in the ICCVE newsletter.

Objective 2) To demonstrate grape best management practices.

Demonstration blocks were maintained by Keith Striegler and Andy Allen at each of the six cooperating vineyard sites in Arkansas and Missouri. These locations were Altus and Hindsville, AR and Ste. Genevieve, St. James, Hermann/Augusta, and Columbia, MO. Vines were balance pruned during the winter of 2005/6. Selected canopy and crop load management practices were to be performed in each of these blocks, depending on the variety and trellis system. At Altus, AR the vineyard block was Merlot trained to a Vertical Shoot Positioned (VSP) trellis and the management practices to be utilized were shoot thinning, leaf removal within the fruiting zone, cluster thinning and all treatment combinations. At Hindsville, AR the vineyard block was Chambourcin trained to a high-wire, single curtain trellis and the management practices were shoot thinning, shoot positioning, leaf removal, cluster thinning and all treatment combinations. At Ste. Genevieve, MO a block of Chardonel trained to VSP was used and the practices to be utilized were the same as those at Altus. At St. James, MO the block was Chardonel trained to a high-wire, single curtain trellis system and the management practices included shoot thinning, shoot positioning, cluster thinning and all treatment combinations. At Rocheport, MO the block was Vignoles trained to a high-wire single curtain trellis system and the practices included shoot thinning, shoot positioning, leaf removal, and all treatment combinations. At Hermann, MO a block of Vignoles trained to a high-wire, single curtain trellis was used. The treatments in this case were designed to reduce cluster susceptibility to bunch rot by altering the very tight cluster architecture of Vignoles, which is highly susceptible to bunch rot. These treatments included leaf removal, brushing of the clusters and spraying with Stylet oil, all at trace bloom. These demonstration blocks, with the exception of the Ste. Genevieve and Altus blocks, were harvested the day before the growers harvested the entire variety block. Yield, cluster counts, and where appropriate, bunch rot incidence data were collected. Also, berry samples for average berry size and fruit composition analysis were collected. Other variables were calculated from these data.

In the Altus, AR Merlot block the vines displayed uneven budburst and shoot growth possibly as a result of winter injury. Consequently, we were unable to use this block.

In the Hindsville, AR Chambourcin block, few statistically significant treatment differences were observed in 2006(data not shown). Hot, dry conditions and an inadequate supply of irrigation water combined to give a

growing season with several periods of severe water deficit.

The Chardonel demonstration block at Ste. Genevieve, which could not be used in 2005 due to poor vine growth, was moved to a more vigorous area of the vineyard in 2006. Unfortunately, very low crop level throughout the Chardonel blocks at this vineyard precluded data collection during the 2006 season. This was most likely the result of very severe drought stress during the 2005 growing season combined with high crop loads on a majority of the vines.

In the St. James, MO Chardonel block the treatments had no significant effect on any of the variables measured except cluster number per vine (Table 1). Treatments which featured the combination cluster thinning and shoot thinning significantly reduced cluster number per vine.

At the Rocheport, MO Vignoles block, the number of berries per cluster and cluster weight were significantly increased by shoot thinning, while shoot thinning was associated with significantly lower titratable acidity (Table 2). Leaf removal was similarly but less consistently associated with the effects. Although not significantly different, shoot thinning, and to a lesser extent leaf removal, were also associated with higher Brix and pH levels compared to control and shoot positioned-only vines. Canopy management practices had inconsistent and insignificant effects on all other variables measured.

In the Vignoles cluster architecture modification study at Hermann, MO two experiments were conducted (Tables 3, 4). The control, leaf removal and brushing treatment vines from 2005 were untreated in 2006 and yield and cluster numbers collected at harvest to determine if there were any carryover effects of the treatments from 2005 on yield. Prior studies in other areas had indicated that leaf removal at trace bloom severely reduced bud fruitfulness in the subsequent season. We hypothesized that with the longer and warmer post-harvest growing season in Missouri that the vines would overcome the negative effects of leaf removal at trace bloom. Neither leaf removal nor brushing in 2005 had any carryover effects on yield or fruit composition in 2006 (Table 3). In the second investigation, the cluster modification treatments were applied to vines in another location within the same vineyard. Spraying with a 2% solution of Stylet Oil at trace bloom was added to the control, leaf removal and brushing at trace bloom treatments. Only leaf removal at trace bloom had a significant effect on any variable. Leaf removal reduced the percent rot clusters when compared to the Stylet oil treatment and reduced cluster weight, berry weight, berries/ cluster, and the number of berries in the interior of the cluster compared to the untreated control vines. There was no significant effect of any treatment on fruit composition, although fruit from leaf removal treatment vines was slightly more mature than other treatments.

Vineyard pruning workshops were conducted at each location in January, 2006. Half-day field workshops (a.k.a. – "tailgate meetings") were held in March/April, May, June and July at the six demonstration vineyard sites. During these workshops, Keith Striegler, Andy Allen, Donn Johnson and Barbara Lewis gave presentations to growers and extension personnel. In addition, Dr George Leavitt was brought in as a special guest speaker during the June tailgate meetings to discuss grapevine trunk diseases and powdery mildew. The best winegrape management practices topics covered included:

- Demonstration of canopy and crop load management practices, including shoot thinning, shoot positioning, leaf thinning, and cluster thinning
- Petiole and soil sampling for vineyard nutrient management
- Irrigation
- Weed management
- Pesticide use and pre-harvest intervals
- Demonstration of grape pest scouting and decision-making pest management program for grape berry moth, grape aerial phylloxera, grape root borer, grape scale, Japanese beetle and green June beetle

Growers in these 6 demonstration vineyards in Missouri and Arkansas were shown when and where to set out pheromone traps for grape berry moth (at edge of woods by vineyard by 1 April and move to vineyard center in mid May). These growers or a scout, already under their employ, kept weekly insect trap count records for Missouri vineyards and Arkansas vineyards. Trap data were conveyed weekly to Donn Johnson by phone or email and uploaded into a table of trap catch on two Internet pages:

- Arkansas = http://comp.uark.edu/~dtjohnso/AR%20Recom%2006.html
- Missouri = http://comp.uark.edu/~dtjohnso/MO%20Recom%2006.htm

At field workshops in June and July, growers were shown how to make cluster damage estimates by inspecting 300 clusters for worm damage during each generation of grape berry moth. The recommended

economic threshold was to apply insecticide only to the vineyard edge vines for first generation in May and early June and the whole vineyard for later generations only if > 1% of clusters had new worm damage.

In 2006, Donn Johnson and Barbara Lewis installed a Spectrum™ WatchDog weather station (Spectrum Technologies, Inc., 12360 South Industrial Dr., East Plainfield, IL 60585; (800) 248-8873) each of the six demonstration vineyard locations during the March/April tailgate meetings. This weather station has software to model occurrences of black rot, botrytis, downy and powdery mildew infection events. The grower, vineyard manager or another designated employee at each of the sites was instructed in how to download the data from the weather station and plug it into the disease models to determine if there had been any infection events in their vineyards. They also e-mailed the weather station data to Donn Johnson. Johnson used weather data from local official reporting weather stations near the demonstration vineyards to run the models and posted the results for each area on his website. In 2007 the software's predictive capabilities will be utilized to predict infection events for each of the diseases and this information will be communicated to growers via website, electronic advisory, and phone in order that they may take action if necessary when a disease event is forecasted in their area.

Objective 3) To disseminate grape management, pest and disease event information in a timely manner.

Information on key insect pests and diseases was collected during the 2006 season. This information as well as recommendations for canopy management and other viticultural practices was provided to growers electronically (website) and face-to-face at vineyard workshops. A summary of insect pest and disease information follows:

Grape Berry Moth (GBM). The mean season total catch of GBM in pheromone traps in vineyards varied considerably relative to risk (increased with percentage of vineyard adjacent to woods) as follows: in MO at Ste. Genevieve (25.5 moths = low risk); Hermann (112.5 = high risk site); Rocheport (23 = low-moderate risk); St. James (180 = high risk by shed and 176.5 = moderate to high risk by tower), and AR at Hindsville (75.7 = high risk and only 14.3 = low risk and all caught before placement of mating disruption ties on 1 June). All vineyards reported less than 1% cluster damage due to feeding by GBM larvae. No GBM damage was observed in the three mating disruption blocks in Hindsville, AR. Daily maximum and minimum temperature and rainfall data for select grape growing counties in MO (http://agebb.missouri.edu/weather/stations/) and daily maximum and minimum temperatures for grape growing zones in AR (http://www.aragriculture.org/weather/download.asp) were used to generate graphs of cumulative degree-days for GBM (developmental base 47.14°F and upper threshold of 93°F). Each graph noted predicted periods of grape berry moth hatch (spray periods) for each generation in each grape-growing county in AR and MO. This information was available on the AR/MO Fruit IPM website at: http://comp.uark.edu/~dtjohnso/. This site also had specific vineyard trap catch data and management recommendations.

Japanese beetle. In 2005, adult JB flight occurred from 1 June to mid August in NW Arkansas. Season total counts of adults/JB Jumbo trap in Arkansas were 45,852 JB in UA-Fayetteville Farm and 33,100 JB in the Hindsville vineyard; whereas in Missouri counts were 3,868 JB in Ste. Genevieve and 0 in St. James, Hermann and Rocheport.

In 2006, adult JB flight occurred from 1 June and ended in mid-August in NW Arkansas. The season total count of adults/JB Jumbo trap was 31,823 JB in the Hindsville vineyard.

Green June beetle The flight of GJB in the Ozarks was observed from late June to late August. The overall GJB population in 2006 was higher and more widespread than in 2005 as evidenced by the fact that most fruit growers from Altus, AR to Purdy, MO applied insecticide spray to minimize GJB damage to ripe fruit.

Grape Root Borer. Season total pheromone trap catches more than doubled from 2005 to 2006. In MO vineyards in Ste. Genevieve there were 31 and 65 GRB moths/trap in 2005 and 2006, respectively, in Hermann there were 11 and 130 and in St. James there were 8 and 34 compared to 5 and 33 in Hindsville, AR. Survey of 100+ vines/vineyard in late August resulted in low GRB pupal skin counts in MO - Ste. Genevieve (4 skins), St. James (1), Rocheport (0), and in AR - Altus (1) and Hindsville (0).

Grape phylloxera (GP) were observed in most demonstration vineyards. More research is needed on GP in the Ozark region. Therefore, a two-year grant proposal was submitted to the Missouri Grape and Wine Board Research Committee that has three objectives:

1. To derive an economic threshold by regressing the impact of a series of geometric treatment increases in initial infestation rates of foliar grape phylloxera to grapevine performance (yield, juice quality, pruning weight and return bloom).
2. To compare and demonstrate spray and timing effectiveness of Thiodan against grape phylloxera to that by new formulations of Assail, Admire Pro, and Danitol.
3. To survey and rank infestations of foliar and root grape phylloxera on the major wine grape cultivars growing in the Ozark Mountain Region as self-rooted or grafted on rootstocks.

Results for the first year of that project are reported under the title of the project: *Control and Survey of Aerial and Root Grape Phylloxera on Grape Cultivars*.

At field workshops, growers were trained to make decisions about managing grape insect pests by monitoring pheromone trap catches for GBM, GRB, JB and GP.

Tables of pest trap counts were updated weekly or as data were received from growers or scouts and available on the Internet at:

- Arkansas = http://comp.uark.edu/~dtjohnso/AR%20Recom%2006.html
- Missouri = http://comp.uark.edu/~dtjohnso/MO%20Recom%2006.htm

Temperature and rainfall (daily and cumulative) data were downloaded for each of the four vineyards in Missouri from the Missouri Cooperative Extension Service at: http://agebb.missouri.edu/weather/stations/). Spectrum Technologies Watchdog weather stations were in each vineyard in Missouri and AR to allow for an end-of-season comparison of in-vineyard weather station temperature data to that of the nearest County or region temperature data provided by the Cooperative Extension Service. The regional temperature data for Clarksville, AR that was used for the Altus vineyard site (10 miles apart) came from the Arkansas Cooperative Extension Service at:

- http://www.aragriculture.org/weather/download.asp

Graphs of cumulative daily DD for GBM were available for all six vineyards on Internet. Arkansas data were used to generate graphs of cumulative DD for GBM development available at:

- http://comp.uark.edu/~dtjohnso/AR%20DD%2006.htm

Missouri data were used to generate graphs of cumulative DD for GBM development available at:

- http://comp.uark.edu/~dtjohnso/MO%20DD%20Rain%2006.htm

Objective 4) To produce a Wine Grape Integrated Production Systems Workbook for use in grower grape best management practices workshops.

A meeting of the principle participants in this project was held in September to discuss subject matter and format for the workbook. This workbook will be composed during the winter of 2006/2007 for use in the 2007 season.

Dissemination Activities:

Dissemination of information is a key objective of this project and in 2006 was accomplished through the use of a website (http://comp.uark.edu/~dtjohnso/) and the vineyard field workshops in March/April, May, June, and July. A season wrap-up meeting was held in December, 2006 at four of the locations. Additionally, the following presentations were given:

Johnson, Donn. Demonstrating best management practices for winegrape production in the Ozark Mountain Region. Presentation to the Mid America Fruit Growers Conference. Jan. 19, 2006.

Striegler, Keith. Balancing Crop Loads for Quality in the Ozark Mountain Region. Presentation to the Texas Wine and Grape Growers Association Grape Camp Meeting. Nov. 12, 2005.

Striegler, Keith. Canopy and Crop Load Management. Presentation at the Oklahoma Grape Production Short Course. June 15,, 2006.

Detailed data may be obtained by contacting

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APPENDIX

Impact Statement:

The presence and population levels of several key insect pests of grapes and grapevines were identified in each of the areas of the Ozark Mountain region encompassed in this project. Growers were trained in identification and scouting techniques for each of these pests. Cooperators were trained in the use of computerized weather stations with disease-predictive software. Canopy and crop load management techniques and the benefits of these techniques were demonstrated to growers at each location.

Publications and Presentations:

Allen, Andy. 2006 Results from Canopy Management Demonstration Blocks. Presentation at season wrap-up meetings of the Vineyard Best Management Practices Project. Dec. 4-7, 2006.

Keels Creek Winery, Eureka Springs, AR – Dec. 4
Tiger Ridge Restaurant, Ste. Genevieve, MO – Dec. 5
Robller Vineyards and Winery, New Haven, MO – Dec. 6
Les Bourgeois Winery, Rocheport, MO – Dec. 7

Bergmeier, E.A., R.A. Allen, R.K. Striegler, and D.T. Johnson. 2007. Baseline Survey of Vineyard Best Management Practice Adoption in the Ozark Mountain Region. HortTechnology (in preparation).

Johnson, Donn. Demonstrating best management practices for winegrape production in the Ozark Mountain Region. Presentation to the Mid America Fruit Growers Conference. Jan. 19, 2006.

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Tables and Graphs:

Table 1. Effect of canopy and crop load management practices on yield and fruit composition of Chardonel grapevines. Schoolhouse Vineyards, St. James, MO. 2006.

Treatment[z]	Yield (lbs/vine)	Yield (tons/acre)	Clusters/ vine	Cluster Wt (g)	Berry Weight (g)	Berries/ Cluster	Soluble Solids (%)	pH	Titratable Acidity (g/100 ml)
Control	34.9	10.6	85 a[y]	185.9	2.2	86	18.9	3.21	0.80
CT	32.9	10.0	73 ab	204.0	2.3	91	20.1	3.27	0.81
SP	34.8	10.5	86 a	187.5	2.1	91	18.5	3.23	0.82
SP+CT	26.6	8.0	66 ab	181.2	2.2	83	19.2	3.27	0.80
ST	26.4	8.0	62 ab	193.7	2.3	84	20.1	3.24	0.82
ST+CT	26.9	8.1	58 b	206.1	2.3	90	19.7	3.29	0.80
ST+SP	27.4	8.3	65 ab	191.7	2.2	89	18.9	3.29	0.82
ST+SP+CT	24.3	7.4	54 b	201.9	2.4	85	19.8	3.30	0.82
	n.s.	n.s.		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

[z] Control = no canopy or crop load management treatments imposed; CT = cluster thinning; SP = shoot positioning; ST = removal of noncount shoots

[Y] Means followed by the same letter do not differ significantly; n.s. = not significant. Means separation using the Tukey-Kramer HSD test at the 0.05 level.

Table 2. Effect of canopy management practices on yield and fruit composition of Vignoles grapevines. Les Bourgeois Vineyards, Rocheport, MO. 2006.

Treatment[z]	Yield (lbs/vine)	Yield (tons/acre)	Clusters/ vine	Cluster Wt (g)	Percent Rot Yield by Weight	Berry Weight (g)	Berries/ Cluster	Soluble Solids (%)	pH	Titratable Acidity (g/100 ml)
Control	10.9	4.0	74	66.8 ab[y]	3.6	1.7	40.6 b	23.3	3.29	1.10 ab
LR	10.6	3.8	78	60.5 b	3.1	1.6	38.6 b	23.7	3.32	1.02 abc
SP	14.1	5.1	96	67.0 ab	3.3	1.6	41.9 ab	23.5	3.33	1.12 a
SP+LR	10.8	3.9	71	66.3 ab	1.9	1.6	41.3 ab	23.2	3.33	1.03 abc
ST	9.2	3.3	58	70.0 ab	3.2	1.6	44.4 ab	23.9	3.33	0.99 bc
ST+LR	10.1	3.7	60	76.6 a	2.3	1.6	49.3 a	23.8	3.37	1.00 bc
ST+SP	10.6	3.8	62	77.7 a	2.7	1.6	49.2 a	23.6	3.36	1.03 abc
ST+SP+LR	8.6	3.1	53	74.0 ab	3.8	1.6	45.7 ab	23.9	3.40	0.96 c
	n.s.	n.s.	n.s.		n.s.	n.s.		n.s.	n.s.	

[z] Control = no canopy or crop load management treatments imposed; LR = basal leaf removal; SP = shoot positioning; ST = removal of noncount shoots

[Y] Means followed by the same letter do not differ significantly; n.s. = not significant. Means separation using the Tukey-Kramer HSD test at the 0.05 level.

Table 3. Effect of cluster architecture modification treatments in 2005 on performance of Vignoles grapevines. Stone Hill Winery, Hermann, MO. 2006.

Treatment	Yield (lbs/vine)	Yield (tons/acre)	Clusters/ Number	Cluster Wt (g)	Berries /Cluster	Berry Weight (g)	Soluble Solids (%)	pH	Titratable Acidity (g/100 ml)
Control	7.5	2.7	46	73.5	104	1.7	24.5	3.48	0.98
Brushing	6.9	2.5	40	77.7	107	1.7	24.8	3.48	0.95
Leaf Removal	7.0	2.5	41	76.1	103	1.7	24.9	3.49	0.96
	n.s.[z]	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

[z] Means followed by the same letter do not differ significantly; n.s. = not significant. Means separation using the Tukey-Kramer HSD test at the 0.05 level.

Table 4. Effect cluster architecture modification treatments on performance of Vignoles grapevines. Stone Hill Winery, Hermann, MO. 2006.

Treatment	Yield (lbs/vine)	Yield (tons/acre)	Clusters/ vine	Percent Rot Yield by Weight	Clusters with Rot (%)	Cluster Wt (g)	Berry Weight (g)	Berries/ Cluster	Soluble Solids (%)
Control	9.77	3.5	51.0	12.4	10.7 ab[z]	86.6 a	1.7 a	51 a	24.3
Brushing	8.98	3.3	47.7	11.4	9.6 ab	86.1 a	1.8 a	49 ab	24.2
Leaf Removal	7.38	2.7	49.4	8.1	6.3 b	67.3 b	1.6 b	42 b	24.6
Stylet Oil	9.15	3.3	50.3	14.7	12.0 a	82.7 ab	1.7 a	48 ab	24.4
	n.s.	n.s.	n.s.	n.s.					n.s.

Treatment	pH	Titratable Acidity (g/100 ml)	Average Cluster Length (cm)	External Berry Number	Internal Berry Number	External to Internal Ratio	Total Berry Number	Berries per cm Rachis Length
Control	3.39	1.17	9.7	60.4	11.0 a	8.3	72	7.3
Brushing	3.39	1.19	9.8	56.4	7.2 ab	11.9	64	6.3
Leaf Removal	3.45	1.14	9.4	55.9	6.9 b	12.3	63	6.6
Stylet Oil	3.37	1.16	10.3	64.5	9.9 ab	8.7	74	7.2
	n.s.	n.s.	n.s.	n.s.		n.s.	n.s.	n.s.

[z] Means followed by the same letter do not differ significantly; n.s. = not significant. Means separation using the Tukey-Kramer HSD test at the 0.05 level.