VITICULTURE PROGRAM

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INTRODUCTION

Current efforts of the Viticulture Program of the Institute for Continental Climate Viticulture and Enology fall within the areas of extension, research, and teaching. The teaching program has started with an introductory course, Grapes and Wines of the World, being offered during the Fall 2007 semester. Beginning with the Fall 2008 semester courses will be offered leading to a degree in Plant Science with an emphasis in Viticulture or in Food Science with an emphasis in Enology. Two extension positions have been advertised; one in viticulture and one in enology. Candidates were interviewed and the positions have been filled. Ms. Rebecca Ford from Lincoln University in New Zealand has accepted the Extension Associate – Enology position and Ms. Jackie Harris from Colorado State University has accepted the Viticulture Extension Assistant position. The Enology Program Leader/Research Enologist position

is currently being advertised. The 2007 report will deal strictly with the Viticulture Program efforts.

EXTENSION

The following activities have been completed during the past year:

1. Grape Pruning Workshops - Altus, AR – January 8, 2007
   Rocheport, MO, January 18, 2007
   St. Genevieve, MO, February 13, 2007
   St. James, MO – February 14, 2007
   Hermann, MO, February 15, 2007
2. Midwest Grape and Wine Conference and Missouri Grape Growers Association Annual Meeting, Osage Beach, MO - February 3-5, 2007
3. Missouri Grape Production Short Course - ongoing
4. Make site visits for problem diagnosis or site evaluation as requested
5. Publish an electronic advisory for Missouri and regional growers periodically
6. Respond to requests for information by phone, e-mail or letter as needed
7. Vineyard Best Management Practices Project
8. Crop Loss survey – Fall 2006
9. Freeze Damage Survey – spring and Summer 2007

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

The vineyard best management practices demonstration and verification (BMP) project began in April 2005 upon receiving notice of grant approval in late March. The project is funded jointly by the Missouri Wine and Grape Board and the Viticulture Consortium East. It is a two-state, three-year project with the following objectives:

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

2) To demonstrate grape best management practices.

3) To disseminate grape management and insect pest and/or disease event information in a timely manner.

4) To produce a Wine Grape Best Management Practices Workbook for use in grower best management practices workshops.

Six lighthouse vineyard sites were selected and the cooperation of the owners to participate in the project was obtained. The cooperating vineyards were Wiederkehr Wine Cellars in Altus AR, Lynn Gay Farm in Hindsville, AR, Crown Valley Winery in Ste. Genevieve, MO, St. James Winery in St. James, MO, Stone Hill Winery in Hermann, MO, and Les Bourgeois Winery in Rocheport, MO. (Note: Due to the loss of Viticulture Consortium – East funding in 2007, the tailgate meeting sessions at Altus, AR were cancelled.)

Weather stations with predictive software for major grape diseases (black rot, powdery mildew, downy mildew, and botrytis) were placed in each of the lighthouse vineyards during the March/April 2006 round of tailgate meetings. Grape berry moth traps were also placed at each site in early April to monitor grape berry moth presence and development. Japanese beetle traps were set out in Hindsville, AR in June and grape root borer traps were set out in July at each vineyard site. A person at each location was instructed in how to scout for the presence of these insect pests in the traps weekly and trap counts were reported to Dr. Johnson on a regular basis. Vineyard personnel were instructed how to download data from the weather station and operate the predictive models. They were responsible for sending the weather data to Johnson. Johnson and Lewis collected weather data at the Arkansas sites. Trap catch and degree day were posted on the web (http://comp.uark.edu/~dtjohnso/) for each site. Allen and Striegler established canopy management demonstration plots at each of the sites in 2005 and applied the canopy management techniques appropriate for the time of season and cultivar and trellis system used at each location. These techniques included some, but not all (except in one instance), of the following: shoot thinning, shoot positioning, cluster thinning, leaf removal, and all possible combinations thereof. In 2006, the demonstration blocks were not renewed at the Crown Valley Winery and Wiederkehr Wine Cellars locations due to poor crop level and severe winter injury to the

vines, respectively. The plots were harvested in 2005 and 2006 and the data were analyzed and presented to the growers at season wrap-up meetings scheduled in December of each of those years. Due to vine damage and reduced and variable crop levels caused by the Easter freeze of 2007, these plots were not managed or harvested in 2007.

A benchmark survey of current industry vineyard management practices was conducted in the winter of 2005/2006. The data were summarized and a report on current viticultural practices in the Ozarks Mountain region is being submitted to HortTechnology.

The most important aspect of this project is the communication of information to growers in the region. As part of this project, pruning demonstrations were held at each location in January and four vineyard tailgate meetings were held at each site (except Altus, AR) in March/April, May, June, and July. Growers from MO, AR, and IL were invited to and in attendance at the site nearest their location. Allen and Striegler discussed aspects of vineyard management, including nutrition monitoring and fertilization, canopy and crop load management, fungicide spray programs and pre-harvest intervals. A topic of great interest and much discussion during this season was vine recovery and vineyard management in the aftermath of the Easter freeze. Canopy management techniques were demonstrated and explained to growers in attendance and their relative beneficial contribution to crop quality and pest management was discussed. Johnson discussed identification of the various insect pests and how to monitor for their presence and for damage through trapping and scouting within the vineyard. Insect life cycles and their relation to temperature were explained and growers were instructed how to determine action thresholds and in the most appropriate times to make efforts at controlling each insect pest. Additionally, Dr. David Lockwood was a guest speaker during the July tailgate meetings, discussing grape root borer control and vertebrate pest management techniques. Other methods of communicating information are also being utilized. As previously mentioned, Johnson posted weather data, disease model outputs, and insect trap catch data on his website. A website for the ICCVE has been established (http://iccve.missouri.edu) and information is beginning to be posted to it. A BMP workbook that will define what the best management practices are and how and when they are to be applied for maximum benefit will be developed this fall and

reviewed by a committee composed of industry personnel. The workbook will be revised as new information from the BMP project is developed.

RESEARCH

The following research priorities were compiled from a survey of Missouri growers in 2003:

1. Cultivar evaluation with emphasis on adaptability to Missouri conditions
   Key areas: cold hardiness, disease resistance and fruit quality

2. Efficient and sustainable production systems for Missouri vineyards
   Key areas: canopy management, nutrition/fertilization, vineyard mechanization, rootstock evaluation and irrigation

3. Management of insect pests and diseases
   Key areas: integrated pest management and propagation of virus free material

4. Viticultural practices to address issues in production of Norton and Vignoles

A new survey of research priorities will be conducted in Winter/Spring 2008.

Research activities in the Viticulture Program are focused on these priorities and are as follows:

CULTIVAR EVALUATION

Evaluation of winegrape cultivars for Missouri and the Ozark Mountain Region
(R.K. Striegler)

Grape cultivar selection is an important part of the vineyard establishment process. Planting the right cultivar in an appropriate site can often mean the difference between profit and loss for the vineyard enterprise. In the mid 1990's, hybrid wine grape selections were imported from breeding programs in Eastern Europe (Bulgaria, the Czech republic, Hungary, Moldavia, Romania and the Ukraine). The viticultural performance of these selections and selections and/or cultivars from breeding programs in Germany and the eastern United States (Cornell and the University of Minnesota) are

being evaluated in southern Missouri at the MSU – Mountain Grove campus. All cultivars from Eastern European sources are certified free from known viruses before they are planted into evaluation blocks. Over the course of several years five separate experiments were established as new selections were made available. Control treatments are Norton/Cynthiana (red cultivars) and Vignoles (white cultivars).

Data collection includes dates of important phenological events, dormant pruning weight, yield, components of yield, fruit composition and primary bud cold hardiness. Selected cultivars (those showing superior viticulture performance) are made into wine, and wine chemistry is determined. The first three of the experiments have been completed and the plantings removed. Results from the earlier plantings indicated that Kozma 55, Laurot and Regent are promising red wine grape cultivars. These varieties have been moved to a second stage experiment where they have been grafted to several rootstocks. Within the fourth experiment two of the selections from Cornell University, NY62.122.1 and NY70.809.1, were named (Valvin Muscat and Corot noir, respectively) and commercially released in July, 2006. Additionally, another Cornell University selection that was planted in the third experiment block, NY73.136.17, now known as Noiret, was also released in July. Many of the Eastern European selections begin growth very early in the season and are at higher risk of frost or freeze injury. The Easter freeze of 2007 resulted in many of these selections being severely damaged to the point where cordons or trunks are being retrained this season. Evaluation of the materials in the fourth and fifth experiments are ongoing.

ROOTSTOCK EFFECTS ON YIELD AND QUALITY

Effect of rootstock on performance of Chambourcin and Vignoles grapevines

(R.K. Striegler and J.R. Morris)

Two of the more important wine grape cultivars for the Ozark Mountain Region are Chambourcin (red) and Vignoles (white). These cultivars are generally planted as own-rooted vines since the use of rootstocks is not widespread in this district nor is there sufficient information on the appropriate combinations of scion/rootstock for optimum productivity and adaptation to the environmental stresses found in the region. A study was established in 2000 at the Arkansas Agricultural Research and Extension

Center, Fayetteville, AR to determine the effect of rootstock on productivity, fruit composition and wine composition of Chambourcin and Vignoles. Vines were planted in a drip-irrigated vineyard with plant spacing of 2.4 m x 3.1 m (vine x row) and a Captina silt loam soil. Vines were trained to a Geneva Double Curtain trellis system and row orientation is north to south. Rootstock treatments for Chambourcin were: own-rooted, 5BB Kober, Freedom, 3309 Couderc, 1103 Paulsen, and 44-53 Malègue. Treatments for Vignoles were: 3309 Couderc, 5BB, Freedom, and own-rooted.

In 2006, rootstock selection did not have a significant affect on any component of yield for Chambourcin. As in 2004 and 2005, Chambourcin grafted on 44-53 Malègue rootstock exhibited yield which was numerically lower than the other rootstocks but the difference was not statistically significant from vines grafted to any of them. All treatments produced very high yields (>9 tons/acre). Cluster number and cluster weight was not significantly different between rootstock treatments in 2006. Berry weight and the number of berries per cluster were not significantly altered by rootstock treatment. Choice of rootstock had a limited effect on fruit composition of Chambourcin vines in 2006. Juice titratable acidity of fruit from vines grafted to 44-53 was significantly lower than own-rooted vines and vines grafted to all other rootstock treatments except 3309C. Pruning weights indicated no significant difference in vine size as affected by rootstock.

As in 2005, rootstock selection had no significant effect on yield or fruit composition of Vignoles in 2006. Yield of Vignoles vines grafted on 3309C rootstock was numerically higher than yield of vines grafted to other rootstocks. All treatments produced very high yields (>8 tons/acre). Clusters/vine was highest for vines grafted on 3309C and lowest for vines grafted on 5BB. Vines grafted to 3309C produced the largest berries. Percentage soluble solids and pH of fruit from all vines were very similar. Titratable acidity was numerically higher for fruit from own-rooted vines as compared to grafted vines in 2006. Vine size as measured by pruning weights displayed no significant difference between rootstock treatments although vines grafted to 5BB were numerically smaller. These experiments have been completed and the vineyards removed.

Effect of rootstock on performance of Cynthiana/Norton grapevines
(R.K. Striegler and J.R. Morris)

Vines were planted in a drip-irrigated vineyard with plant spacing of 2.4 m x 3.1 m (vine x row) and a Captina silt loam soil. Vines were trained to a Geneva Double Curtain trellis system and row orientation was north to south. Rootstock treatments were: own-rooted, 5C, 101-14 MGT, 3309 Couderc, 1103 Paulsen, and 44-53 Malègue.

Rootstock had no significant effect on components of yield in Norton grapevines in 2006. Vines grafted on 3309 rootstock had numerically higher yield than vines grafted to other rootstocks while own-rooted vines had the lowest. Yields of all treatments were high (>10 tons/acre). Cluster number per vine and cluster weight did not differ significantly between rootstock treatments. As with total yield, values for these variables were numerically highest for vines grafted to 3309C. Berry weight was highest from vines grafted to 3309C. The number of berries/cluster was not significantly affected by rootstock selection and was nearly identical for all treatments.

Rootstock selection had no significant impact on fruit composition in 2006. Percent soluble solids of fruit from vines grafted to 3309 was slightly lower than that from vines grafted to other rootstocks or from own-rooted vines. Fruit pH and titratable acidity were not significantly affected by rootstock in 2006. As with the Chambourcin and Vignoles rootstock experiments at the Arkansas Agricultural Research and Extension Center, this experiment has been completed and the vineyard block removed.

New rootstock evaluation projects

New rootstock experiments have been established in several commercial vineyards in Arkansas and Missouri during recent years. These trials will examine the performance of many important winegrape cultivars grafted to several rootstocks. Most of these will enter their first production year in 2008. Scion cultivars included in these experiments include: Chambourcin, Traminette, Vignoles, Cabernet Franc, Norton, and Chardonel. Most of these will enter their first production year in 2008.

OTHER STUDIES

Influence of shoot thinning, shoot positioning, and leaf removal on yield, fruit composition and vegetative growth of Norton grapevines

(R.K. Striegler)

Norton is the flagship variety of the Missouri wine industry. While the fruit is generally of very high quality, high juice pH and high acidity can be a problem. This situation is often aggravated by dense canopies that result in fruit developing in very shaded conditions. New esperiments were established in commercial vineyards at two locations in Missouri in 2006 to examine the effect of different canopy management treatments on canopy density, yield, and fruit composition of Norton. Vines were balance-pruned during the winter and canopy management treatments (shoot thinning – ST, shoot positioning – SP, leaf removal – LR) were applied at the appropriate time during the 2006 season. The blocks were harvested in late September, 2006.

At the southwest Missouri location, canopy management treatments only had significant effects on yield and titratable acidity (TA). The application of ST+SP+LR significantly reduced yield as compared to the control vines. Treatments which included both SP and LR (SP+LR, ST+SP+LR) reduced TA as compared to the ST only treatment. No treatment was significantly different from the control vines. At the central Missouri location, canopy management treatments significantly affected yield, average cluster number, average cluster weight and fruit pH. Treatments that included removal of non-count shoots (ST) significantly reduced yield compared to the Control treatment, except where ST was applied alone. This was due to a reduction in average cluster number per vine in treatments which included ST, but only the treatment combination of ST and SP was significantly different from the Control vines. Treatments that included LR had the lowest average cluster weights while treatments that included ST but not LR had the highest.

In 2007, this project was expanded to include plots at another central Missouri location. While yields were reduced by the freeze, all of these plots will be harvested later this season.

Improved management of bunch rot diseases on Vignoles

(R.K. Striegler, T.B. Sutton. A. Allen)

Vignoles is one of the more important winegrape cultivars in Missouri, comprising 9 percent of the state's grape acreage in 2001. However it is very susceptible to bunch rot diseases and in well-managed vineyards losses of one third of the crop are not uncommon in wet growing seasons. Most growers think of bunch rot as being primarily caused by Botrytis (*Botrytis cinerea*) and indeed, most grape literature and the spray guides from major grape producing areas, when discussing bunch rot, speak primarily of Botrytis bunch rot. However, bunch rot is a "catch-all" term for many diseases that affect fruit as they begin to mature. Surveys of grape fruit rot diseases in Missouri and North Carolina showed that among the most important bunch rot diseases in hot summer climate grape production regions of the eastern U.S. are bitter rot (*Greenaria uvicola*), ripe rot (*Colletotrichum acutatum*, *C. gloeosporioides*, *C. cingulata*), macrophoma rot (*Botryosphaeria dothidea*), phomopsis (*Phomposis uvicola*), and sour rot (disease complex). *Botrytis cinerea* was only found in a very small percentage of infected clusters in these surveys. A limited survey of Vignoles vineyards in Missouri conducted in 2005 (T. Sutton and A. Allen unpublished) found that sour rot, macrophoma rot and bitter rot were the most common diseases. Many of these pathogens had previously been considered to mainly occur in muscadine grapes and the information available about their occurrence in vineyards of the U.S. has come primarily from muscadine pathology research. As researchers have become aware of the presence of these organisms in the summer rot complex of bunch grapes, however, more effort has been devoted to research on their epidemiology and control. The objectives of this trial are (1) to evaluate various fungicide programs in small plots and demonstration blocks and (2) to survey vineyards of Vignoles at harvest throughout Missouri to determine the major bunch rot diseases present.

Small plot fungicide spray trials were established at two commercial vineyards in Missouri with a history of bunch rot problems on Vignoles. Applications of different fungicide spray programs began shortly after bloom and continued up to harvest. Just before harvest plots at both locations were rated for incidence and severity of the different bunch rot organisms. Additionally, 10 vines were surveyed for the presence of different bunch rot disease-causing organisms at each of four commercial vineyards

that used the recommended “best” program from the small plot fungicide trials. Samples were collected at each site for further lab analysis.

Results from the 2006 fruit rot survey showed that sour rot, macrophoma rot, bitter rot, and ripe rot were the primary fruit-rotting organisms present in Missouri Vignoles vineyards. No botrytis was found at any location. The 2006 season was extraordinarily dry leading up the start of the Vignoles harvest and overall disease incidence was very low, leading to a notably clean crop. Of the diseases that were found, sour rot had the greatest incidence of occurrence, followed by bitter rot, ripe rot, and macrophoma rot. Bitter rot had the greatest rating for severity, followed by sour rot, ripe rot and macrophoma rot. In this low disease-incidence season, there were no significant differences in control by any of the spray programs tested and none were different from the control.

Due to the reduction in the Vignoles crop at all locations caused by the Easter freeze, the second year of this project was put on hold until the 2008 season.

Evaluation of Mechanical Pruning and Shoot Thinning on Chardonel Grapevines
(E.A. Bergmeier, R.K. Striegler, and J.R. Morris)

The cost and availability of labor are important considerations for winegrape growers in Missouri and the Ozark Mountain Region. Successful grape production requires that growers produce a sustainable yield of high quality fruit at the lowest possible cost per ton. Production systems which feature mechanization of key practices such as pruning, canopy management, and crop control provide a means by which growers can potentially meet the requirements for successful grape production.

A study was initiated in 2005 to compare mechanical pruning and shoot thinning with the same hand-performed operations on Chardonel. The experimental plot is located in central Missouri on a Union silt loam soil with artificial drainage and drip irrigation. Vine and row spacing are 7’ X 9’, and vines are trained to a high bilateral cordon system. Vines are grafted on 3309C rootstock. Hand pruning and hand shoot thinning serve as the controls in this experiment with four treatment combinations: hand pruning (utilizing a pruning severity of 20 nodes retained per lb. of cane prunings) plus hand shoot thinning (removal of all non-count shoots at 4-6” shoot length), hand pruning plus

machine shoot thinning, machine pruning plus hand shoot thinning, and machine pruning plus machine shoot thinning. Mechanical pruning and shoot thinning were accomplished using a Korvan Vineyard Products unit. The experimental design is a split plot with pruning strategy serving as the main plot and thinning strategy serving as the subplot. Data being collected include vegetative growth, yield, components of yield, fruit composition, and canopy characteristics according to shoot origin (count vs. non-count vs. lateral). The goal is to produce experimental wines from the four treatments in 2008 and 2009 and perform chemical and sensorial analysis on these wines.

Preliminary results from the 2006 season indicate that machine pruned vines produced statistically higher yields from count shoots than hand pruned vines regardless of thinning treatment. This result was due to machine pruned vines having a higher number of count clusters per vine than hand pruned vines, again regardless of thinning treatment. Pruning treatment had a significant impact on composition of fruit from count shoots. Hand pruned, machine thinned vines produced the highest percentage soluble solids, while hand pruned, hand thinned vines produced the highest pH and lowest titratable acidity for count fruit. Yield data from non-count shoots differed when compared to yield data from count shoots in several important ways. Yield from non-count shoots was highest for the hand pruned, hand shoot thinned treatment, and this was statistically different than the other treatments. Pruning and thinning treatments did not significantly impact fruit composition of the crop born on non-count shoots, but did impact the amount of secondary (lateral) crop produced. Hand pruning plus machine shoot thinning produced the greatest amount of second crop, and the machine pruned, hand shoot thinned treatment produced the lowest amount. The other two treatments were intermediate, and did not differ statistically from each other. This experiment will continue through at least the 2009 season.