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INTRODUCTION

There were major changes in viticulture and enology programs in Missouri during 2006. Personnel from the Mid-America Viticulture and Enology Center (MVEC), Missouri State University – Mountain Grove moved to the University of Missouri (MU) campus at Columbia to become part of the newly formed Institute for Continental Climate Viticulture and Enology (ICCVE). Keith Striegler and Andy Allen were the only MVEC faculty and staff to move to the ICCVE. Current efforts of the Viticulture Program of the Institute for Continental Climate Viticulture and Enology fall within the areas of extension and research, although a major goal of the Institute is to establish a teaching program in 2007. The viticulture teaching program will be developed working in collaboration with colleagues in Plant Science while the enology teaching program will be developed working in collaboration with colleagues in Food Science.

EXTENSION

The following activities have been completed during the past year:

1. Grape Pruning Workshops -
 - Altus, AR – January 13, 2006
 - Hindsville, AR – January 14, 2006
 - St. Genevieve, MO, January 17, 2006
 - St. James, MO – January 18, 2006
 - Hermann, MO, January 19, 2006
 - Rocheport, MO, January 20, 2006
2. Midwest Grape and Wine Conference, Osage Beach, MO - February 4-6, 2006
3. Missouri Grape Growers Association Annual Meeting, Ste. Genevieve, MO - March 11, 2006
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

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 was begun 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.

Once notice of grant approval was given, six lighthouse vineyard sites were selected and the cooperation of the owners to participate in the project was obtained. The cooperating vineyards are 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. 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 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 Winecellars locations due to poor crop level and severe winter injury to the vines, respectively. The plots are now being harvested and the data will be analyzed and presented to the growers at season wrap-up meetings scheduled for the week of December 4th. A benchmark survey of current industry vineyard management practices was conducted in the winter of 2005/2006. The data is currently being summarized and a report and magazine article on current viticultural practices in the Ozarks Mountain region will be published.

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 in March/April, May, June, and July. Growers from MO, AR, OK, KS, 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, and berry sampling for maturity determination. 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 and Lewis 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. George Leavitt was a guest speaker during the June tailgate meetings, discussing grapevine canker diseases, powdery mildew modeling, and grape bunch rot trials in California. 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. The ICCVE is currently working to establish a website for the Institute. A page will be devoted to the BMP project. 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

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 Europe sources are certified free from known viruses before they are planted into evaluation blocks. Over the course of several years five separate trials 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 trials 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. Within the fourth trial 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 trial block, NY73.136.17, now known as Noiret, was also released in July. Evaluations of the materials in the fourth and fifth trials 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 are trained to a Geneva Double Curtain trellis system and row orientation is north to south. Rootstock treatments are: own-rooted, 5BB Kober, Freedom, 3309 Couderc, 1103 Paulsen, 44-53 Malègue, and 110 Richter.

In 2005, rootstock selection did not have a significant affect on any component of yield for Chambourcin. As in 2004, 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. Cluster weight was not significantly different between rootstock treatments in 2005. Berry weight and the number of berries per cluster was not significantly altered by rootstock treatment. Choice of rootstock had a limited effect on fruit composition of Chambourcin vines in 2005. Juice titratable acidity of fruit from vines grafted to 44-53 was significantly lower than vines grafted to 1103 P or 5BB or own-rooted vines.

Rootstock selection had no significant effect on yield or fruit composition of Vignoles in 2005. 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. Clusters/vine was highest for vines grafted on 3309C and lowest for own-rooted vines. Own-rooted Vignoles vines produced the largest berries. Percentage soluble solids of fruit from vines grafted on Freedom was higher than for the other treatments. This result may be related to the yield obtained from this treatment which was lower than the yield recorded for the other rootstocks or own-rooted vines. Fruit pH was highest for vines grafted to Freedom rootstock. Titratable acidity was relatively high for all treatments in 2005. The 2006 season will be the final year for these rootstock trials. Pruning weight and shootless node data will be collected this winter and after budbreak and the trials will be discontinued.

Effect of rootstock on performance of Cynthiana/Norton grapevines

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

Norton grapevines exhibited a significant yield response to rootstock selection. In 2005 vines grafted on 3309 and 1103 rootstocks had significantly higher yield than vines grafted on 44-53 rootstock. The yield of vines grafted to 101-14 and 5C rootstocks or own-rooted vines was intermediate. The number of clusters/vine was significantly greater for vines grafted on 1103 and 3309 and own-rooted vines than for vines grafted on 44-53. Clusters/vine for vines grafted on 1103 was also significantly higher than for vines grafted to 101-14 or 5C. Cluster weight did not differ significantly between rootstock treatments. Berry weight from vines grafted to 44-53, 3309, and 101-14 was significantly higher than for own-rooted vines. Additionally, berry weight from vines grafted to 44-53 was also significantly higher than for vines grafted to 1103 and 5C. The number of berries/cluster was not significantly affected by rootstock selection.

Rootstock selection had a significant impact on fruit composition in 2005. Percent soluble solids of fruit from vines grafted to 3309 was significantly higher than that from vines grafted to 44-53 or from own-rooted vines. Fruit pH and titratable acidity were not significantly affected by rootstock in 2005. As with the Chambourcin and Vignoles rootstock trials at the Arkansas Agricultural Research and Extension Center, this will be the final year for this rootstock trial. Pruning weight and shootless node data will be collected this winter and after budbreak and the trial will be discontinued.

Other rootstock trials have been established in several commercial vineyards in Arkansas and Missouri. These trials will examine the performance of many important winegrape varieties grafted to several rootstocks. Most of these will enter their first production year in 2007.

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 trials were established in commercial vineyards at two locations in Missouri in 2006 to examine the affect 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 were applied at the appropriate time during the 2006 season. Harvest of these blocks has not occurred at the time of this report.

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 (*Phomopsis 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. The data is currently being compiled for analysis.

Morphological and molecular characterization of fungal species associated with grapevine trunk diseases in Missouri

(R.K. Striegler, W.D. Gubler, J.R. Urbez-Torres)

Grapevines are affected by many diseases but fungal trunk diseases especially lead to massive damage in this crop worldwide. Trunk diseases of grapevines are caused by fungal pathogens that invade through pruning wounds located on the woody parts of the plant, and symptoms include a slow decline and dieback of the vine as a result of interruption of xylem conductivity and/or toxin production. Grapevine trunk diseases principally include esca (black measles) and young vine decline, caused by different species of *Phaeoacremonium* and *Phaeomoniella chlamydospora*, respectively; Eutypa dieback, caused by *Eutypa lata* and *Eutypa leptoplaca*, and Botryosphaeria canker caused by at least 9 different species of *Botryosphaeria*. These diseases decrease the life of a vineyard, reduce yields and increase production costs due to control treatment applications, cultural practices to prevent infections, pruning out of the diseased tissue, and training new cordons and spur positions to replace those killed by the disease. However, the actual situation of grape trunk diseases in Missouri and more generally the fungal pathogens associated with those diseases remains unclear, rendering difficult all attempts to control disease development. Also, this confusion may mislead farmers towards the application of inappropriate, unnecessary and costly methods to control disease development. The objectives of this project are:

1) to identify and characterize the current population of fungal species associated with grapevine dieback in Missouri and 2) to determine the pathogenicity and virulence of fungal species associated with grapevine dieback in Missouri.