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A History of Bunch Grapes Research in Mississippi

ERIC T. STAFNE

Abstract

Bunch grapes research in Mississippi has helped shape the current grape industry in the southeastern United States. Cultural management studies, cultivar and rootstock trials, processing (wine, juice, raisin), and Pierce's disease research all contributed to the base knowledge of the region. Research began at Mississippi A&M College as early as 1888 and presently continues at Mississippi State University. The most impactful research over the years was primarily in the areas of Pierce's disease identification and plant response and cultivar development. Norman Loomis, United States Department of Agriculture, pushed grape research forward in Mississippi for decades. His work was influential and eventually led to the release of three bunch grape cultivars, Miss Blanc, Miss Blue, and MidSouth. Today, the grape industry in Mississippi is very small, but with rapidly growing industries in surrounding states it seems only a matter of time before Mississippi follows and grape research once again becomes a substantial area of interest.

It is not often that the bunch grapes (*Vitis* spp. subgenus *Euvitis* Planch.) research done in Mississippi is cited or even recalled in current literature. Mississippi is better known for muscadines (*Vitis rotundifolia* Michx. syn. *Muscadinia rotundifolia* subgenus *Muscadinia* Planch.), but several native species of bunch grapes also exist throughout Mississippi. Bunch grapes have played a significant role in Mississippi horticultural research over the past 125 years, most notably the work of Norman Loomis who worked at the United States Department of Agriculture (USDA) in Meridian, Mississippi, as well as several researchers at Mississippi A&M College (later Mississippi State University). Loomis performed much of the formative research in the early to mid-20th century with contributions from other researchers before and after that time.

For many years bunch grapes research was emphasized by horticultural researchers, especially in the work of trialing new cultivars for the state. At one time or another several experiment stations around Mississippi had bunch grape trials, including those in Beaumont, Crystal Springs, McNeill, Meridian, Ocean Springs, Starkville, Stoneville, and Verona. The primary areas of research can be divided into five main areas: Cultural Studies, Pierce's Disease (PD) (*Xylella fastidiosa* Wells et al.), Cultivar and Rootstock Trials, Cultivar Development, and Processing.

Cultural Studies

Pruning, tipping, thinning, and fertilizer studies were performed to understand how those practices would affect different grape cultivars under Mississippi growing conditions (Overcash, 1950). As in many grape growing regions, one specific concern in Mississippi is frost. Even in south Mississippi frost is a concern, especially with early budbreak cultivars. In one study with 'Extra', Loomis (1939) found that late winter pruning (early to mid-March) retarded growth and may be of use in frost avoidance. Even though late pruning delayed foliation and flowering, it did not affect fruit ripening or subsequent vine growth.

A later study by Loomis (1942) with 'Champanel' examined cane pruning vs. spur pruning. 'Champanel' was known to yield poorly when cane pruned. The study also included a treatment where the tip of the shoot was pinched off after the point of the last in-

[1] Associate Extension and Research Professor, Mississippi State University

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florescence. Yields of 'Champanel' improved significantly when spur pruned. The pinching treatment improved cluster weights as well, but not yields. Thus, spur pruning was recommended for 'Champanel', but the value of the pinching treatment was questioned.

Loomis (1949) followed up the earlier 'Champanel' study by expanding on the pinching aspect of the first study. The earlier study showed no significant differences in yield and vine growth between pinched and nonpinched treatments, although the data showed an increase in yield of 3.08 kg with pinching. Although not statistically significant, further examination was warranted. In the later study, more vines were used and the study encompassed five seasons. This additional work showed that pinching 'Champanel' shoots at or just after flower increased fruit yields and decreased pruning weights. Loomis suggested that pinching be used for only very vigorous cultivars and when vines were unbalanced.

Uneven ripening is another problem for many red grape cultivars in the South, especially 'Concord'. Cluster thinning is one strategy to combat uneven ripening. Ragland (1939) cluster thinned 'Campbell's Early', 'Concord', and 'Delaware' in hopes of improving uniformity in fruit ripening. Leaving one cluster per shoot reduced yields by 25% and leaving two clusters per shoot reduced yields by 10%; however, cluster size was increased significantly as was ripening uniformity. For 'Concord', clusters had 20.3% and 9.8% fewer green berries when one and two clusters per shoot were retained, respectively. Thinning also hastened harvest by approximately one week. Although undiagnosed at the time, Ragland described symptoms of "leaf scorch" which was probably PD. Cluster thinning dramatically reduced these symptoms and improved the overall vine appearance, likely due to an overall reduction in vine stress. Overcash (1955a) performed similar studies on 'Concord' and 'Delaware' when grafted to 'Dog Ridge' rootstock.

Another method to alter ripening is through the use of plant growth regulators (PGRs). Overcash (1955b) applied several PGRs to 'Concord', but failed to enhance ripening uniformity. Four PGRs (sodium thiocyanate (NaCNS), 2,4,5-trichlorophenoxypropionic acid (2,4,5-TP), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), and maleic hydrazide (MH)) were applied at several rates, but no treatment increased ripening uniformity. However, some were phytotoxic to the leaves and shoots, especially 2,4,5-T, which often led to berry shatter.

Much of this work done by Loomis, Overcash, and others, along with research in surrounding states, especially in Florida, helped shape current recommendations for Mississippi (Stafne, 2016). Past research also played a role in determining new research needs. Current vine cultural management research includes crop forcing, compensatory fruit yields, and timing of fruit removal as it affects vine establishment.

Pierce's Disease

Pierce's disease was largely unknown for the first half of the 20th century. It was seen as a mysterious "degeneration". In the 1950s and 1960s it was still considered a virus, not a bacterium (Hewitt et al., 1958). Even as late as the early 1980s the exact cause of PD was undetermined (Stojanovic et al., 1980). Loomis (1958, 1961) reported symptom expression on several cultivars and species of bunch grape. The disease was found in most cultivars, but some lived longer and displayed greater vigor. Lack of these traits was linked to PD infection. Very few cultivars showed no symptoms over a two year period, including 'Dog Ridge' and 'Herbemont'. *Vitis palmata* Vahl was the only species that did not exhibit symptoms or evidence of infection when indexed. 'Beta', 'Concord', and 'Niagara' all showed symptoms and were considered to be short-lived cultivars in areas where PD was prevalent. Loomis opined that it was resistance or klendusity. The study found that seasonal weather conditions played a substantial role in the symptom expression of

the disease. Pierce's disease continues to be a major limitation, because so few commercial quality cultivars are resistant to the disease.

Cultivar and Rootstock Trials

Trialing unproven cultivars, rootstocks, and their numerous combinations were a point of emphasis for Mississippi researchers from the late 19th to the middle of the 20th century. Bunch grapes were widely grown in the eastern U.S., especially 'Concord', but hybrid and *V. vinifera* L. grapes were also making in-roads. The climate of Mississippi is certainly warm enough and with a long ripening season such that grape cultivars can ripen adequately; however, high night temperatures and high humidity make management a challenge. Therefore, it was important to identify cultivars that could survive in these conditions.

An early report from the Mississippi Agricultural Experiment Station (MAES) (1890) stated that 86 cultivars of grapes had been planted for evaluation in 1888. The following year's report (MAES, 1891) described the first harvest of several cultivars. Interestingly, the report said that 10 lb (4.5 kg) of bones obtained from a nearby slaughterhouse were buried under the ground where each vine was planted. 'Brilliant' and 'Niagara' were considered the best after one harvest. Later reports continued to describe the progress of grapevine cultivar trials, with descriptions of fruit quality and disease incidence the primary descriptors (MAMCES, 1892, 1897, 1903). By 1894 the trial had grown to 122 cultivars and two locations, Starkville and Ocean Springs. Fungal diseases such as black rot (*Guignardia bidwellii* (Ellis) Viala and Ravaz) and ripe rot (*Glomerella cingulata* (Stoneman) Spauld. & H. Shrenk) were reported, but no problems with mildews were observed (MAMCES, 1894).

Mississippi A&M College released the first bulletin on growing grapes in Mississippi in 1892 (Tracy and Earle, 1892). The authors recommended grape production in Mississippi as the vines grew well and most diseases could be controlled, aside from bitter rot (*Greeneria uvicola* Berk. & M.A. Curtis). The best performing cultivars in south Mississippi were 'Ives', 'Champion', 'Delaware', 'Niagara', and 'Concord' and best in the north were 'Moore's Early', 'Delaware', 'Brilliant', 'Niagara', 'Eaton', 'Triumph', 'Rommel', and 'Herbemont'. Numerous European (*V. vinifera*) cultivars were tried but were susceptible to spring frost as well as mildew diseases. At this time PD was also unknown and may have contributed to the failure of these cultivars.

By 1895 the cultivar trial grew to 152 (MAMCES, 1895). Insect pests were not mentioned until Earle (1896) described sawfly larvae (*Erythraspides vitis* Harris) and grape leaffolder (*Desmia funeralis* Hübner) as minor problems near the Gulf Coast. The trial was terminated in 1898 and a final report was published by Moore (1899). A total of 124 grape cultivars were described with details of good and bad attributes, but only 11 were recommended as being suitable for shipping and or local market production. Tracy (1900) presented a slightly different list broken down by fruit color and maturity time.

Grapevines were planted again in 1902 at the McNeill Branch Station, with intentions to expand if they proved successful (Ferris, 1903). By 1905, up to 40 more cultivars were being trialed by Mississippi A&M College researchers (MAMCES, 1905). A later publication by Ferris (1922) stated that attempts to establish a rootstock trial with *V. vinifera* cultivars was a complete failure. The losses were attributed to poor growing conditions and later-than-desired planting. Cultivar testing continued after prohibition began on a modest scale, as reported by Anderson (1924) and later by Loomis (1948), but new trials shifted toward evaluating rootstocks.

Many popular grape cultivars, such as 'Concord' and some *V. vinifera*, perform poorly in Mississippi due to factors including high heat, humidity, and disease pressure. To combat these conditions, rootstocks were tri-

aled as an attempt to improve vine productivity, fruit quality, and overall vine health and survival. An early trial (Loomis and Lutz, 1937) focused on the poor ripening of own-rooted 'Concord'. The purpose of the study was to determine if grafting 'Concord' could improve the amount of leaf area produced on the vine, as an earlier study showed promise in yielding better quality fruit when leaf area was greater than 20,000 cm^2 per vine. After testing 10 different rootstocks, they concluded that the use of a rootstock could influence 'Concord' fruit quality via vine vigor and that grafted vines were superior to own-rooted vines. Therefore, they recommended using grafted 'Concord' to improve uneven ripening and lack of vigor.

Soil-borne problems, such as diseases, insects, and excess salinity, may also exist, necessitating the need for tolerant rootstocks (Loomis, 1943). A study in the Gulf Coast region of Mississippi (Poplarville) evaluated 42 rootstocks for their survival and commercial potential (Magoon et al., 1937). Results were not consistent. Some *V. riparia* Michx. x *V. rupestris* Scheele rootstocks performed well and others were failures. Those that contained *V. champini* Planch. (i.e. 'Barnes', 'Joly', 'De Grasset', and 'Dog Ridge') all performed well. In a concurrent study in Meridian, MS (Loomis et al., 1939), 'Dog Ridge' performed well and 'Aramon' x rupestris Ganzin 2 was also rated highly, whereas at Poplarville it was a complete failure. 'Solonis' x Othello No. 1613 also failed at Poplarville, but acceptable at Meridian. The studies differed in that the Poplarville study only evaluated rootstocks while the Meridian study had grafted vines. Several cultivars improved when grafted, depending on the rootstock; some cultivars performed better on certain rootstocks only to die on others. Only eight cultivars out of 58 proved successful when grown on their own roots over a six-year period: 'Champanel', 'Champion', 'Delaware', 'Extra', 'Herbemont', 'Lenoir', 'Marguerite', and 'R.W. Munson'. The study was continued another two years (Loomis et al., 1943) whereupon 'Dog Ridge' was declared the clear superior rootstock; however, they cautioned that scion-rootstock interactions occurred and continued evaluation was necessary to elicit the best combinations for each cultivar.

Two further rootstock trials (Loomis, 1952; Loomis, 1965) also found that the proper scion-rootstock combination was key to success. Of particular note in the 1952 study, a triploid muscadine hybrid proved very successful. It was described in the 1965 study as B-4 5, a 'Scuppernong' x 'Louisiana' hybrid. 'Dog Ridge' again performed well for many cultivars, especially 'Concord' where yields were twice that of other rootstocks in the 1952 trial. In the 1965 study, Loomis suggested that 'Dog Ridge' was the best overall option because it had resistance to PD and nematodes.

In 1972 grape and wine research became a major focus (Hegwood, 1987). By 1975 Mississippi State University researchers were testing 80 grape cultivars at four locations in the state: Crystal Springs, Richton (Beaumont), Stoneville, and Verona. Hegwood (1987) stated that many of the hybrid cultivars tested, including 'Seyval blanc', 'Vidal blanc', 'Chancellor', 'De Chaunac', 'Aurora', 'Baco Noir', 'Chelois', 'Rosette', 'Alwood', 'Moored', 'Carman', and all *V. vinifera* cultivars (Cabernet Sauvignon, Pinot Noir, Chardonnay, Chenin blanc, Sauvignon blanc, and Semillion) died in fewer than 10 years and some by the third growing season. Only 'Villard blanc' was still alive after 10 years. Trials continued on into the 1980s with inclusion of the Florida hybrid grapes, such as 'Lake Emerald' and 'Blue Lake' (Tyner et al., 1982, 1983). Many of the cultivars were removed in 1984 to facilitate more planting space for muscadine vines (Tyner et al., 1984).

Cultivar Development

Three bunch grape cultivars were released from Mississippi State University in the early 1980s: 'MidSouth', 'Miss Blue', and 'Miss

Blanc' (Overcash et al., 1981; 1982). These three cultivars are resistant to PD, making them among the few bunch grape cultivars that can be grown successfully in the Deep South. Presently, they are difficult to obtain and are not available through the nursery trade. However, enterprising hobbyists and some research stations have kept them in circulation. The grape breeding program was originally part of the USDA Horticultural Field Station near Meridian, Mississippi under the leadership of Norman Loomis. The USDA and Mississippi State University collaborated to test new grape selections from the 1940s to the 1970s. 'Miss Blue', resulting from a 'Dog Ridge' x 'Moore Early' cross, has a 'foxy' aroma and flavor from the *V. labrusca* L. parent. 'MidSouth' was also reported to have this characteristic, but it has no *V. labrusca* in its parentage, but rather *V. champini*, *V. vinifera*, *V. rupestris*, *V. berlanieri* Planch., and *V. lincecumii* syn. *V. aestivalis* var. *lincecumii* Buckley (Munson) (Stafne, 2015b). Neither of these grapes were recommended for wine production upon release although Overcash et al. (1981) indicated they might produce wines in the same class as 'Concord' and 'Cynthiana'. Recently, 'MidSouth' has found new life when used in blends with mead (honey wine) (Stafne, 2015a). 'Miss Blanc' was released as a juice grape with potential for use in wine blends (Overcash et al., 1982).

Processing

The A.B. McKay Food and Enology Laboratory was constructed on the campus of Mississippi State University in 1974 to support new agricultural enterprises. It began operation in 1975 which was followed by the Native Wine Act in Mississippi that allowed for commercial production and sale of wine made from grapes produced solely within the state (MSU, n.d.). Wine research by Boris Stojanovic was well under way by the late 1970s and many *V. labrusca*, *V. vinifera*, and French-American hybrid grapes were evaluated for their wine quality when grown in Mississippi environments (Vine et al., 1982). The lab still exists today, but has not made wine for some time.

There is no substantial raisin production outside of California in the United States. However back in the early 1940s, American grapes were dried in an attempt to make raisins. Loomis (1946) stated that this type of production was suggested (without saying by whom), but it could have been part of wartime agricultural efforts. In a study done during 1943 and 1944 on grapes grown in Meridian, MS and Beltsville, MD few of the grapes made high quality raisins. 'Seneca' was deemed the most palatable, but many of those with high amount of *V. labrusca* were described as having an objectionable taste (i.e. foxy). Sun drying was an acceptable method, especially when dipped in lye for a short period of time prior to drying. The conclusion was that American-type grapes could be useful for home use, but not likely for commercial purposes.

Future Directions

Bunch grapes are not big business in Mississippi. There are very few wineries and those in existence primarily use muscadine fruit to produce wine. One of the biggest needs is better cultivars. As Stafne et al. (2015) stated, the South may be the region in the most need of grapevine breeding. Other factors in need of improvement, outside of political challenges, include disease resistance (especially anthracnose (*Elsinoë ampelina* (de Bary) Shear), seedlessness, reduced fruit cracking, higher quality fruit for wine production (both white and red, but particularly red), and increased length of fruit storage.

Currently, several studies are being conducted with bunch grapes in south Mississippi. Cultivar trials are comparing standard PD-resistant and tolerant cultivars (e.g. 'Blanc Du Bois', 'MissBlanc', 'Villard blanc') with newer genotypes that have not been tested under Deep South conditions. From these cultivars, a small-scale breeding program has been initiated to develop new

selections with a focus on disease resistance (PD and anthracnose), loose cluster architecture, and high fruit yields. Other concurrent studies include vine spacing, crop forcing, and different pruning strategies to achieve the best quality fruit in the hot, humid Gulf South climate.

Nearby states like Tennessee, Alabama, and Georgia are enjoying strong, vibrant grape and wine industries that continue to grow year after year. Areas of Mississippi can produce good quality fruit for the processing or fresh markets. The current research projects are on a small-scale, but the pieces are in place to expand if stakeholders dictate the need for it.

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