The muscadine, or muscadine grape (Vitis rotundifolia Michx., or, alternatively, Muscadinia rotundifolia Small), is native to the Southeastern United States and has been cultivated for >400 years. Indigenous muscadine populations range throughout the southeastern U.S., except in mountainous areas, but are most abundant in the coastal plains along the Atlantic Ocean and the Gulf of Mexico. There is no other fruit with such strong personal associations for many native Southerners. The fruit has a distinct fruity, or “musky” aroma, while the juice by itself is sweet with a light taste and aroma, and lacks the “sticky” after-taste of some fruit juices. If the southeastern U.S. were to establish an official regional fruit, it would quite likely be the muscadine (Gohdes, 1982). The fruit has been eaten fresh and made into juice, wine, pies, jelly, etc., for as long as people have inhabited the natural range of muscadines. Native Americans preserved muscadines as dried fruit long before Europeans inhabited this continent (Bartram, 1791).

There are currently >1600 ha of muscadines in commercial production (Olien, 1990). More than 95% of this production is in coastal states from North Carolina to Louisiana. The commercial history of this crop has been based primarily on wine production. As early as 1765, Captain John Hawkins reported that the Spanish settlements in Florida made large quantities of muscadine wine (Hedrick, 1908). The current industry includes production for wine, fresh fruit, and “U-pick” operations. A recent motivating force has been the production of unfermented juice and other processed products on an industrial scale for national markets.

Native muscadines are functionally dioecious (Hedrick, 1908; Reimer and Detjen, 1910), with male vines making up three quarters of the population (Reimer and Detjen, 1910). Nearly all native female vines produce dark purple to black fruit, but a small percentage of the population bear light yellow (bronze) fruit at maturity. These rare bronze-fruited vines have been especially valued from early times because of greater stability when made into wine (Gohdes, 1982; Hedrick, 1908). In marked contrast to Eu- vitis grapes, the anthocyanin constituents of dark-fruited muscadines are readily oxidized, resulting in off-colors and -flavors after aging (Ballinger et al., 1974). Recently discovered muscadine germplasm may allow improvements in the anthocyanin balance in future breeding of dark-colored muscadine cultivars (Goldy et al., 1989).

For much of the history of this crop, cultivars were simply wild selections preserved through vegetative propagation. The first recognized muscadine cultivar was a bronze selection, found before 1760 by Isaac Alexander in Tyrrell County, N.C. (Reimer, 1909). This selection is important historically, as well as viticulturally, as the first American grape cultivar. It was at first known as ‘The Big White Grape’ or ‘Hickmans Grape’, and was later named ‘Scuppernong’ after the area in which it was found (Reimer, 1909). With time, the name scuppernong became generic for all bronze muscadines, regardless of actual cultivar name. In common usage, scuppernongs are sometimes even thought of as a separate species from muscadines or “bullises”, traditional generic names for the dark-fruited types.

Bullis and its variants (bullace, bullet grape, bull grape) are very old names for dark-fruited muscadines. The origin of this name is not so generally known as that of scuppernong, but it is an intimate part of muscadine heritage and lore. Not surprisingly, there is no consensus on the etymology. Bartram wrote in 1802 (as cited in Hedrick, 1909) that “Bull grape” was an abbreviation of “Bullet grape”, so called because the fruit were the size of a musket ball. Others state that “Bull” reflects comparison of the berries with cow pig eyes, or, alternatively, that muscadines were called “Bullace” because of their resemblance to a European plum of the same name, and that Bullis, Bull, and Bullet are corruptions of Bullace (Gohdes, 1982).

Muscadines are usually considered to be a grape, both in common terminology and in taxonomic classification. However, there is a long and controversial history regarding how closely “bunch grapes” (i.e., “true grapes”, or Euvitis, such as the European Vitis vinifera L., American V. labrusca L., etc.) and muscadines are related. These groups differ on every level, including chromosome number, vine and berry anatomy and morphology, and physical and chemical characteristics of the fruit and juice (Olien, 1990).

The most commonly used nomenclature for muscadines and true grapes is that accepted by Bailey (1937), Hedrick (1908), Liberty Hyde Bailey Hortorium (1976), Radford et al. (1968), and Terrell et al. (1986). These authors follow the classification of Planchon, published in 1803 (as cited in Hedrick, 1980), which divides the genus Vitis L. into two subgenera: Euvitis Planch. and Muscadinia Planch. Euvitis contains ≈60 species (Winkler et al., 1974), with >20 species of American origin (Muson, 1909; Bailey, 1937). There have been only three species identified in the Muscadinia group, all native to North America (Fennell, 1940; Weaver, 1976; Winkler et al., 1974). Of these, the common name “muscadine” refers exclusively to V. rotundifolia Michx., initially described by Michaux in 1803 (Hedrick, 1908).

An alternative classification was provided by Small (1913). He did not recognize the subgenera classification of Planchon, but instead placed the “true grapes” under Vitis, and the Muscadinia as a separate genus. Thus, the scientific name for muscadines becomes Muscadinia rotundifolia Small. In light of the cytogenetic, anatomical, and morphologic differences referred to previously, some recent authors have adopted Small’s nomenclature (Bouquet, 1980; Chaparro and Goldy, 1989; Olmo, 1986; Weaver, 1976). In fact, there is reason to believe that the Muscadinia are the remnants of a much older group once widely distributed around the world, and that “true grapes” descended from the Musca-dinia after the last ice age (Bouquet, 1980).

Regardless of taxonomic classification, musca-dines and Euvitis are different in necessary horticultural practices and in fruit and processing characteristics (Olien, 1990).

Nearly 100 years of breeding work has resulted in the release of many improved cultivars. An early goal was to develop perfect-flowered, self-fertile cultivars. The first of these were released in 1948 (Dearing, 1948). Since that time, many cultivars have been released with improved yield and fruit quality for both fresh fruit and processing uses. At present, about 25 cultivars account for most of the commercial production (Olien, 1990). There are scores of additional cultivars in limited production and grown in backyards. ‘Scuppernong’, long the major cultivar, has been replaced by ‘Carlos’, ‘Doreen’, ‘No-bel’, ‘Magnolia’, and others for juice and wine; and by ‘Fry’, ‘Jumbo’, ‘Sugargate’, etc. for fresh fruit. The first seedless muscadine cultivar, Fry Seedless, is now available commercially. Further development of seedless types is expected (Goldy et al., 1988).

A second long-standing goal among both V. vinifera and V. rotundifolia breeders has been to produce hybrids between these species (Einset and Pratt, 1975). Hybridization is difficult due to a difference in chromosome number (2x = 2n = 38 in Euvitis and 2x = 2n = 40 in Muscadinia), and has only been successful when Euvitis is used as the female parent (Einset and Pratt, 1975). Hybrids could overcome weaknesses in both species. Vitis vinifera is highly susceptible to pests and diseases, requiring the use of pesticides, especially in humid regions, and must be grown on resistant rootstock to avoid devastation from grape phylloxera (Phylloxea vitifoliae Fitch), a root-infesting insect, and other pests and diseases (Bouquet, 1980; Einset and Pratt, 1975; Winkler et al., 1974). In contrast, muscadines are relatively tolerant to pests and diseases common in North America. This degree of tolerance would make muscadines extremely valuable as
rootstock for *Euvitis* grapes, except that *Eu-
vitis* and muscadines are graft-incompatible (Winkler et al., 1974). Thus, there has been a
desire to genetically incorporate pest- and
disease-tolerance from muscadines into bunch
grape cultivars and rootstock. At the same
time, breeders would like to incorporate *Eu-
vitis* traits into muscadine to increase juice
yield per tonne of fruit, to modify juice
chemistry (especially anthocyanins) for im-
proved juice and wine stability, and to in-
corporate heedlessness from *Euvitis* into
muscadine-like hybrids (Carroll, 1985; Goldy
et al., 1988; Lane, 1978).

The hybrids that have been produced are
completely or nearly sterile (Einset and Pratt,
1975), and no hybrid cultivars have been re-
leased for fruit production. However, there is
evidence that *V. vinifera* is graft-compat-
ible with *Euvitis × rotundifolia* hybrids, and
two such hybrid rootstock have recently been
released as disease- and pest-tolerant root-
stock (Walker et al., 1989). In vitro tech-
niques, including embryo culture (Goldy et al.,
1988,) and protoplasmosis isolation (Lee and
Wetzstein, 1988), are being developed to fa-
cilitate hybridization of these species.

In addition to cultivar improvement, en-
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In addition to cultivar improvement, en-
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quality of wine, juice, and products such as
jelly, syrup, etc. These subjects recently were
reviewed by Carroll (1985). Current efforts
include developing means to increase mus-
cadine juice yield per tonne of fruit (Carroll,
1985). Content of ellagitannin and ellagic acid
in muscadine products is also becoming an
important topic (Lin and Vine, 1989). Ellag-
itannins are easily hydrolyzed to release el-
lagic acid (Robinson, 1983). Under in vitro
laboratory conditions, ellagic acid inhibits the
activity of chemical carcinogens such as
polycyclic aromatic hydrocarbons, aflatoxin,
and nitrosamines (Stoner, 1989; Windholz,
1983). It is yet to be determined whether
consumption of muscadine, strawberry,
raspberry, blackberry, and other fruit high in
ellagitannins are effective in reducing cancer
(Stoner, 1989).

Viticultural problems of muscadines have
been dealt with to a much lesser extent than
breeding and processing. Detailed musca-
dine production manuals have been pub-
lished for >100 years, but many of the
recommendations have come from observa-
tion, and not from controlled, replicated
studies. There has often been an assumption
that cultural methods developed for *Euvitis*
grapes should directly transfer to muscadines,
but differences in growth and fruiting habit
make this impractical in many cases (Olien,
1990). The concept of canopy design for op-
timum light climate and a pruning system to
balance vegetative and reproductive growth
have never been adequately addressed in
muscadines. Additional topics that need fur-
ther research include optimum planting and
establishment methods, nutrient fertility
needs, optimum soil moisture control through
the season, vineyard floor management, and
integrated control strategies for pests and
diseases, especially the grape root borer (*Vi-
tacea polistiformis* Harris). Lack of physio-
logical and cultural research in these areas
are major limitations to continued growth and
stability of the muscadine industry. Research
is needed in these areas before the grower
and processor can be assured of consistent
yields, high fruit quality, maximum eco-
nomic efficiency, and reasonable profit.

Complete installation costs for a new
vineyard (including an irrigation system, la-
bor, equipment, etc.) are estimated at (in U.S.
dollars) $865/ha ($3500/acre) and costs of
harvest, recommended cultural practices,
equipment depreciation, etc., in mature
vineyards are about $370/ha ($1500/acre)
(Bateman et al., 1987). Some states have in-
stituted programs to help offset interest pay-
ments on loans for new vineyards until produc-
tion begins in the 3rd or 4th year. Fresh
fruit and U-pick sales are more limited than
to processors, but prices paid to the
grower are four to seven times that for
processing muscadines. Current prices paid
growers by processors are around $220/ton
($200/ton), with net profit from mature vine-
yards estimated at $940/ha ($380/acre) for
yields of 20 t/ha (9 tons/acre) (L. Bate-
man, unpublished data). Average yields are
below these values in many states, but yields of
> 20 t/ha are readily attainable with im-
proved cultivars and cultural practices.

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