

VARIATION AND CORRELATION OF BUD BREAKING, FLOWER OPENING AND FRUIT RIPENING IN MUSCADINE GRAPE CULTIVARS

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Abstract. The most important muscadine grape cultivars used as table grapes are pistillated and need pollinators in order to set fruits. This study investigated the anthesis time and pollen quality among the major muscadine cultivars, from which different perfect-flower cultivars are hopefully recommended as pollen donors for females. Thirty-four cultivars (15 female and 19 self fertile) grown in the Experimental Vineyard at Florida A&M University were chosen for this study. Time for flower opening in 1%, 50% and over 90% were recorded for each cultivar. The earliest anthesis was found in 'Triumph' and 'Fry', while the latest were 'Summit' and 'Marsh'. 'Triumph', 'Southern Home', 'South Land', 'Digby', 'Doreen' and 'Alachua' began anthesis earlier and had shorter duration time than other perfect-flower cultivars. The anthesis of 'Senoia' and 'Tara' was the latest among the perfect-flower cultivars. The perfect-flower cultivars 'Carlos', 'Nesbitt', 'Coward' and 'Noble' had a long duration of anthesis that overlapped many pistillate cultivars and should be considered as good pollinators. According to the different time of anthesis, fifteen female-flower cultivars can be divided into early and late groups. The early group was 'Fry', 'Rosa', 'Higgins', 'Jumbo' and 'Pink Hunt'. The late group included 'Black Fry', 'Sweet Jenny', 'Big Gill', 'African Queen', 'Pam', 'Darlene', 'Farrer', 'Black Beauty', 'Supreme' and 'Summit'. Based on the anthesis time, 'Alachua', 'Triumph' are recommended as pollinators for the early anthesis female cultivars, while 'Senoia' and 'Tara' are recommended for the late-anthesis female cultivars. 'Noble', 'Coward', 'Carlos' and 'Nesbitt' can be used for both early- and late-anthesis cultivars. Correlation among bud breaking, flower opening and fruit ripening was estimated among the 20 selected cultivars. Results showed that there are some correlations between bud breaking and anthesis, anthesis and fruit ripening.

The muscadine grape (*Vitis Rotundifolia* L.), a species adapted to a humid, warm climate and resistant to many diseases and pests (Olmo, 1971), are originated and commercially cultivated in the southeast United States. Muscadines are different from *Euvitis* species (bunch grape) in many aspects such as dioeciousness, bark, leaf, and cluster characteristics (Olmo, 1971).

Perfect flower, pistillate flower, and staminate flowers are three types of flowers found in grapes (Pratt, 1971). The stamens of perfect flowers (hermaphrodite) are erect with the anthers producing functional pollen and the pistil is functional. Nearly all commercially important cultivars of *Vitis vinifera* are hermaphrodite (Michael, 1992). In pistillate flowers found on female vines of dioecious species or cultivars, the pistil is well developed and functional but the stamens are

more or less reflexes and the pollen is generally sterile. Muscadine grapes have all three types of flowers, but the commercial grapes are either female flowers or perfect flowers. Anthesis in muscadine is weeks later than most *Euvitis* grape species (Bunch grapes). The anthesis time of most muscadine cultivars, particularly to those recently released cultivars in recent years, has not been recorded. Gupton (1998) reported the effects of pollen productivity and viability of different cultivars on fruit set and suggested that pollination may not be a problem in present muscadine cultivars. Variation in yield among cultivars apparently relates to genetic differences in cluster number, fruit set and berry weight. Selection of pollen parents that can overlap most of other cultivars should be noted for getting a higher yield. A better understanding of the time difference for anthesis among the muscadine cultivars can help growers to select suitable pollinators.

Another characteristics of muscadines is that it has a longer anthesis duration that leads to uneven fruit ripening. Only limited research has been reported on bud breaking of muscadines (Onokpise, 1987). No report has been found on the correlation among bud breaking, flower opening and fruit ripening in muscadine grapes. Coefficient correlation calculation is a simple and effective method for interpreting relationships among these three events, which will be useful for facilitating selection of pollinators and estimating time for fruit maturation.

Materials and Methods

Thirty-four cultivars (15 female and 19 self fertile), with two vines in each cultivar, were selected for investigation of anthesis. The time of flower opening at 1%, 50% and over 90% were recorded for each cultivar between May and June, 1999. Twenty out of the thirty-four cultivars were selected for correlation calculation. The date of 1%, 50% and over 90% bud breaking, flower opening and fruit ripening, respectively, were used for calculation of the Correlation Coefficient (R_{xy}) among these three events. R_{xy} represent the degree of relationships between two independent variables:

$$R_{xy} = \frac{C_{xy}}{(V_x V_y)^{1/2}} = \frac{\Sigma X \cdot Y - \Sigma X \cdot \Sigma Y / n - 1}{\{[\Sigma X^2 - (\Sigma X)^2 / n - 1][\Sigma Y^2 - (\Sigma Y)^2 / n - 1]\}^{1/2}}$$

where X is Variable A and Y is Variable B and R_{xy} is in between 0-1 (Richards, 1997). In our case, variables are a relative time of bud breaking, anthesis and fruit maturation. The input data for Variable A and Variable B is the fraction of relative days for the correspondent cultivar which was derived from the actual date for that cultivar minus the earliest date happened among the 20 cultivars as numerator and total duration days (from the earliest to the latest cultivars) as denominator. For example, the correlation coefficients between the beginning (1%) of anthesis and fruit ripening of cultivar "Noble" can be estimated by this way: 1% anthesis happened on May 11, fruit maturation occurred on August 3. The earliest day for anthesis was May 9 and fruit ripening was July 13. An-

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thesis occurred among the cultivars for 11 days and fruit ripening took 29 days. The input record for X (variable A) is 3/11 and Y (variable B) is 22/29 for Noble.

If R_{xy} is closed to 1, it means that Variable A and Variable B have a highly positive correlation. When R_{xy} is less than 0.5, it will normally be considered that no significant relationships existed between A and B.

Result and Discussion

Muscadine cultivars showed uneven anthesis. The time for anthesis ranged from 11 to 22 days among different cultivars, beginning (1%) on May 9 for cultivars "Triumph" and "Fry" and ending (over 90%) on June 4 for "Marsh". "Marsh" took the shortest time to complete over 90% anthesis (11 days) while the longest one was "Cowart" (22 days). Among the perfect-flower cultivars, "Triumph", "Southern Home", "Southland", "Digby", "Doreen" and "Alachua" had earlier and shorter anthesis time compared with other cultivars while "Senoia" and "Tara" started the latest in anthesis.

The fifteen female-flower cultivars can be divided into the early- and late-anthesis groups. The early group consisted of 'Fry', 'Rosa', 'Higgins', 'Pink Hunt', 'Jumbo' and Ga 9-11-2 which started between May 9 and May 11. The late group included 'Black Fry', 'Sweet Jenny', 'Big Gill', 'African Queen', 'Pam', 'Jumbo', 'Pink Hunt', 'Darlene', 'Farrer', 'Black Beauty', 'Supreme' and 'Summit' of which anthesis were between May 12 and May 19.

One important factor to select good pollinators for female muscadine cultivars is to look at the overlapping in an-

thesis. Based on this investigation, 'Alachua' and 'Triumph' are good pollinators for the early anthesis female cultivars, while 'Senoia' and 'Tara' are recommended for the late-anthesis group. 'Noble', 'Cowart', 'Carlos' and 'Nesbitt' can be used for both early and late female-flower groups because they have a long anthesis duration that overlapped most of the female cultivars. Other factors like pollen viability and quantity should also be considered for selection.

Correlation coefficient (R_{xy}) among bud breaking, flower opening and fruit ripening was estimated. There was a positive correlation between 1% bud breaking and flower opening ($R_{xy} = 0.67$), and between completion (over 90%) of anthesis and fruit ripening. Correlation was also found between peak (50%) of bud breaking and flowering opening. No correlation was identified among the rest of events. There was no correlation at all between bud breaking and fruit ripening at all the three stages (1%, 50% and over 90%).

Literature Cited

- Gupton, C. L. 1998. Reproductive efficiency in muscadine grapes. HortSci. 33(3):483
Mullins, M. G., A. Bouquet and L. E. Williams. 1992. Biology of the Grapevine. Cambridge University Press.
Olmo, L. 1971. *Vinifera rotundifolia* hybrids as wine grapes. Am. J. Enol. Vitic. 22:87-91.
Onokpise, O. U. and I. Inyang. 1987. Early pruning of muscadine and bunch grapes in North Florida. Proc. Fla. State Hort. Soc. 100:310-312
Pratt, C. 1971. Reproductive anatomy in cultivated grapes: a review. Am. J. Enol. Vitic. 22:92-109
Richards, A. J. 1997. Plant Breeding Systems. Second edition. Chapman & Hall.

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SPRING FROST DAMAGE TO FOUR PIERCE'S DISEASE RESISTANT BUNCH GRAPE CULTIVARS IN NORTH FLORIDA

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Abstract. Two unseasonal spring frosts (daily low temperature below 0°C) occurred in North Florida in March of 1996 and 1998, when the new shoots of the four studied bunch grape cultivars ('Blanc du Bois', 'MidSouth', 'Orlando Seedless', and 'Suwannee') were up to a few cm long. The freeze damage se-

verity (number of collapsed young shoots / total young shoot number) of each vine was calculated. All four cultivars lost more than 70% of their new shoots. Results from Duncan's multiple range test ($\alpha = 0.01$) indicated that damage to 'Orlando Seedless' (severity mean = 0.94) was significantly different from 'Blanc du Bois', 'MidSouth', and 'Suwannee' with the severity means of 0.76, 0.74, and 0.82, respectively.

Although Pierce's disease (PD, *Xylella fastidiosa* Wells et al.) is a major obstacle to grape production, interests remain in growing high quality bunch grapes (*Vitis vinifera* L. and its hybrids) in Florida and the Gulf Coastal regions (Burgess, 1991). Several bunch grape cultivars were released from University of Florida and Mississippi State University in the 1980's. While these cultivars are regarded as PD resistant and possess acceptable horticultural traits, their capacities to resist or tolerate other unfavorable factors remain to be tested. For example, cultivar 'Orlando Seedless' was found to be highly susceptible to anthracnose (*Elsinoe ampelina* [de Bary] Shear) after its release in 1986 (Mortensen and Gray).

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