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Field Observations of Machine-harvest Inefficiencies and Suggested Corrective Measures for a Commercial 'Noble' Muscadine Grape Block Trained to a Single Cordon

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For two growing seasons, 2010 and 2011, in northeastern Florida, several producers sharing the same mechanical harvester reported difficulty harvesting 'Noble' muscadine grape (*Vitus rotundifolia* Michx.) berries. Field observation during the 2011 harvest of a 'Noble' muscadine by a model 2720 Braud® harvester showed visual differences in berry harvest depending on whether harvesting in the direction of the single-cordon or against it. Paired-row replicated hand-harvests of with-cordon and against-cordon harvests were systematically sampled on a diagonal field transect at progressive, four-row intervals for a total of four replications. Mean berry weight left in the vineyard was 2158 lb/acre when harvested in the direction of the cordon compared to 674 lb/acre when harvested against the direction of the cordon (F-test, $P = 0.001$). Field recommendation was to harvest every other row against the direction of the single cordon immediately. The additional 1484 lb of harvestable berries per acre justified the second pass by the mechanical harvester. Fruiting wood also appeared to have been aggressively pruned, placing the fruiting nodes close to the cordon. A recommendation was to not prune so closely to the cordon, so berries would be further from the cordon and more harvestable. Harvest direction efficiencies may need to be tested multiple seasons with this harvester before recommending training cordons in alternating directions for future plantings of 'Noble' vineyards.

The single-curtain training system with bilateral cordons of fruiting wood on the wire has been the standard training practice for commercial muscadine grape (*Vitus rotundifolia* Michx.) producers because of the ease of mechanically pruning and harvesting (Morris and Blevins, 2001). Recently, some growers have trained new plantings to a single cordon for early coverage of the wire, and hopefully more early production with less pruning and training labor. Posts are set at 19- to 21-ft centers. A vine is planted approximately a foot away from the support post. When the vine approaches the trellis wire it is bent over and allowed to run the full 18 to 20 ft to the next support post as a single cordon of fruiting wood.

For two growing seasons in northeastern Florida (2010 and 2011), several producers sharing the same mechanical harvester, having trained their vines to a single cordon in the same direction, reported difficulty harvesting 'Noble' muscadine grape berries. The 'Noble' berries tended to stay on the vine, in spite of repeated passes of a model 2720 Braud® harvester (Fiatagri, Coex, France). Field observation on 22 Aug. 2011 during the harvest operation within a 'Noble' block appeared as if only every other row was being harvested because of the amount of muscadine berries left on the cordons. The pattern of alternating rows of well-harvested vs. poorly-harvested berries visually appeared consistent through the field. Observation showed that when the harvester went with the run of the single cordon there was better harvest efficiency (Fig. 1.) than against the run of the single cordon (Fig. 2.). This was not the case in the 'Carlos' block that had been harvested several days previously adjacent to the 'Noble' block, with a similar field slope. This occurred in spite of having the harvester properly adjusted (Fiatagri, 1990) and operated by the same experienced person in all vineyards. There was a need to quantify the amount of berries left in the against- vs. with-cordon harvested rows.

Fig. 1. Muscadine grape harvested against the run of the cordon.

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Fig. 2. Muscadine grape harvested with the run of the cordon.

Materials and Methods

The Braud 2720® mechanical harvester had been freshly serviced according to the manual (Fiatagri, 2000) with the position of the shaker bars on the front plate and rear gantry assembled for the vine structure as well as the yoke, spread, and frequency adjustments. Evidence of proper mechanical harvester adjustment was the immediately prior harvest of 6 tons/acre of 'Carlos' muscadine berries in a small block adjacent to the 'Noble' block with no visually apparent irregularities. The vineyards had been planted with rows and single-cordon direction on the wire running north and south. The Braud 2720® mechanical harvester had begun on the south end of the first row of the 'Noble' vineyard. At the north end of the first row it was turned south onto the second row. So the pattern of with-cordon harvest direction started with the first row and continued on odd-numbered rows. The pattern of against-cordon harvest direction occurred on even-numbered rows.

In order to determine the pounds of berries left in the field as a result of the Braud 2720® harvest direction, a diagonal transect was run across the harvested portion of the vineyard. Using the direction of the Braud 2720® harvest as a reference point, sample rows were selected and flagged for berry yield data. Adjacent rows of with- and against-cordon were flagged in pairs to protect identity as we progressed across the harvested portion of the field on the diagonal transect. Four rows were then skipped to the next yield samples progressing on the transect, in order to maintain identity and systematically sample the harvested portion of the vineyard. A total of four replications of paired-row harvests were conducted. The entire 20-ft cordon of each pair was harvested and weighed separately. Weights per 20 linear ft were converted to berry weights per acre. A simple one-way analysis of variance was conducted to test the hypothesis that berry weight was a result of direction of cordon harvest.

Results and Discussion

Berry weight differences, left on the cordon after machine harvest, were significantly different ($F = 34.2$, $P = 0.001$) depending on direction of harvest. Mean berry weight left in the vineyard was 2158 lb/acre when harvested in the direction of the cordon compared to 674 lb/acre when harvested against the direction of the cordon (Table 1.).

Table 1. Paired cordon sample 'Noble' muscadine yields as a result of machine-harvest direction and harvestable difference.

Paired cordon samples	Harvested against the direction of cordon growth	Harvested with the direction of cordon growth	Harvestable difference
1	525	2787	2263
2	688	1774	1086
3	525	2226	1701
4	959	1846	887
Means	674*	2158*	1484

*Significantly different at $P = 0.001$.

Field recommendation to the grower was to harvest every other row against the direction of the single cordon immediately. This second pass was costly time-wise, as complete rounds of the block were required of the mechanical harvester. The additional 1484 lb of harvestable berries justified the second pass by the mechanical harvester. Table 2 shows varying contract price of the grapes and the value of the 1484 lb/acre of harvestable berries left when harvested in the direction of cordon growth. A range of contract prices are listed to provide an indicator of the potential cost of the field occurrence. Average contract price in Georgia was estimated at $400/ton (Krewer et al., 2002). Average contract price was estimated at $500 per ton of muscadine grape berries in North Carolina (Carpio et al., 2006).

It would have been advantageous if cordons had been trained in alternating directions in alternating rows for this block of 'Noble' so the harvester could have turned at the end of the row rather than having to drive completely around the block to harvest the next row against the direction of cordon growth.

Further field observation suggested another possible source of harvest inefficiency, for even the well-harvested rows left 674 lb of berries per acre (Table 1). Fruiting wood appeared to have been aggressively pruned, placing the fruiting nodes close to the cordon, where the shakers may not have been able to dislodge the berries (Fig. 3). Winter pruning recommendation was to not prune so closely to the cordon on the 'Noble' muscadine block, so berries would be further from the cordon and perhaps more harvestable.

Further investigation is needed to define the source of mechanical harvesting inefficiencies associated with harvest-direction of 'Noble' muscadine unilateral cordons trained in the same direction. If this is a continuing problem, an easy solution would be to train unilateral cordons in alternate directions when new vineyards of 'Noble' are planted. Perhaps other harvesters might be more efficient. The manufacturer should become involved in solving

Table 2. Estimated value of the 1484 harvestable berries left when harvested in the direction of cordon growth with various contract prices.

Contract price per ton ($/ton)	Contract price per pound ($/lb)	Value of 1484 lb of berries ($/acre)
500	0.25	371.00
450	0.225	339.00
400	0.20	296.80

Fig. 3. Berries set close (approximately 2 inches from the cordon and wire) were left by the mechanical harvester.

the problem. It appeared that pruning to more than two nodes so that berries are set at least more than 2 inches from the cordon may be helpful for further harvest efficiency.

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