

FINAL REPORT

Title: Balanced Pruning in (Fresh) Muscadine Grapes

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Extension Proposal

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Objectives:

1. To demonstrate the potential benefits of using “balanced pruning” to optimize yields, fruit quality and overall vine health in fresh muscadine grape vineyards.
2. To support the educational programs of commercial fresh muscadine growers in the Southeast with new, science-based information on dormant pruning procedures for fresh muscadine grapes.
3. To support an in-service agent small fruit pruning program for the SRSFC in early January 2014 (following the Savannah meeting at a local vineyard).

Justification:

Dormant pruning is the most important, costly and skill-requiring operation in fresh muscadine production. How you prune your vines will largely determine the quality and quantity of the crop. In this Final Report for a two (2) year project from January 2012 – December 2013, we provide information on how balanced pruning may be utilized with the fresh market muscadine cv. Supreme. Ideally, we would like to have at least three (3) more seasons to evaluate the benefits of this approach, but we are excited to report that in

just two (2) seasons are some indication that a 100 + 15 balanced pruning formula in Supreme may be a better way to prune this cultivar than the conventional practice of simply pruning every vine in a vineyard the same way, regardless of the productive ability of each vine (vine capacity). The way the 100 + 15 pruning formula works is that you leave 100 buds for the first 3 lbs. of pruning, and then add another 15 buds for each additional pound. For a Supreme vine with 6.6 lbs. of annual prunings, for example, you would leave 154 buds at dormant pruning $\{(100 \text{ buds for first 3 lbs} + (3.6 \times 15, \text{ or } 54) = 154\}$. The way that some growers prune Supreme is to leave about 180 (count) buds per vine, or 90 buds per 10 ft cordon (9 buds/ft) on every vine in the vineyard, no matter how great or small the weight of vine's annual prunings (the wood weight of canes from preceding summer's shoot growth). The problem with this approach is that a less productive vine with say 4.5 lbs. of annual prunings, should probably only have about 123 buds $\{(100 \text{ buds for first 3 lbs} + (1.5 \times 15, \text{ or } 22.5) = 123\}$ retained after dormant pruning, and not 180!

In bunch grape production, the weight of vine's annual pruning (the wood weight of canes from preceding summer's shoot growth) can be used as a good indicator of a vine's bearing capacity. Vine bearing capacity can, and does, vary greatly between vines even in the same row. As it turns out, the particular vine shown in Fig. 1 (plot 13) had 6.6 lbs of annual dormant prunings (weight of canes from preceding summer's shoot growth) in February 2012. And, this amount of pruning weight was about average for this 5 year old vineyard in King's Mountain, NC (in 2012). However, other Supreme vines in the same row had pruning weights as high as 9 lbs per vine, while others were as low as 4.5 lbs/vine ($\frac{1}{2}$ the pruning weight of the most vigorous vines in this vineyard). It is our hypothesis that each muscadine vine should be dormant pruned according to its actual vine capacity (as indicated by annual pruning weights), and not according to a pre-determined bud number per vine, which essentially ignores in vine-to-vine differences in bearing capacity. Likewise, we would also suggest that recommendations like the one found in the book, *Muscadine Grapes*, to cut back all shoot (cane) growth of the previous summer to spurs about 4 inches (10.2 cm) long (two to four buds), may be similarly inappropriate (Figure 2).



Figure 1. On this particular Supreme muscadine vine you can see evidence of sun-scalding and berries that did not ripen normally. This may be due to over-cropping - too many buds retained.

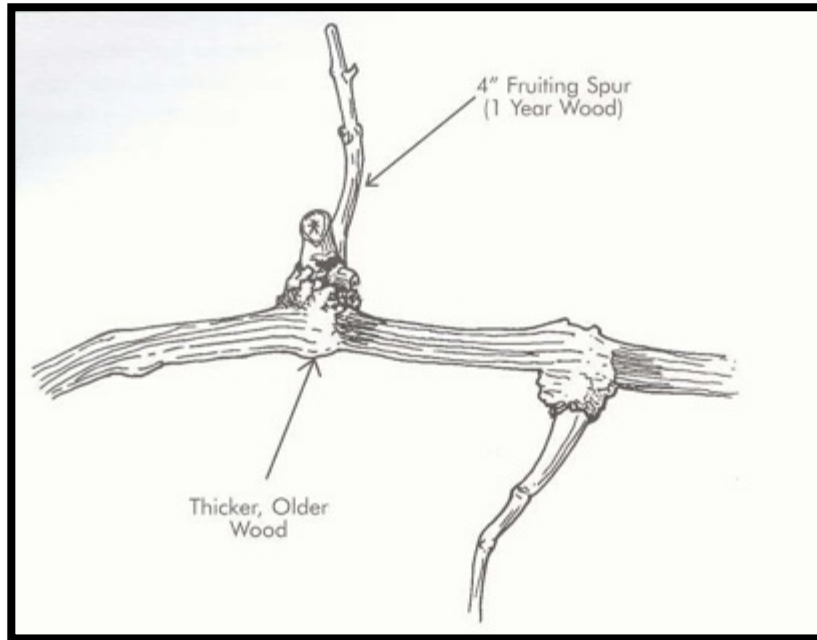


Figure 2. Typically, growers will try to select healthy fruiting spurs about every 5–6 inches. The individual spurs are pruned to two to four buds. Unfortunately, this is not a science-based formula, and it can lead to problems with removing too many buds on vines with higher productive ability (capacity).

For the very vigorous Carlos vine, published research findings at NC State University have shown that a $120 + 20$ balanced pruning formula may be more appropriate to follow for dormant pruning than trying to retain the same number of buds per vine, or doing what some people refer to as “architectural pruning” (Figure 2).

Table 1. Proposed pruning formulas for balanced pruning of Carlos muscadine grapes

Carlos muscadines cane prunings/pounds per vine											
Formula	5	6	7	8	9	10	11	12	13	14	15
120 + 20	200	220	240	260	280	300	320	340	360	380	400
110 + 20	190	210	230	250	270	290	310	330	350	370	390
100 + 20	180	200	220	240	260	280	300	320	340	360	380

Our working hypothesis for Supreme has been that a $100 + 15$ formula may be a better approach to dormant pruning of this popular fresh market muscadine than leaving a fixed number of buds/vine (e.g. 180), or from following a $100 + 5$ formula, which could lead to under-cropping (not leaving enough buds), or from using a $100 + 25$ formula, which could lead to over-cropping.

Methodologies:

Balanced pruning – five steps

1. Complete an initial rough pruning. In commercial vineyards, standard operating procedure in muscadine pruning includes using a tractor-mounted sickle bar (Figure 3) for the initial rough pruning (Figure 4) of the vineyard to an approximate 12 × 12-inch box. However, we used hand held hedgers for the rough pruning.



Figure 3. Tractor-mounted sickle bar



Figure 4. Unpruned muscadine vine

2. Follow up with hand pruning and how the pruning was accomplished

Rough pruning is often done in commercial vineyards in early winter, and follow-up hand pruning occurs anytime in January or early February. Our pruning was done in mid to late February of 2012, and late February and early March of 2013. It was a much colder March in 2013 than 2012, so this delay in pruning in 2013 did not pose a problem for vine bleeding.

2012 (Feb) – Kings Mountain (transition piedmont/foothills)

In our 2012 balanced pruning investigation in Kings Mountain, we tested 3 pruning formulas plus a control. With 8 single vine replicates per treatment and 4 treatments, we had 32 vines per location. The 3 balanced pruning formulas we tested were 100 + 5, 100 + 15 and 100 + 25, and these formula pruned vines were compared to a control treatment which is the grower's standard pruning practice (e.g. 180 buds/vine at the Kings Mountain vineyard). In 2012 we kept track of pruning weights for each vine, and in August and September we harvested each vineyard and kept yield records for each treatment vine as well as collected grape samples for berry color, maturity, pH, acidity and brix. The vines were 4 years old, 20 ft in-row spacing, and single wire trellis with drip irrigation.

2013 (Feb) Kings Mountain (transition piedmont/foothills) – all treatments repeated

2012 – Pine Level (transition coastal plain/piedmont)

A second balanced pruning strategy was tested in Pine Level, NC. In this eastern NC vineyard, we varied the base number of the 1st pound of pruning, and the treatments imposed on 11 year old Supreme vines were:

- 100 buds for the 1st lb of pruning weight + 20 buds for ea. added pound
- 150 buds for the 1st lb of pruning weight + 20 buds for ea. added pound
- 200 buds for the 1st lb of pruning weight + 20 buds for ea. added pound
- Control – 200 buds/vine

With 8 single vine replicates per treatment and 4 treatments, we had 32 vines.

2013 – Pine Level (transition coastal plain/piedmont) – all treatments repeated.

3. Determine spur distribution and number. After we completed the rough pruning (Step 1) and determined vine size by weighing the one-year cane prunings, we had an idea about the number of count buds to retain when hand pruning (Step 2). This is when you distribute the count buds up and down the cordon. Typically, growers will try to select healthy fruiting spurs about every 5–6 inches along the cordon. The individual spurs are then pruned to 4–7 inches. If spurs exceed 7 inches, they are technically called *canes*. We do not recommend cane pruning in Carlos or Supreme at this time (without further research). So we shortened most 1 year wood to 6-7 inches or less. On a 6-inch spur, you should see four good count buds. Consider that spurs are spaced an average of 5 inches apart (24 per 10-ft arm) and that each fruiting spur is about 6 inches long and has four buds. This would yield 192 total retained buds/vine (96 per 10-ft arm).

If a vine had 5 lbs of cane prunings at the Lineburger vineyard, and the treatment was 100 + 5, then we would leave 100 buds for the first pound of prunings, and 20 buds for the additional 4 lbs. of pruning ($4 \times 5 = 20$), or a total of 120 buds/vine. Thus, we would next need to thin out spurs and reduce total bud numbers to 120 buds/vine.



Figure 5. Ervin Lineberger, Kings Mtn.



Figure 6. Retaining a 5 bud spur on Supreme

If a vine was in Mr. Lineberger's 180 buds/vine treatment, then we would only have to take an additional 12 buds off a 192 bud vine. Of course, with the 100 + 25 treatment, we had to be

careful to leave slightly more than 300 buds/vine after the initial rough pruning, as some of the larger capacity vines were balance pruned to slightly more than 300 buds for this treatment.

4. Select quality one-year fruiting wood. An important characteristic of one-year wood on Supreme is that the wood is about the diameter of a pencil. The spur that is being retained in this photo is very high quality wood; whereas, you can see the thinner (twiggy) wood that is being removed to the left of the pruners in Figure 7. So, you must be selective in your pruning. The goal is to twofold: Retain one-year wood that is close to the diameter of a pencil (notice the fatter buds), and prune out thinner, less fruitful one-year wood.



Figure 7. Be selective. Try to retain one-year wood that is close to the diameter of a pencil and remove thinner canes with smaller count buds (which are less fruitful).

5. Renew the cordon. Spur pruning is part of a training system that makes muscadines relatively easy to prune and manage. Serious problems can occur, however, if the grower is not conscious of the need to continually renew the cordon with new spurs. Periodically renew the cordon by thinning out old bearers and allowing new spurs to develop from shoots that grow from latent buds in the cordon. With 4 year old vines, it is not necessary to do this, but it may be advisable by the 7th-8th year to implement a cordon renewal spur strategy.

Results for Kings Mountain, NC (2012-2013):

In this section of the report we wish to provide the data on pruning weights, yields, pH

and Brix for the Kings Mountain locations in 2012 and 2013. At this site, we achieved *remarkable yields* in 2013 of as much as 30,000 lbs./acre in the 100+15 balanced pruning treatment, or nearly 140 lbs/vine (10 x 20 ft). Similarly, the grower's approach (180/vine), was nearly as successful (Figure 8).

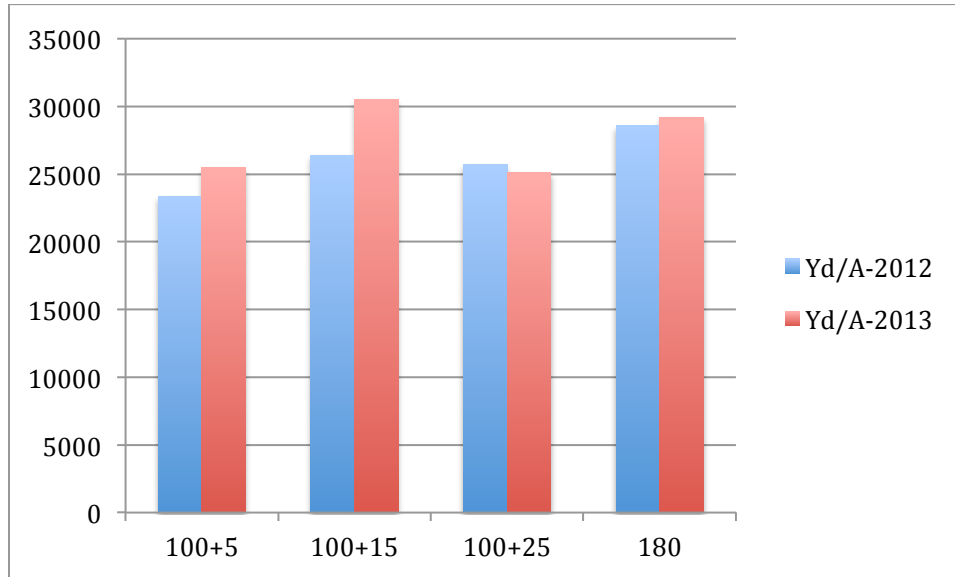


Figure 8. Kings Mountain, NC – Two years of yield data for vines with balanced pruning formulas 100 + 5, 100 + 15, and 100 + 25; as well as the grower's 180 buds/vine.

Overall yields were highest in 2013 (red columns) for the 100 + 15 treatment, but not statistically different from the grower's 180 bud/vine pruning practice. And, overall yield differences as related to pruning treatment were *not* statistically important in 2013, as shown in Table 4.

Table 4. Kings Mountain, NC - 2013 Yields (lbs/acre)

Pruning formula	Ave. yield	Duncan Grouping ^z
100 + 15	30,502	A
180 (control)	29,192	A
100 + 5	25,494	A
100 + 25	25,145	A

^z Means with the same letter are not significantly different (<.001)

Because these yield differences are not statistically significant, we have to be very cautious at this stage about recommending the about the suitability of the 100 + 15 balanced pruning formula for Supreme. Very frankly, in the first two years of this

investigation (2012-2013), we did not anticipate obtaining results that would be statistically important, as it normally takes a period of five (5) years at least for vines to settle down! In 2012, Dr. Sara Spayd, Professor and Extension Viticulturist commented, “My greatest concern regarding this proposed research is that the first year of any pruning study is usually atypical of the response that can be expected in future years. It usually takes a couple of years for the vines to *settle down* or balance out with the new regime. One or two years are typically not adequate to understand what is going to happen.” Unfortunately, we have been advised by the SRSFC that they could only sustain funding for this project for just two years (\$5,000/year), and so it is unlikely that we will be in a position to continue this extremely promising work even another year (meaning 2014). It is also very interesting to note that vines with the highest retained bud numbers (100 + 25 treatment had 289 buds) were lower in yield than the 100 + 15 pruning level, which had an average of 197 buds.

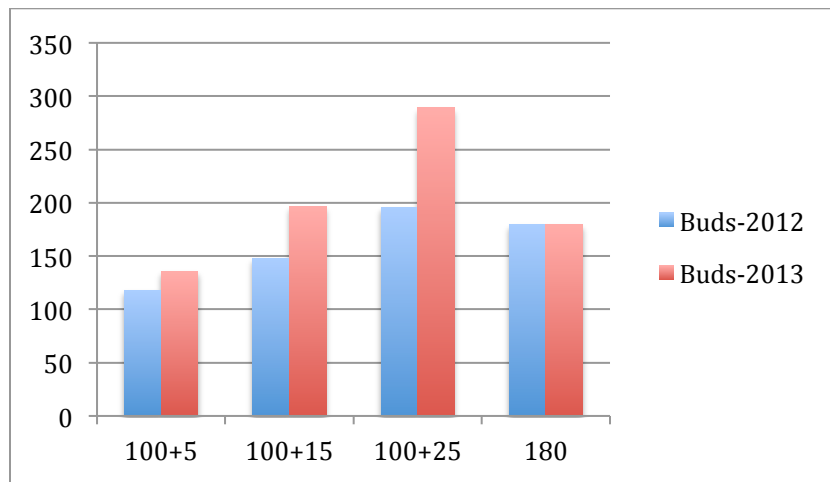


Figure 9. Kings Mountain, NC – Two years of average bud numbers using 100 + 5, 100 + 15, 100 + 25 and 180 buds/vine.

In 2012, the 100+25 treatment and 180 (control), had comparable bud numbers (blue column), but in 2013 the average number of buds for the 100 + 25 level were significantly higher than all other treatments (Table 5).

Table 5. Kings Mountain, NC - 2013 Average Bud Numbers

Pruning formula	Mean bud number	Duncan Grouping ^z
100 + 25	289.75	A
100 + 15	197.73	B
180 (control)	180.00	B
100 + 5	136.60	C

^z Means with the same letter are not significantly different (<.001)

It can be said at this point that the 100 + 15 balanced pruning formula *appears* to have some promise for helping Supreme fresh market growers to achieve higher yields without any negative effect on soluble solids (Table 6), or pH (data not shown). We did note that the grower's approach (180 buds/vine) had the lowest Brix level of all treatments, and we are not sure why that occurred (Table 6).

Table 6. Kings Mountain, NC - 2013 Soluble Solids (Brix)

Pruning formula	Brix	Duncan Grouping ^z
100 + 5	14.05	A
100 + 15	13.87	AB
100 + 25	13.80	AB
180 (control)	13.49	B

^z Means with the same letter are not significantly different (<.001)

Results for Pine Level, NC

Experimentally, we had several challenges with the Pine Level site. The study done at this location in 2012 was done on 11 year old Supreme vines, which had varying degrees of vigor, and some vines utilized had previously sustained cold injury. Then, in 2013, the owner asked us to move our trial to a younger vineyard (3 years) old, as they needed to use some of the 11 year vineyard for access roads. Thus, we are reporting here our findings for what are two different vineyards, ages 11 (2012) and 3 (2013). The yield

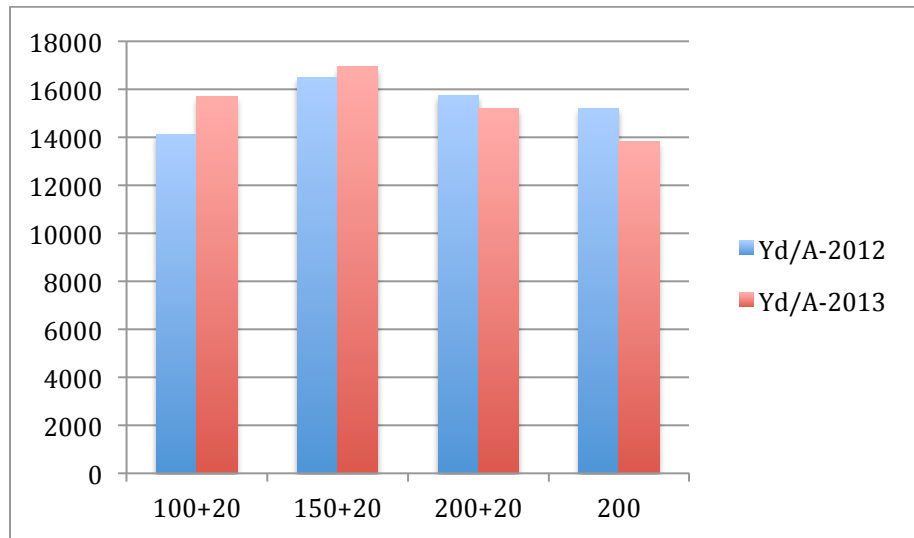


Figure 10. Pine Level, NC – Two years of yield data for vines with balanced pruning formulas 100 + 5, 100 + 15, and 100 + 25; as well as the grower's 180 buds/vine.

comparisons by balanced pruning treatment between 2012 and 2013 were shockingly similar, given that we are dealing with two different vineyards of different ages (Figure 10). The highest yield in the Pine Level Supreme vineyard in 2013 was associated with the 150 + 20 balanced pruning formula (16,943 lbs/A), but this was not a statistically important effect. Thus, no conclusion can be drawn about the influence of balanced pruning on the Supreme vines in the Hinnant vineyard can be drawn. Clearly, another 4-5 years of study in this vineyard would be essential for determining what benefits may be associated with a balanced pruning approach. It is noteworthy that the overall yields of Supreme in this Eastern NC location, which is in transition coastal plain/piedmont region, were substantially below the yields we recorded in Kings Mountain (Figure 8).

Table 7. Pine Level, NC - 2013 Yields (lbs/acre)

Pruning formula	Ave. yield	Duncan Grouping ^z
150 + 20 (trt. 2)	16,943	A
100 + 20 (trt. 1)	15,704	A
200 + 20 (trt. 3)	15,215	A
200 (trt. 4)	13,842	A

^z Means with the same letter are not significantly different (<.001)

The highest bud number in the Pine Level study in 2012 was associated with the 200 + 20 pruning level in both years, followed by the 150 + 20 and 100 + 20 levels. The vines in

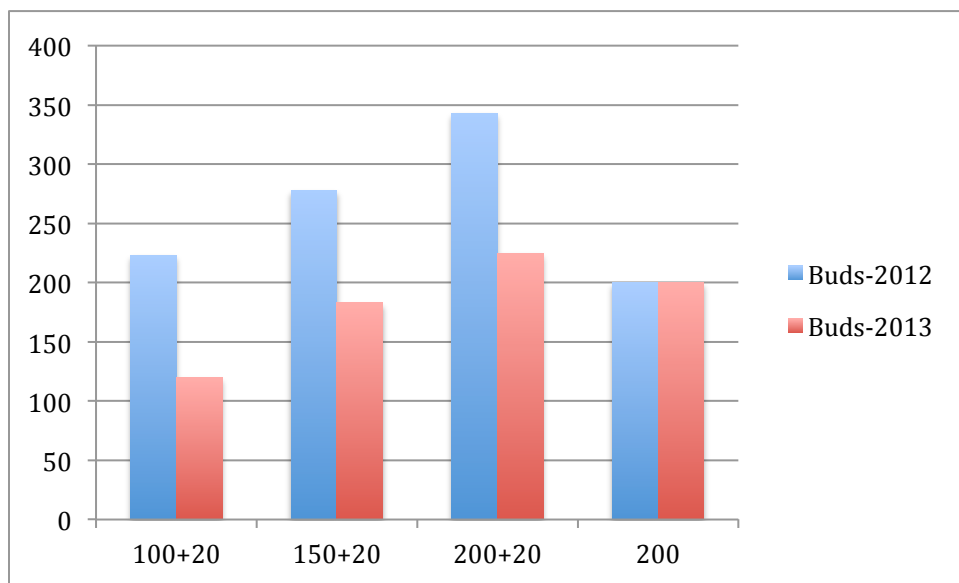


Figure 11. Pine Level, NC – Two years of average bud numbers using 100 + 20, 150 + 20, 200 + 20 and 200 buds/vine.

2013 study were only 3 years old, so we expected to have much lower numbers of retained buds (because of lower pruning weights on these new vines).

Conclusions:

Vine bearing capacity can, and does, vary greatly between vines even in the same row. As it turns out, one of the reasons we must be cautious about making any recommendation about the suitability of balanced pruning for Supreme at this point in time relates to the fact that vines in the Kings Mountain had *definitely not settled down* after just two seasons. We observed enormous variability in vine to vine pruning weights, and this is no doubt having an important influence on our results, and may explain why the differences in yields for our several pruning levels were not statistically important. Even so, overall yields for the 100 + 15 treatment at Kings Mountain in 2013 (5th leaf) exceeded 30,000 lbs/acre, and this was followed by a yield of 29,192 lbs/acre for the growers preferred approach of leaving 180 buds/vine, regardless of vine capacity. By contrast, our highest yields in the Pine Level study were only about 17,000 lbs/acre, and though the highest yield at this location was associated with the 150 + 20 balanced pruning formula, the yield differences for vines pruned to 100 + 20, 150 + 20, 200 + 20 and 200 buds/vine, were not statistically important after one year of study (vines in 3rd leaf). In another vineyard pruning study with Carlos that lasted seven (7) years (2006-2012), we have been able to demonstrate that once vines do settle down, it is possible to achieve statistically important differences that can be related to pruning severity levels (reported in the SRSFC Small Fruit News, “Progress Report on a 7 Year Muscadine Pruning Severity Trial with Carlos). I have little doubt that a similar time frame is needed to clearly establish a science-based recommendation for balanced pruning of the fresh market muscadine variety Supreme.

Impact statement:

Balanced pruning holds promise for NC, SC, GA, TN and AR muscadine growers for avoiding the adverse effects of over-cropping or under-cropping of fresh muscadine vines. It is quite possible that a 100 + 15 balanced pruning formula could be appropriate for Supreme in a Piedmont/Foothill type growing region, but several years of further investigation are needed for us to actually be able to make that recommendation. Balanced pruning is widely used in bunch grapes, and it is our definite belief that further years of vineyard research at the Kings Mountain location where we realized yields of over 30,000 lbs/acre with the 100 +15 formula, are well justified.

Publications related to this project:

E. B. Poling, R. Schiavone, and S. M. Romelczyk, (VCES Agent), *Progress Report on a 7 Year Muscadine Pruning Severity Trial with Carlos*, Small Fruit News, Vol. 13, No. 1, SRSFC, 11-15.

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