Specialty Melon Yield and Quality Response to Grafting in Trials Conducted in the Southeastern United States

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Abstract

In 2013, the US melon industry grossed over $394 million from approximately 34 thousand hectares of cantaloupe and honeydew crops. North Carolina (NC) and South Carolina (SC) produced about 5% of the USA acreage and value, yet the melon crop in these two states are still valued at several million dollars. Most melon production involves various types of orange flesh melons commonly marketed as cantaloupes. In addition to cantaloupes, there are other types of "specialty" melons that provide new production opportunities. Several of these melon types have relatively soft flesh and limited shelf life, and are less suited for shipping or the larger grocery store retail market. Grafting was evaluated in three tests in 2011 through 2013 in NC and SC to determine if there were any advantages with respect to yield (earliness and total production) and quality (fruit size, soluble solids, and flesh firmness). The were 7 melon entries evaluated in 2011, and 16 melon entries evaluated in 2012 and 2013 studies, which were replicated 5 or 3 times, respectively. Generally, yields were reduced with the various melon cultivars and types tested when using grafted rather than self-grafted or non-grafted plants indicating that the graft itself was not a detriment to yields. Grafted plants of most melon cultivars tended to yield more fruit numbers in earlier harvests than non-grafted plants. Flesh firmness was generally found to be inferior for fruits obtained from grafted plants. Soluble solid levels differed between cultivars, with 'Sprite' having some of the highest readings, but did not differ between grafted and non-grafted treatments. Fruit length and width were variably affected, with little response to grafting in the SC location, and reduced fruit lengths measured in the NC location.

INTRODUCTION

There is increasing interest in grafting in the United States (US), especially in some vegetable crops such as tomatoes, watermelon and melon (Davis et al., 2008a, b). Grafting experiments have indicated many benefits associated with its practice, including disease resistance, especially fusarium wilt (Yetsir et al., 2003; Bletsos, 2005; Sakata et al., 2007); yield increase (Lee et al., 2010; Wu et al., 2006)); less need of fertilizer or better nutrient uptake (Lee and Oda, 2003; Ruis et al., 1997); more vigorous plants (Cohen et al., 2000; Sakata et al, 2007; Lee and Oda, 2003); and in some cases improved fruit quality such as improved nutritional value (Perkins-Veazie et al., 2007) and flesh firmness (Roberts et al., 2005; Salem et al., 2002).

Grafting is a well adopted practice on cucurbits in countries such as China, Korea, Spain, and Japan (Lee et al., 2010; Davis et al., 2008a). However, adoption of grafting as a production management practice has been slow in the US. Key factors that have inhibited adoption (particularly with cucurbits) are added costs versus benefits, and the land required to rotate crops in order to avoid disease build up (Taylor et al., 2008). In

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spite of these obstacles, there is still much interest in determining the effects of grafting on yield and production quality, as well as best management practices to mitigate the increased cost of using grafted plants, such as a reduction in planting densities (Schultheis et al., 2009). With this in mind, we used a common interspecific squash rootstock cultivar, 'Carnivor' and grafted a range of melon cultivars and types with the goal of determining what effects resulted with respect to yield, earliness of yield, fruit size, flesh firmness, and soluble solids when compared with non-grafted or self-grafted plants from each scion cultivar.

MATERIALS AND METHODS

Plant Material

To better understand the potential benefits of melon grafting, we compared the effects of using grafted transplants versus self-grafted transplants. Seven melon cultivars were evaluated in 2011 in South Carolina (SC). The planting was established in early April on plastic mulch with drip irrigation. Plot length was 6.1 m and contained 10 plants. Plants were spaced 0.61 m apart and row spacing was 2.4 m.

In 2012, the study was replicated 3 times with each North Carolina (NC) location serving as a replication. The trial was planted at the research stations in Clinton and Kinston, and on-farm near Wilson, NC. In 2013, the study was again replicated 3 times and planted at the research station in Clinton, NC. There were a total of 16 melon entries and each entry type or cultivar had either grafted or non-grafted plant plots at each location in 2012. Plots in each location/replication in 2012 and the three replicated plots in 2013 were established with either 15 grafted plants or 15 non-grafted plants of each cultivar. A total of 32 plots were planted at each location in late May or early June in 2012, and on 17 May in 2013.

All melon transplants were grown in Charleston, South Carolina (SC) and grafted using the one cotyledon graft method (Hassell et al., 2008), then transported to NC to their respective field locations in 2012 and 2013. Plants were planted on black plastic mulch and drip irrigated. Spacing between bed centers was 1.5 m and in-row spacing was 0.61 m. Recommended cultural practices were followed for irrigation, fertilizer, and pesticide application (Kemble, 2013).

Data Acquired

When ripe, each fruit was harvested and weighed. Harvests occurred three times per week. In SC, the first harvest was 6 June and the last of the 12 harvests was on 1 July 2011. In NC, harvests were initiated 25 July 2012 and 11 July 2013, and completed 23 August and 7 August, respectively. There were a total of 10 harvests in 2012 and a total of 12 harvests in 2013 with early yield being defined as the first 4 harvests.

Interior fruit quality was determined by taking at least 5 fruit samples at the appropriate commercial harvest stage. Flesh sweetness levels were quantified using a Atago Model PAL-1 digital refractometer (Atago USA, Inc., Bellevue, WA), and flesh firmness was determined using a fruit pressure tester (QA Supplies LLC, Norfolk, VA) by taking two readings on each side of the longitudinally cut fruit between the seed cavity and the rind. Other notes such as vine vigor and fruit appearance were observed. The most common melon types grown in the United States are muskmelon (*Cucumis melo* var. *reticulatus*) and honeydew (*Cucucmis melo* var. inodorus). These melon types were valued at over $394 million and produced on 34,000 ha in 2013 (United States Department of Agriculture, 2014). In addition to muskmelon and honeydew melon types, there were seven fruit cultivars evaluated in SC and 16 in NC which included specialty melon types; Athena (eastern muskmelon), Caldeo (Tuscan), Camina Europa (canary), Camposol (canary), Courier (galia), Crème de Menthe (honeydew), Duke (ananas), Hibrix (canary), Jade Delight (honeydew), NUN 7225 (honeydew), Proteo (Tuscan), Sancho (piel de sapo), Sprite (oriental crisp flesh), SXM 7057 (canary), and Visa Premium (galia). These specialty melons of each type are established as some of the best adapted for production in the southeastern United States (Schultheis et al., 2001; Kemble, 2013).

Data Analysis

The data analysis for this research was generated using SAS/STAT software, Version 9.3 of the SAS System for Windows. The study design for SC in 2011 was a randomized complete block design with grafted and self-grafted plants from seven cultivars. The study design for the NC studies was a randomized complete block with grafted and non-grafted plants from 16 melon cultivars. The SC study was conducted in 2011 with 5 replications and the NC studies were conducted in 2012 and 2013 with three replications each year. The combined two-year data set for NC was analyzed using the MIXED procedure to test for cultivar and grafting differences as well as cultivar-grafting interactions. The same procedure was used for the one study conducted in SC.

RESULTS

Because we were most interested in comparing the response of melon cultivar or type of response to grafting versus the non-grafted or self-grafted treatment, each interaction is presented in the tables that follow (Tables 1, 2, 3, 4 and 5). Significance of main effects and interactions are noted in each table.

SC Study (2011)

Across all harvests, total yields for tonnage of fruits produced per hectare were the same whether the cultivar was grafted onto 'Carnivor' rootstock or self-grafted, as the two way interaction was not significant (Table 1). The honeydew cultivar Crème de Menthe yielded the most tonnage while Sprite yielded the least. There was a significant interaction (P=0.1) between cultivar and grafting treatment for the number of fruit produced per hectare. Sprite produced a greater number of fruit when self-grafted than when not grafted, while yields for all other cultivars were similar. Melon size by type was dramatically different in some cases between cultivars, as Sprite produced much smaller fruit than all other melon cultivars. In most cultivars, self-grafted plants generally out yielded grafted plants on 'Carnivor' rootstock. This provides strong evidence that the graft itself did not inhibit yields.

With regards to quality measures, the cultivar by grafting treatment interaction was significant for soluble solids at the 0.1 level of significance (Table 2). Soluble solid measures appeared to be higher when grafted plants were used for the cultivars Athena and Proteo, while self-grafted Caldeo, Crème de Menthe, and SXM 7057 plants tended to have higher soluble solids than grafted plants on 'Carnivor' rootstock. Grafting appeared to alter flesh firmness in certain cultivars, as flesh was softer in Athena and firmer in Crème de Menthe when 'Carnivor' was used as the rootstock than if self-grafted. There was no measurable difference in the length or width of the fruit due to grafting treatment; however, cultivars differed amongst each other with regards to their length and width.

NC Studies (2012 and 2013)

There were no differences in yield and quality between the two growing seasons in NC, therefore, the data were combined (Tables 3, 4 and 5). Within each variable or parameter, significance for main effects between grafting and cultivar treatments were determined.

Athena, Courier, Esmeralda, Sprite, and Visa Premium cultivars yielded more fruit (MT and numbers per hectare) in the early harvests than other cultivars (Table 3). No difference in the early harvests was measured due to grafting treatment. We observed most grafted cultivars produced higher numbers of fruit in the early harvests than if not grafted (data not shown). Average fruit weight was affected by cultivar and grafting treatment in the early harvests. Fruits for the Camposol, Jade Delight and Sancho cultivars were heavier when using non-grafted versus grafted plants when fruits were obtained in the early harvests. Likewise, for most cultivars, fruits tended to be smaller in size when grown with grafted than with non-grafted plants.

For the various specialty melon cultivars and types, there were differences in yield when scions were grafted on ‘Carnivor’ rootstock versus non-grafted plants (Table 4). However, when yields were considered over the entire season, certain cultivars out yielded others. The cultivars that produced the greatest tonnage were Athena, Crème de Menthe, Proteo, and Visa Premium while the lowest tonnage was produced from Camino Europa, NUN 7225, Sancho, and SXM 7057. As with tonnage, yields based on fruit numbers were significant only for cultivar and not for grafting treatment. The cultivars yielding the highest number of fruits were Sprite and Visa Premium, while the cultivar yielding the lowest number of fruits was Sancho. There was an interaction between grafting treatment and cultivar with respect to fruit weight. Heavier fruits were produced from non-grafted plants from Camino Europa, Crème de Menthe, Jade Delight, NUN 7225, and Sancho cultivars than if derived from grafted plants. In general, grafted plants yielded less, both in number and weight of fruit produced per hectare, when all harvests were considered, and fruits were smaller on grafted plants than non-grafted.

Soluble solids were generally low for the 2012 and 2013 studies due to the wet, cloudy weather regardless of cultivar (Table 5). Significance in soluble solids only differed amongst cultivars and not due to grafting. Caldeo, Hibrix, Jade Delight, and Sprite cultivars displayed higher soluble solids, while Courier, Duke, and SXM 7057 exhibited lower. There was a significant interaction between cultivar and grafting treatment for flesh firmness. Cultivars that had firmer flesh when non-grafted than grafted were Caldeo, Camino Europa, Camposol, Courier, Duke, and Esmeralda. The only cultivar with firmer flesh from grafted plants rather than non-grafted plants was Crème de Menthe. Flesh firmness was generally similar among other cultivars. The cultivar graft treatment interaction was significant for fruit length and width, with generally shorter fruit length for grafted than non-grafted plants, as one-half of the cultivars had shorter lengths. Fruit width was also significantly affected by the cultivar graft interaction with shorter fruits being obtained from grafted Sancho plants versus non-grafted plants.

DISCUSSION

Yield improvement was generally not found for the various melon types and cultivars that were grafted versus not grafted or self-grafted in these studies. Similar results in which fruit yield was not affected by *Cucurbita* spp. rootstock was reported by Traka-Mavrona et al. (2000). ‘Carnivor’ was the only rootstock used in these studies. Davis et al. (2008a) report that the type of rootstock used has a direct bearing on yield. Distinctly different rootstocks in subsequent studies should be evaluated using fewer melon cultivars that have specific differences from one another.

A primary objective of this study was to enhance melon flesh firmness by grafting. An impediment in shipping ability has been reported for certain melon types (i.e., galia, ananas, Crenshaw) (Cantliffe et al., 2004; Schultheis et al., 2001) due to soft flesh. Our studies did not find flesh to be firmer with grafted versus not grafted plants. Rather, many cultivars had comparatively softer flesh. Traka-Mavrona et al. (2000) reported a “remarkable deterioration” in some of the rootstock scion combinations. However, these results are contrary to several reports in which watermelon has increased flesh firmness due to grafting (Schultheis et al., 2009; Roberts et al., 2005, 2006; Yamasaki et al., 1994 reported by Davis et al., 2008b). A challenge when assessing flesh firmness among the various melon types is that it can be difficult to harvest certain melons at the same maturity which can make it difficult to detect differences between treatments. This has been reported to be the case in honeydew, Asian, Charentais, etc. (Cantwell, 1996; Schultheis et al., 2001) and may have impacted the results of this study.

Average fruit weight was measured in these studies and in many cases was similar between grafted and self-grafted or non-grafted plants and reflects what Traka-Mavrona et al. (2000) have reported. However, we also found that there were a number of cultivars in these studies in which grafted plants produced smaller fruits. We observed vine growth in the field to sometimes be reduced in grafted plants compared with non-grafted plants.

The soluble solids response to grafting in NC was variable with some grafting cultivar combinations producing fruit with higher percentages of soluble solids than non-grafted plants, and some cultivars producing lower. No consistent response in soluble solids was apparent in the SC study. Traka-Mayrona et al. (2000) reported lower percentages of soluble solids when melon plants were grafted and planted in the field.

CONCLUSIONS

It is clear from these studies that no outstanding, consistent yield and quality benefits were obtained. However, future considerations should include the use of diverse rootstock melon type combinations as these may provide more consistent yield and/or quality benefits. More vigorous rootstocks than 'Carnivor' may translate into higher yields as this has been reported in other studies with various crops (Davis et al., 2008b as reported by Imazu, 1949). Lastly, because of the cost and lack of consistent yield or quality benefit(s), grafting of melon is less likely to increase in practice unless grafting is needed as a management strategy to control soil borne diseases in which the scion has no genetic resistance.

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Literature Cited

Bletsos, F.A. 2005. Use of grafting and calcium cyanamide as alternatives to methyl bromide soil fumigation and their effects on growth, yield, quality, and fusarium wilt control in melon. J. Phytopath. 153:155-161.

Cantliffe, D.J., Shaw, N.L. and Jovicich, E. 2004. New vegetable crops for greenhouses in the southeastern United States. Acta Hort. 633:483-487.

Cantwell, M. 1996. Case study: Quality assurance for melons. Perishable Handling Newsletter 85:10-12. (Accessed 03-10-2014, ucce.ucdavis.edu/files/datastore/234-114.pdf).

Cohen, R., Pivonia, S., Burger, Y., Edelstein, M., Gamliel, A. and Katan, J. 2000. Toward integrated management of *Monosporascus* wilt of melons in Israel. Plant Dis. 84:496-505.

Davis, A.R., Perkins-Veazie, P., Sakata, Y., Lopex-Galarza, S., Maroto, J.V., Lee, S., Huh, Y., Sun, Z., Miguel, A., King, S.R., Cohen, R. and Lee, J. 2008a. Cucurbit grafting. Critical Rev. Plant Sci. 27:50-74.

Davis, A.R., Perkins-Veazie, Hassell, R., Levi, A., King, S.R. and Zhang, X. 2008b. Grafting effects of vegetable quality. HortScience 43(6):1670-1672.

Hassell, R.L., Memmott, F. and Liere, D.G. 2008. Grafting methods for watermelon production. HortScience 43(6):1677-1679.

Kemble, J.M. (ed.) 2013. Southeastern U.S. Vegetable Crop Handbook 2014. Vance Publishing Corp., Lincolnshire, IL.

Lee, J.M., Kubota, C., Tsao, S.J., Bie, Z., Echevarria, P.H., Morra, L. and Oda, M. 2010. Current status of vegetable grafting: Diffusion, grafting techniques, automation. Scientia Hort. 127:93-105.

Lee, J.M. and Oda, M. 2003. Grafting of herbaceous vegetable and ornamental crops. Hort. Rev. 28:61-124.

Perkins-Veazie, P.M., Zhang, X., Lu, G. and Huan, J. 2007. Grafting increases lycopene in seedless watermelon. HortScience 42:959 (Abstr.).

Roberts, W., Bruton, B.D., Popham, T.W. and Fish, W.W. 2005. Improving the quality of fresh- cut watermelon through grafting and rootstock selection. HortScience 40(3):871. (Abstr.)

Roberts, W., Bruton, Fish, W.W. and Taylor, M. 2006. Year two: Effects of grafting on watermelon yield and quality. HortScience 40(3):871519 (Abstr.).
Ruiz, J.M., Belakbir, A., Lopez-Cantarero, I. and Romero, L. 1997. Leaf-macronutrient content and yield in grafted, melon plants. A model to evaluate the influence of rootstock genotype. Scientia Hort. 71:227-234.
Sakata, Y. Takayoshi, O. and Mitsuhiro, S. 2007. The history and present state of the grafting of cucurbitaceous vegetables in Japan. Acta Hort. 731:159-170.
Salem, M.S., Masum, A.S.M.H., Chowdhury, S.S., Dahr, M., Saddeque, M.A. and Islam, M.R. 2002. Growth and yield of watermelon as influenced by grafting. J. Biol. Sci. 2:298-299.
Schultheis, J.R., Jester, W.R. and Augostini, N.J. 2001. Screening melons for adaptability in North Carolina. p.439-444. In: J. Janick and A. Whipkey (eds.), Trends in New Crops and New Uses. ASHS Press, Alexandria, VA.
Schultheis, J.R., Hassell, R., Kelley, T., Kumar, R., Olson, S. and Wehner, T.C. 2009. Grafted watermelon: Evaluation of planting density for high yields, 2008 results. Accessed 3/10/2014 http://www.nationalwatermelonassociation.com/pdfs/Grafted%20Watermelon%20article.pdf
Taylor, M., Bruton, B., Fish, W. and Roberts, W. 2008. Cost benefit analysis of using grafted watermelon transplants for fusarium wilt disease control. Acta Hort. 782:343-350.
Traka-Mavrona, E., Koutsika-Sotiriou, M. and Pritsa, T. 2000. Response of squash (*Cucurbita spp*.) as rootstock for melon (*Cucumis melo* L). Scientia Hort. 83:353-362.
Wu, Y.F., Chen, Y. and Zhao, Y.J. 2006. Effect of pumpkin stock on growth, development, yield, and quality of grafted muskmelon. J. Agr. Sci. 21:354-359.
Yetsir, H., Nebahat, S. and Yucek, S. 2003. Rossstock resistance to fusarium wilt and effect on watermelon yield and fruit quality. Phytoparasitica 31(2):163-169.
United States Department of Agriculture, National Agricultural Statistics Service. 2014. Vegetables 2013 Summary. p.83. Accessed 19 April 2014. http://usda.mannlib.cornell.edu/usda/current/VegeSumm/VegeSumm-03-27-2014.pdf

Tables

Table 1. Season yield (12 harvests) and fruit size response of specialty melon cultivar to grafting on 'Carnivor' rootstock, South Carolina, 2011.

Cultivar	Company	MT/ha[z]	Number/ha[z]		Fruit weight (kg)[z]
			S[y]	GR[x]	
Athena	Syngenta	39ab	19367	13180	2.4a
Caldeo	Syngenta	37a-c	21115	14391	2.1b
Crème de Menthe	Nunhems	45a	20308	20846	2.2b
Duke	Hollar	31b-d	16542	18829	1.7c
Proteo	Syngenta	37a-c	21788	12373	2.2b
Sprite	Sakata	23d	63480a	39003b	0.4e
SXM 7057	Nunhems	29cd	22460	16408	1.5d
Average		40	19655		2.4
LSD		9	-		0.1
Pr>F	Main effects				
	Cultivar (C)	0.004	<0.001		<0.001
	Graft (G)	0.002	0.004		0.762
	Interaction				
	C*G	0.349	0.089		0.343

[z] Significant at the 0.10 level within a given cultivar (column) for MT/ha and fruit weight, or for non-grafted (NG) and grafted (GR) plants for No./ha if designated with "a" and "b" for cultivar.
[y]S = Self-grafted.
[x]GR = Grafted onto 'Carnivor' rootstock (interspecific squash).

Table 2. Interior quality and fruit size response of specialty melon cultivar to grafting on 'Carnivor' rootstock, South Carolina, 2011.

Cultivar	Company	Soluble solids[z]		Flesh firmness[z]		Fruit length[z]	Fruit width[z]
		S[y]	GR[x]	S	GR		
Athena	Syngenta	11.7	13.3	7.3a	2.6b	19.1a	16.6a
Caldeo	Syngenta	12.1	11.2	9.2	7.2	18.7a	15.0bc
Crème de Menthe	Nunhems	11.6	10.4	6.6b	9.8a	19.2a	16.5a
Duke	Hollar	10.6	10.7	3.6	1.8	16.1b	14.2bc
Proteo	Syngenta	10.8	12.1	6.9	5.6	18.8a	15.3b
Sprite	Sakata	13.1	12.9	17.0	14.9	11.5c	9.8d
SXM 7057	Nunhems	13.1	12.1	7.8	11.0	18.0a	14.1c
Average		11.8		8.3		17.3	14.5
LSD		-		-		1.2	1.1
Pr>F	Main effects						
	Cultivar (C)	<0.001		<0.001		<0.001	<0.001
	Graft (G)	0.479		0.293		0.631	0.412
	Interaction						
	C*G	0.098		0.002		0.272	0.562

[z]Significant at the 0.10 level within a given cultivar (column) for fruit length and fruit width, or for non-grafted (NG) and grafted (GR) plants for soluble solids and flesh firmness if designated with "a" and "b" within cultivar.
[y]S = Self-grafted.
[x]GR = Grafted onto 'Carnivor' rootstock (interspecific squash).

Table 3. Early season yield and fruit size response of specialty melon cultivar to grafting on ‘Carnivor’ rootstock for two growing seasons in North Carolina, 2012 and 2013.[z]

Cultivar	Company	MT/ha[y]	Number/ha[y]	Fruit weight (kg)[y]	
				NG[x]	GR[w]
Athena	Syngenta	31ab	12338b	2.5	2.7
Caldeo	Syngenta	8e	3448cd	2.3	2.1
Camino Europa	Seedway	5e	3312cd	2.3	1.7
Camposol	Seedway	3e	1172d	4.6a	2.3b
Courier	Hollar	27b	13053b	2.1	2.0
Crème de Menthe	Nunhems	10c-e	3459cd	3.5	3.0
Duke	Hollar	3e	1041d	2.7	2.1
Esmeralda	Nunhems	17c	13266b	1.5	1.2
Hibrix	Nunhems	3e	1411cd	2.6	2.4
Jade Delight	Nunhems	4e	1544cd	3.4a	2.1b
NUN 7225	Nunhems	8de	3116cd	3.5	2.6
Proteo	Syngenta	16cd	5564c	2.8	2.8
Sancho	Syngenta	3e	1030d	3.5a	2.4b
Sprite	Sakata	17c	23251a	0.8	0.7
SXM 7057	Nunhems	4e	1699cd	3.1	2.2
Visa Premium	Seedway	38a	21015a	1.7	1.8
Average		16	6444	2.3	
LSD		8	4189	-	
Pr>F	Main effects				
	Cultivar (C)	<0.001	<0.001	<0.001	
	Graft (G)	0.705	0.461	0.188	
	Interaction				
	C*G	0.662	0.633	0.064	

[z]Early season constitutes first four of 10 total harvests in 2012 and 12 total harvests in 2013.

[y]Significant at the 0.10 level within a given cultivar (column) for each variable (MT/ha, Number/ha), or for non-grafted (NG) and grafted (GR) plants for fruit weight (kg) if designated with “a” and “b” within cultivar.

[x]NG = Non-grafted.

[w]GR = Grafted onto ‘Carnivor’ rootstock (interspecific squash).

Table 4. Season yield and fruit size response of specialty melon cultivar to grafting on 'Carnivor' rootstock for two growing seasons in North Carolina, 2012 and 2013.

Cultivar	Company	MT/ha[z]	Number/ha[y]	Fruit weight (kg)[z]	
				NG[y]	GR[x]
Athena	Syngenta	54a	20974b-d	2.5	2.7
Caldeo	Syngenta	44a-d	17716b-e	2.5	2.4
Camino Europa	Seedway	30e	14441c-e	2.4a	1.8b
Camposol	Seedway	38b-e	13640de	3.0	2.5
Courier	Hollar	47a-c	22539b-d	2.1	2.0
Crème de Menthe	Nunhems	50ab	16357c-e	3.4a	2.8b
Duke	Hollar	35c-e	13820de	2.6	2.4
Esmeralda	Nunhems	36c-e	25748bc	1.5	1.4
Hibrix	Nunhems	35c-e	14228de	2.5	2.4
Jade Delight	Nunhems	38b-e	12419de	3.3a	2.7b
NUN 7225	Nunhems	32de	11153de	3.3a	2.6b
Proteo	Syngenta	49ab	18017b-e	2.7	2.8
Sancho	Syngenta	27e	9180e	3.6a	2.3b
Sprite	Sakata	44a-d	61597a	0.7	0.7
SXM 7057	Nunhems	32de	12971de	2.6	2.5
Visa Premium	Seedway	50ab	28527b	1.7	1.8
Average		40	19655	2.4	
LSD		13	11462	-	
Pr>F	Main effects				
	Cultivar (C)	0.009	<0.001	<0.001	
	Graft (G)	0.239	0.172	<0.001	
	Interaction				
	C*G	0.305	0.501	0.001	

[z] Significant at the 0.10 level within a given cultivar (column) for each variable (MT/ha, number/ha), or for non-grafted (NG) and grafted (GR) plants for fruit weight (kg) if designated with "a" and "b" within cultivar.

[y]NG = Non-grafted.

[x]GR = Grafted onto 'Carnivor' rootstock (interspecific squash).

Table 5. Interior quality and fruit size response of specialty melon cultivar to grafting on 'Carnivor' rootstock for two growing seasons in North Carolina, 2012 and 2013.

Cultivar	Company	Soluble solids[z]	Flesh firmness[z]		Fruit length[z]		Fruit width[z]	
			NG[y]	GR[x]	NG	GR	NG	GR
Athena	Syngenta	11.0fg	5.5	5.0	20.0	20.3	17.1	18.1
Caldeo	Syngenta	12.7b-d	7.8a	6.9b	19.9a	18.2b	16.6	16.0
Camino Europa	Seedway	12.5cd	6.5a	5.2b	21.0a	19.4b	16.1	15.4
Camposol	Seedway	12.1de	6.5a	5.6b	22.1a	19.5b	17.2	16.6
Courier	Hollar	11.0g	5.2a	3.9b	16.8	17.3	15.2	16.2
Crème de Menthe	Nunhems	11.6e-g	5.8b	6.8a	20.5	19.4	20.1	18.5
Duke	Hollar	11.0fg	5.3a	4.2b	20.7	20.9	16.8	16.5
Esmeralda	Nunhems	11.4e-g	6.7a	5.6b	14.7a	13.0b	14.0	13.3
Hibrix	Nunhems	12.9bc	6.1	5.9	21.3a	19.0b	17.2	17.0
Jade Delight	Nunhems	13.4b	7.4	7.7	19.2	17.7	19.5	17.7
NUN 7225	Nunhems	12.6cd	7.2	7.5	20.7a	18.8b	19.1	17.4
Proteo	Syngenta	11.7ef	7.2	6.6	21.2	20.5	17.2	17.4
Sancho	Syngenta	11.1fg	5.9	5.7	27.0a	21.5b	17.8a	15.8b
Sprite	Sakata	14.6a	10.0	9.5	12.6	11.8	10.8	10.7
SXM 7057	Nunhems	12.5cd	6.3	5.6	21.3a	19.6b	17.5	16.7
Visa Premium	Seedway	11.5e-g	4.7	4.3	16.9	17.2	14.7	15.3
Average		10.5	6.6		16.9		14.7	
LSD		1.7	-		-		-	
Pr>F	Main effects							
	Cultivar (C)	<0.001	0.004		<0.001		<0.001	
	Graft (G)	0.695	0.190		0.197		0.418	
	Interaction							
	C*G	0.717	0.044		0.045		0.039	

[z]Significant at the 0.10 level within a given cultivar (column) for soluble solids, or for non-grafted (NG) and grafted (GR) plants for flesh firmness, fruit length and fruit width if designated with "a" and "b" within cultivar.

[y]NG = Non-grafted.

[x]GR = Grafted onto 'Carnivor' rootstock (interspecific squash).