Are the Effects of Crop Load Altered by Rootstock? An Update on the 2003 NC-140 Apple Physiology Trial

Wesley R. Autio and James S. Krupa
Department of Plant, Soil, & Insect Sciences, University of Massachusetts

As part of the 2003 NC-140 Apple Rootstock Physiology Trial, a planting of Gibson Golden Delicious on three rootstocks was established at the University of Massachusetts Cold Spring Orchard Research & Education Center in Belchertown. Trees in this trial grew very poorly during their first two seasons. They grew well in 2005, 2006, and 2007, but fruit set was very low in 2006. In 2007, trees were allowed to crop, and crop load was adjusted to between 3 and 14 fruit per cm^2 trunk cross-sectional area (TCA). Results from 2007 were published in the winter 2007 issue of *Fruit Notes* [72(1):13-17].

In 2008, return bloom was assessed, and crop load of all trees was reduced to light crop of no more than about 3 fruit per cm^2 trunk cross-sectional area (TCA). The planting included ten trees of each rootstock in a completely random design. Means from 2008 (6^{th} growing season) are included in Tables 1 and 2 and Figures 1 and 2.

Table 1. Trunk cross-sectional area, suckering, yield, yield efficiency, and average crop load in 2008 of Gibson Golden Delicious trees on three rootstocks in the Massachusetts planting of the 2003 NC-140 Apple Rootstock Physiology Trial.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Root suckers (no./tree, 2003-08)	Yield per tree (kg)		Yield efficiency (kg/cm^2 TCA)		Average fruit weight (g, 2006-08)
			2008	Cumulative (2006-08)	2008	Cumulative (2006-08)	
G.16	23.5 b	0.1 b	6.8 a	32 a	0.30 a	1.37 ab	177 a
M.26 EMLA	30.8 a	0.2 b	6.9 a	36 a	0.23 a	1.15 b	175 a
M.9 NAKBT337	18.7 c	1.7 a	6.6 a	28 a	0.37 a	1.56 a	189 a

[z] Means within column not followed by a common letter are significantly different at odds of 19 to 1.

Table 2. Flowering, crop load, and fruit weight in 2008 of Gibson Golden Delicious trees on three rootstocks in the Massachusetts planting of the 2003 NC-140 Apple Rootstock Physiology Trial.[z]

Rootstock	Blossom density (no. clusters /cm^2)	Spur density (no./cm^2)	Blooming spurs (%)	Crop load (no./cm^2)	Fruit weight (g)
G.16	4.4 b	14.6 b	31 a	1.6 a	166 ab
M.26 EMLA	4.2 b	13.7 b	31 a	1.4 a	154 b
M.9 NAKBT337	9.1 a	20.5 a	43 a	1.9 a	185 a
Correlation with:					
Crop load 2007	-0.54**	+0.20^{ns}	-0.70***	-0.68***	-0.64***
Crop load 2008	+0.93***	+0.17^{ns}	+0.85***	---	+0.70 ***

[z] Rootstock means within column not followed by a common letter are significantly different at odds of 19 to 1.

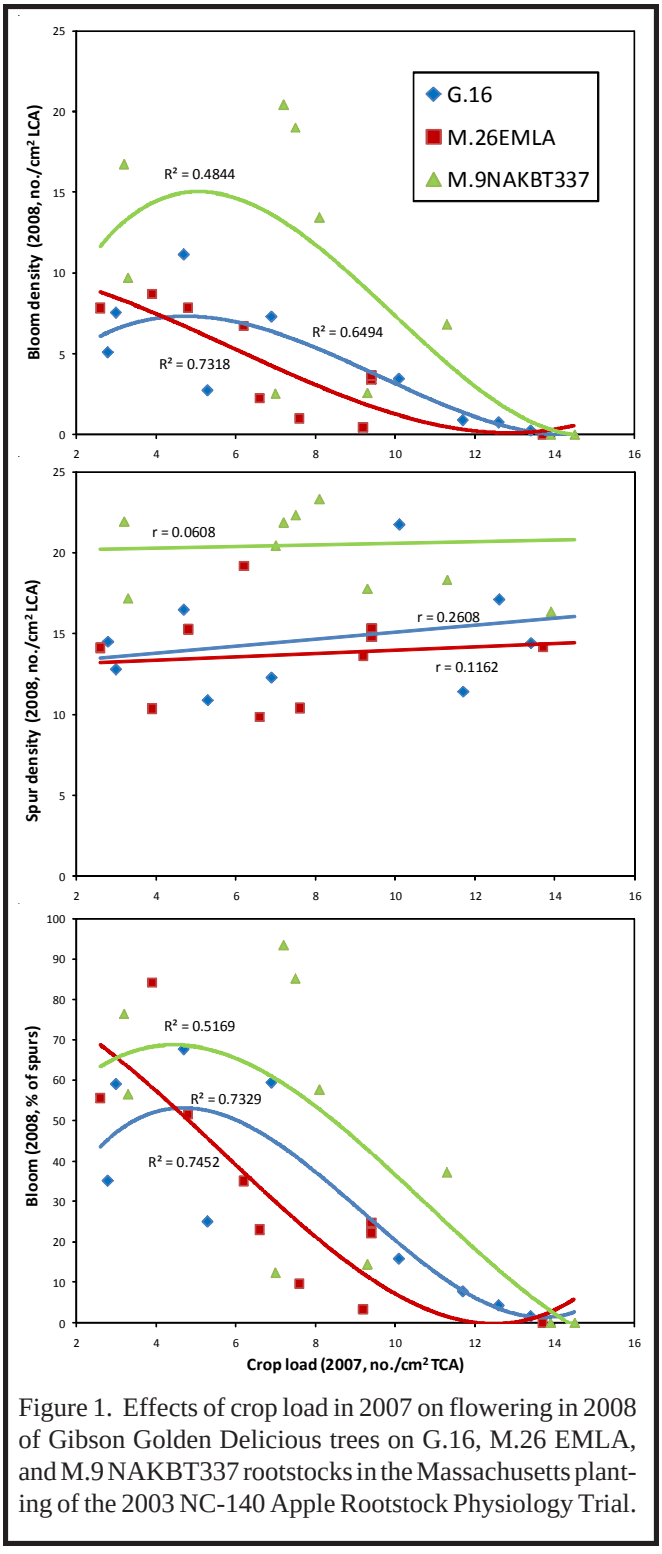

Figure 1. Effects of crop load in 2007 on flowering in 2008 of Gibson Golden Delicious trees on G.16, M.26 EMLA, and M.9 NAKBT337 rootstocks in the Massachusetts planting of the 2003 NC-140 Apple Rootstock Physiology Trial.

At the end of the 2008 growing season, trees on M.26 EMLA were significantly larger than trees on G.16, which were significantly larger than trees on M.9 NAKBT337 (Table 1). M.9 NAKBT337 resulted in significantly more root suckers (2003-08) than did G.16 or M.26 EMLA (Table 1). Yield per tree (2008 or cumulatively) was not affected by rootstock, nor was 2008 yield efficiency (Table 1). Cumulative yield efficiency was greater for trees on M.9 NAKBT337 than for those on M.26 EMLA. Trees on G.16 were intermediate. Average fruit size (2006-08) was not different by rootstock (Table 1).

The purpose of this trial was to determine if crop load and rootstock interacted to affect tree physiology, or in other words, to determine if trees on different rootstocks responded differently to changing crop load. The effects measured in the year of crop-load adjustment were reported in the winter 2007 issue of *Fruit Notes* [72(1):13-17]. Here we report just those effects seen in the year after crop-load adjustment. Again, remember that crop load was adjusted from 3to 14 fruit per cm^2 trunk cross-sectional area, a range from less than half of a normal crop to more than double. In 2008, rootstock effects were evident, and 2007 crop load effects were evident, but the effects of 2007 crop load adjustment did not vary with rootstock.

Looking first at the effects on bloom, rootstock affected return bloom (Table 2, Figure 1). Specifically, M.9 NAKBT337 resulted in a greater spur density and a comparable percent of spurs blooming compared to the other two rootstocks. The result was twice the blossom density of trees on M.9 NAKBT337 than those on G.16 or M.26 EMLA.

Crop load in 2007 significantly and negatively affected blossom density in 2008 (Figure 1), primarily by negatively affecting the percent of spurs blooming (Table 2). This response is exactly what you would expect. Where crop was heavy in 2007, return bloom was light in 2008.

As one would expect, crop load in 2008 was positively related to blossom density and percent of spurs blooming in 2008 (Table 2). Interestingly, this resonse occurred even though crop loads were artificially reduced to give a target level of no more than 3 fruit per cm^2 trunk cross-sectional area.

Also as expected, there was a negative correlation between crop load in 2007 and crop load in 2008 (Table 2, Figure 2). The more interesting response was that crop load in 2007 was negatively correlated with fruit weight in 2008, even though it also was negatively correlated with crop load in 2008 (Table 2, Figure 2). That is, a heavy crop in 2007 carried

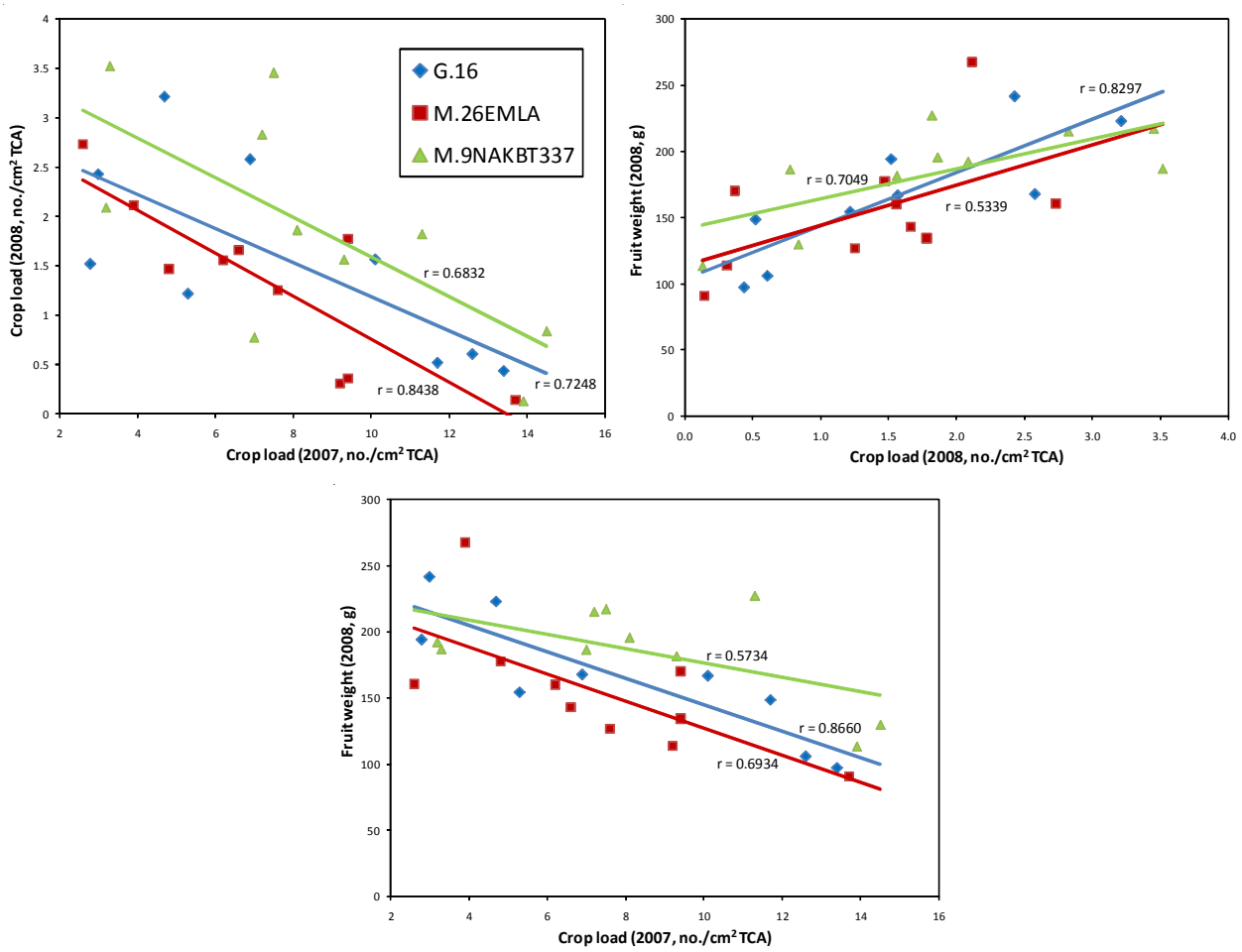

Figure 2. Effects of crop load in 2007 on crop load and fruit weight in 2008 and effects of crop load in 2008 on fruit weight in 2008 of Gibson Golden Delicious trees on G.16, M.26 EMLA, and M.9 NAKBT337 rootstocks in the Massachusetts planting of the 2003 NC-140 Apple Rootstock Physiology Trial.

over its effect to reduce size in 2008. Likely, the trees were stressed in 2007 by the heavy crop and this crop load negatively affected the tree's ability to size fruit a year later. This stress was evident in the field as small leaves in 2008 on trees that had fruited heavily in 2007. Because of this carry-over effect, trees with heavier crops in 2008 (because of light crops in 2007) produced larger fruit in 2008 (Table 2, Figure 2).

The 2008 results from this study suggest that rootstock does not alter the trees carry-over response to crop load the previous season. They do, however, show that rootstock alters fruiting characteristics. The more interesting results are the carry-over effects of crop load. For these trees, heavy crops one year not only affected fruit size that year but in the next year as well. A thinning failure, therefore, may be a problem for 2 years, reducing fruit size in year one and reducing return bloom and fruit size in year 2.

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